

**SECTION – A**

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

1. Find the value of "sum" after the given program segment is executed (variables are integers). (12)

[Show the counting in details.]

```

increment := 0
sum := 0
for i := 1 to 10 do
  for j := 1 to i do
    for k := 1 to j do
      begin
        increment := increment + 1
        sum := sum + increment
      end
    end
  end
end

```

- (b) Write down the principle of "Mathematical Induction". (3+7=10)

Using induction prove that for energy  $n \in \mathbb{Z}^+$  where  $n \geq 14$ ,  $n$  can be written as a sum of 3's and 8's.

- (c) How many distinct paths are there from  $(-1, 2, 0)$  to  $(1, 3, 7)$  in Euclidean three space if each move is one of the following types? (13)

$$(H): (x, y, z) \rightarrow (x+1, y, z)$$

$$(V): (x, y, z) \rightarrow (x, y+1, z)$$

$$(A): (x, y, z) \rightarrow (x, y, z+1)$$

2. (a) For integers  $n, r$  with  $n \geq r \geq 1$ , prove that  $\binom{n+1}{r} = \binom{n}{r} + \binom{n}{r-1}$  (7)

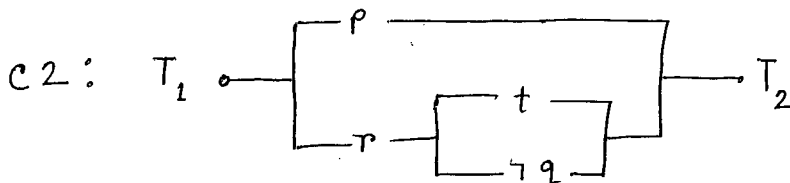
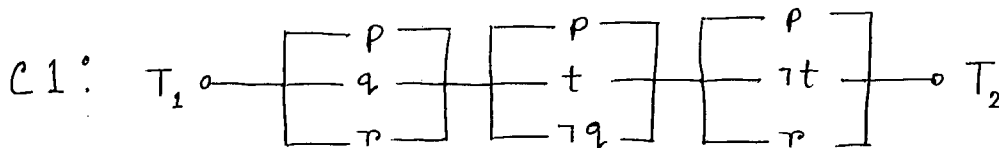
(b) A technical officer of a computer manufacturing company finds 30% of RAM coming from company A, 60% of RAM coming from company B and 10% of RAM coming from company C. During assembling she finds 2% of RAM supplied by company A is defective, 3% of company B is defective and 5% of company C is defective. If randomly tested what will be the probability of finding a defective RAM? What will be the probability of finding company C's RAM be defective? (Use set theory concept) (13)

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**Contd... Q. No. 2**

(c) Find whether the following switching circuits are equivalent or not.

(15)



(Show details of logical reasoning & rules).

3. (a) For a loop free connected planar graph  $G(V,E)$  with  $|V| = v$  and  $|E| = e > 2$  and  $r$  regions prove that  $3r \leq 2e$  and  $e \leq 3v - 6$ .

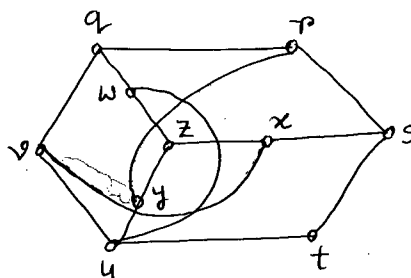
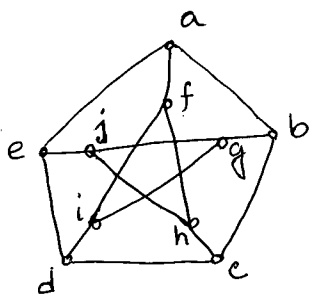
(7)

(b) Schedule the final exams for CSE1, CSE2, CSE3, CSE4 and ME101, ME201, ME301, ME401 with the fewest number of different time slots, if there are no students taking both ME101 and CSE4, both ME201 and CSE4, both ME401 and CSE1, both ME401 and CSE2, both ME101 and ME201, both ME101 and ME301, both ME301 and ME401, but there are students in every other combinations of courses. (Use graph for modeling).

(15)

(c) Find whether the following graphs are isomorphic or not if the following mapping is given.

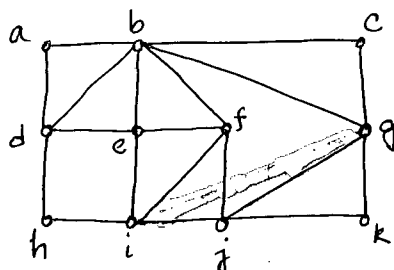
(5)



mapping.  $a \rightarrow q, c \rightarrow u, e \rightarrow r, g \rightarrow x, i \rightarrow z, b \rightarrow v, d \rightarrow y, f \rightarrow w, h \rightarrow t, j \rightarrow s$ .

(d) Find Euler circuit from the graph starting from 'a'. (Show the steps)

(8)



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4. (a) Find the statements in symbolic form (8)
- (i) There exists a positive integer that is even.
- (ii) If x is even and x is perfect square, then x is divisible by 4.

Open statements are:

$$p(x): x > 0$$

$$q(x): x \text{ is even}$$

$$r(x): x \text{ is a perfect square}$$

$$s(x): x \text{ is (exactly) divisible by 4}$$

$$t(x): x \text{ is (exactly) divisible by 5.}$$

$p(x), q(x), r(x), s(x)$  and  $t(x)$  are applicable for the universe of all integers.

- (b) Prove that,  $(\neg p \vee q) \rightarrow r$  (15)

$$r \rightarrow (s \vee t)$$

$$\neg s \wedge \neg u$$

$$\neg u \rightarrow \neg t$$

---


$$\therefore p$$

(show the steps and the rules)

- (c) Find if the argument is valid. "If the band could not play rock music or the snacks were not delivered on time, then the party would have been cancelled and Maria would be angry. If the party were cancelled, then refund would have had to be made. No refunds were made. Therefore, the band could play rock music." (12)

**SECTION – B**

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

5. (a) What is an abelian group? Show that any group G is abelian iff  $(ab)^2 = a^2b^2$  for all  $a, b \in G$ . (9)

- (b) Prove that for every finite group G, each group element appears exactly once in each row and each column of the group table. (10)

- (c) Show that the set of rigid motions (symmetries) of an equilateral triangle with the binary operation of composition is a nonabelian group. (16)

6. (a) Let  $S_5$  be the symmetric group on five symbols. Also, let (15)

$$\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 4 & 5 \end{pmatrix} \text{ and } \beta = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 1 & 5 & 3 & 4 \end{pmatrix}$$

Determine  $\alpha\beta, \alpha^3, \beta^4, (\beta\alpha)^{-1}$  and  $\beta^{-1}\alpha^{-1}$ .

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**Contd... Q. No. 6**

(b) Solve the following linear congruence for  $x$ : (10)

$$5x \equiv 8 \pmod{37}$$

(c) What is a proper divisor of zero for the algebraic structure "ring"? Prove that a finite integral domain is a field. (10)

7. (a) What is a partial ordering relation? Explain how we can construct a Hasse diagram for a partial ordering relation with an illustrative example. (9)

(b) What is an equivalence relation? Show that congruence modulo  $n$  is an equivalence relation on  $Z$ . (14)

(c) Let  $A = \{1, 2, 3, 4, 5\}$  be a set. Give an example of a relation  $R$  on  $A$  that is (12)

- (i) reflexive and symmetric but not transitive
- (ii) reflexive and transitive but not symmetric
- (iii) Symmetric and transitive but not reflexive
- (iv) both symmetric and antisymmetric.

8. (a) Find the unique solution of the recurrence relation: (9)

$$6a_n - 7a_{n-1} = 0, \quad n \geq 1, \quad a_3 = 343$$

(b) Show that in a group of six people, where any two people are either friends or enemies, there are either three mutual friends or three mutual enemies. (8)

(c) Determine projections  $\pi_A(D)$  and  $\pi_B(D)$  for each of the following sets  $D \subseteq A \times B$  (6)

(i)  $D = \{(x, y) \mid y = 2x + 1\}, \quad A = B = Z$

(ii)  $D = \{(x, y) \mid x^2 + y^2 = 4\}, \quad A = B = R$

(d) During the first six weeks of his senior year in college, Herbert sends out at least one resumé each day but no more than 60 resúmes in total. Show that there is a period of consecutive days during which he sends out exactly 23 resúmes. (12)

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**SECTION – A**

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

1. (a) Explain with reference to the context any two of the following: (15)
- (i) "It will do you good to sit down for a while and chat with me."
  - (ii) At last I came to the conclusion that I could never find the one, complete and satisfying book I sought.
  - (iii) Feelings like these are the normal by-products of imperialism.
- (b) Answer any one of the following: (15)
- (i) What evidence do you find that Jack is likely to be Ralph's opponent?
  - (ii) Analyze the character of the Astrologer in "An Astrologer's Day".
- (c) Answer any three of the following: (15)
- (i) Why did the writer want to have a book of philosophy?
  - (ii) What were the "endless discussions" about the shooting of the elephant?
  - (iii) Why was the astrologer unable to carry on the work of his forefathers in his village?
  - (iv) What is Maugham's assessment of Bertrand Russel?
  - (v) Why does the writer say the young Buddhist priests were the worst?
2. (a) Recast and correct any ten of the following sentences: (15)
- (i) The courthouse annals is not the place to look for the date of marriage.
  - (ii) I shall accompany the winners, whomever they may be.
  - (iii) The committee are empowered to make a recommendation.
  - (v) Laura is an alumnus of the Oxford.
  - (v) He sat his plane down in the farmer's pasture.
  - (vi) We suspicioned that something was amiss.
  - (vii) The jury are arguing among itself.
  - (viii) The boat slipped out of the harbor, I suddenly realized I was on my way to Myanmar.
  - (ix) I have no appetite at all to study.

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**Contd... Q. No. 2(a)**

- (x) I enjoyed during the holidays.
- (xi) The old president has been defeated and new officers elected.
- (xii) He was absent one time or two times.

(b) Give meanings of and make sentences with any ten of the following words: **(15)**  
Alluring, Bicker, Credulous, Facile, Gauche, Hilarious, Intrepid, Moron,  
Obsequious, Perforate, Quell, Wayward

3. Amplify the idea in any one of the following: **(30)**

- (i) Victory has many fathers but defeat is parentless.
- (ii) If winter comes, can spring be far behind?

4. Write a précis of the following: **(30)**

In all history, nothing is so surprising or so difficult to account for as the sudden rise of civilization in Greece. Much of what makes civilization had already existed for thousands of years in Egypt and in Mesopotamia, and had spread thence to neighbouring countries. But certain elements had been lacking until the Greeks supplied them. What they achieved in art and literature is familiar to everybody, but what they did in the purely intellectual realm is even more exceptional. They invented mathematics and science and philosophy; they first wrote history as opposed to mere records; they speculated freely about nature of the world and the ends of life, without being bound in the chains of any inherited orthodoxy. What occurred was so astonishing that, until very recent times, men were content to gaze and talk mystically about the Greek genius. It is possible, however, to understand the development of Greece in Scientific terms, and it is well worth to do so. Philosophy begins with Thales, who fortunately, can be dated by the fact that he predicted an eclipse which, according to the astronomer, occurred in the year 585 B.C. Philosophy and science — which were originally separate — were therefore born together at the beginning of the sixth century. What had been happening in Greece and neighbouring countries before this time? Any answer must be in part hypothetical, but archeology, during the present century, has given us much more knowledge that was possessed by our grandfathers.

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**SECTION – B**

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

5. Read the passage carefully and answer the questions the follow:

**(45)**

Most people can remember a phone number for up to thirty seconds. When this short amount of time elapses, however, the numbers are erased from the memory. How did the information get there in the first place? Information that makes its way to the short term memory (STM) does so via the sensory storage area. The brain has a filter which only allows stimuli that is of immediate interest to pass on to the STM, also known as the working memory.

There is much debate about the capacity and duration of the short term memory. The most accepted theory comes from George A. Miller, a cognitive psychologist who suggested that humans can remember approximately seven chunks of information. A chunk is defined as a meaningful unit of information, such as a word or name rather than just a letter or number. Modern theorists suggest that one can increase the capacity of the short term memory by chunking, or classifying similar information together. By organizing information, one can optimize the STM, and improve the chances of a memory being passed on to long term storage.

When making a conscious effort to memorize something, such as information for an exam, many people engage in "rote rehearsal". By repeating something over and over again, one is able to keep a memory alive. Unfortunately, this type of memory maintenance only succeeds if there are no interrupts. As soon as a person stops rehearsing the information, it has the tendency to disappear. When a pen and paper are not handy, people often attempt to remember a phone number by repeating it aloud. If the doorbell rings or the dog barks to come in before a person has the opportunity to make a phone call, he will likely forget the number instantly. Therefore, rote rehearsal is not an efficient way to pass information from the short term to long term memory. A better way is to practice "elaborate rehearsal". This involves assigning semantic meaning to a piece of information so that it can be filed along with other pre-existing long term memories. For example, a reader engages in elaborate rehearsal when he brings prior knowledge of a subject to a text.

- (i) According to the passage, how do memories get transferred to the STM?
- (ii) How do theorists believe a person can remember more information in a short time?
- (iii) What is the author's believe about "rote rehearsal"?
- (iv) According to the passage, what are the places in which memories are stored?
- (v) Give a proper title to the passage.

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6. (a) Briefly discuss the different parts of a business letter. (5)
- (b) The people of Khulna have been badly affected by a flood. They immediately need food and medicine. As the Managing Director of Square Pharmaceuticals Ltd., write a goodwill letter to the Mayor of Khulna offering your company's help. (15)
- (c) Write phonetic transcriptions of the following words (any five): (10)
- cat, father, computer, university, paid, education.
7. (a) Define quotations and tenders. (5)
- (b) Write a dialogue between you and your friend on Human Trafficking. (10)
- (c) Write a short essay on any one of the following topics: (15)
- (i) Social Networks (ii) Globalization and English Language (iii) Tourist Spots in Bangladesh
8. (a) Transform the following sentences as directed (any five): (10)
- (i) The tourists liked the late spring. (make it interrogative)
- (ii) He was the only man that was alive. (make it simple)
- (iii) Speak the truth and I will let you go. (make it complex)
- (iv) Sitting on a stone, the old sailor watched the people walking past him. (make it compound)
- (v) I was admitted to school at the age of four. (make it complex)
- (vi) Tea is a drink and it is very popular in Bangladesh. (make it simple)
- (b) Discuss the back matters of a report. (5)
- (c) Write short notes on any three of the following topics: (15)
- (i) Floor taking in a dialogue (ii) Frontispiece (iii) ACR (iv) Refusal letter.
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**SECTION-A**

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

- Define the following Terms : (i) rate of reaction (ii) rate of conversion and (iii) rate constant (9)
  - Derive an expression for the rate of a first-order reaction which is opposed by another first-order reaction. How can you determine the equilibrium constant of such a reaction? (17)
  - In studying the decomposition of ozone  $2O_3(g) \rightleftharpoons 3O_2(g)$  in a two liter (2L) reaction vessel; it is found that  $\frac{d[O_3]}{dt} = -1.5 \times 10^{-2} \text{ mol L}^{-1} \text{ S}^{-1}$  (i) what is the rate of reaction? (9)
    - What is the rate of conversion? and
    - What is the value of  $\frac{d[O_2]}{dt}$  ?
- Define Hard and Soft Acids and Bases (HSAB). Discuss the classification of HSAB taking three examples from each class. (10)
  - Two liter (2.0L) distilled water is mixed with three liter (3.0L)  $H_2SO_4$  of specific gravity (Sp. gr.) 1.85. Calculate the Sp. gr. of the acid mixture. (5)
  - Discuss the principle of application of Hard and Soft Acids and Bases (HSAB) in the following fields: (i) Medicinal Chemistry. (ii) Geochemical classification of the elements and their occurrence in nature as minerals (iii) Predicting favorable equilibria (iv) Toxicology. (5×4=20)
- What are the main features of molecular orbital theory (MOT) in covalent bonding? What are bonding and antibonding molecular orbital? Illustrate your answer with examples. (9)
  - Draw molecular orbital diagram of the  $CO^+$ ,  $NO^-$ ,  $O_2$ . Comment on their magnetic properties and calculate their bond order. Write down their molecular electronic configuration also. (6+3+3+6=18)
  - Discuss the shapes of the following molecules: (8)
 

$H_2O$ ,  $NH_3$ ,  $BaCl_2$ ,  $CH_4$
- What is Heisenberg's Uncertainty principle? Prove that the product of Uncertainty in position of an electron with uncertainty in momentum of the same electron is of the order of Planck's constant. (3+8=11)

**CHEM 113****Contd ... Q. No. 4**

- (b) Explain why: (4×6=24)
- (i) Bond in  $\text{BeCl}_2$  is covalent but bond in  $\text{CaCl}_2$  is ionic though Be and Ca are in the same group of the periodic table.
- (ii) Picric Acid is as strong as nitric acid though picric acid is an organic acid.
- (iii) Gold and copper are colored but silver is not though they are the elements of the same group IB.
- (iv) Coordination number of  $\text{Co}^{3+}$  is six but that of  $\text{Zn}^{2+}$  is four though they are the ions of 'd' block elements.
- (v) Potassium is more reactive than copper though they have  $4s^1$  electron in their outer shell orbital.
- (vi) Transition metals generally form colored compounds.

**SECTION-B**

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

5. (a) How can you account for the exceptional solubility of some gases in liquid? (7)
- (b) Some dissolution processes are exothermic and others are endothermic. Provide a molecular interpretation for the difference. (10)
- (c) Show that in dissolution process at equilibrium, the partial molal free energies of each constituent must be same in all phases. (10)
- (d) Hydrogen peroxide is a powerful oxidizing agent; its concentrated solution is used in rocket fuel, but dilute solution in hair bleach. An aqueous solution of  $\text{H}_2\text{O}_2$  is 30% by mass and has a density of 1.11 g/mL. Calculate (i) molality (ii) mole fraction of  $\text{H}_2\text{O}_2$  and (iii) molarity. (8)
6. (a) Write down the Van't Hoff's law of osmosis and show that molecular mass of non-electrolyte and non-volatile solute can be determine from osmotic pressure. (4+4=8)
- (b) Show that the lowering of vapor pressure is dependent on the nature of solvent but not on the nature of the solute. (8)
- (c) How Arrhenius accounts the application of the theories of colligative properties to weak electrolytes? (10)
- (d) Biochemists have discovered more than 400 mutant varieties of hemoglobin, the blood protein that carries  $\text{O}_2$ . A physician dissolves 21.5 mg of one variety in water to make 1.50 mL of solution at  $5.08^\circ\text{C}$ . He measures an osmotic pressure of 3.61 torr. What is the molar mass of protein? [ 1 torr = 1/760 atmosphere] (9)
7. (a) 'Chemical energy is a form of potential energy' – justify the statement. (8)
- (b) What is a fuel? Discuss the prospect of hydrogen as next generation fuel. (3+8+11)

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**Contd ... Q. No. 7**

- (c) Define buffer solution. How does buffer solution work when small quantities of strong acid or bases are added to it. (16)
8. (a) What do you mean by the term "thermodynamic equilibrium constant"? How is equilibrium constant of a reaction related to the free energy change? (10)
- (b) Derive an expression for the variation of equilibrium constant with temperature. (16)
- (c) For the reaction  $\text{Ag(s)} + \frac{1}{2} \text{Cl}_2(\text{g}) \rightarrow \text{AgCl(s)}$ ,  $E^\circ = 0.839 \text{ V}$  at 1000 K. If  $a_{\text{Ag}} = a_{\text{AgCl}} = 1.00$  and  $a_{\text{Cl}_2} = 0.77$ , find the value of  $E$ . Is the reaction less favored under non-standard condition? Justify your answer from the value of  $K$  and  $\Delta G$  for the reaction. (9)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **MATH 143** (Integral Calculus, ODE, PDE, SS)

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**.

1. (a) Workout the following

$$(i) \int \frac{(x+3)}{\sqrt{4x^2 - 4x + 3}} dx \quad (10)$$

$$(ii) \int \frac{dx}{\sin 2x + \sin x} \quad (12)$$

$$(b) \text{ Derive a reduction formula for } \int e^{ax} \cos^n x \, dx. \quad (12)$$

$$(c) \text{ Find the value of } \int_0^{\pi} \frac{x dx}{a^2 - \cos^2 x} \quad (12 \frac{2}{3})$$

2. (a) Find the total area interior to  $y^2 = 2ax - x^2$  and exterior to  $y^2 = ax$  lying in the first quadrant. (22)

$$(b) \text{ Find the length of the perimeter of the asteroid } \left(\frac{x}{a}\right)^{\frac{2}{3}} + \left(\frac{y}{b}\right)^{\frac{2}{3}} = 1. \quad (24 \frac{2}{3})$$

3. Solve the following:

$$(a) \frac{dy}{dx} = \frac{3y - 7x + 7}{3x - 7y - 3} \quad (17 \frac{2}{3})$$

$$(b) \left(y + \sqrt{x^2 + y^2}\right) dx - x dy = 0 \quad (15)$$

$$(c) \frac{dy}{dx} + \frac{1}{x} \sin 2y = x^3 \cos^2 y. \quad (14)$$

4. Find the general solution of the following differential equations:

$$(a) (D^2 + 16)y = \sec 4x \quad (15)$$

$$(b) [(2x-3)^2 D^2 - 6(2x-3)D + 12]y = x^2 + x \quad (15)$$

$$(c) [(x+3)D^2 - (2x+7)D + 2]y = (x+3)^2 e^x. \quad (16 \frac{2}{3})$$

**MATH 143**

**SECTION – B**

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

5. (a) Apply Lagrange method to solve  $(xy^3 - 2x^4)p + (2y^4 - x^3y)q = 9z(x^3 - y^3)$ . (15)

(b) Find the integral surface of the first order linear partial differential equation (16  $\frac{2}{3}$ )

$$x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2)$$

which contains the line  $x + y = 0, z = 1$

(c) Find the complete integral and the singular integral (if it exists) of  $z^2(p^2 + q^2 + 1) = 4$ . (15)

6. Solve the following partial differential equations:

(a)  $(D_x^3 - 4D_x^2D_y + 4D_xD_y^2)z = 4\sin(2x + y)$  (15)

(b)  $(D_x^2 - D_xD_y + 2D_y^2 + 2D_x + 2D_y)z = \exp(3x + 4y) + xy$  (16  $\frac{2}{3}$ )

(c)  $(x^2D_x^2 - 3xyD_xD_y + 2y^2D_y^2 + xD_x + 2yD_y)z = x + 2y$  (15)

7. Identify the nature of singular point of the differential equation (46  $\frac{2}{3}$ )

$$x \frac{d^2y}{dx^2} + (x-1) \frac{dy}{dx} - y = 0$$

Hence solve the equation in series by Fröbenius method.

8. (a) Prove the relation  $\int_{-1}^1 P_m(x)P_n(x)dx = \frac{2}{2n+1}$  if  $m = n$ . (15)

(b) Prove that  $\int_{-1}^1 x^2 \{P_n(x)\}^2 dx = \frac{1}{8(2n-1)} + \frac{3}{4(2n+1)} + \frac{1}{8(2n+3)}$ . (16  $\frac{2}{3}$ )

(c) Prove that  $\frac{d}{dx}[J_2(x)] = \left(1 - \frac{4}{x^2}\right)J_1(x) + \frac{2}{x}J_0(x)$  where  $J_n(x)$  is the Bessel's function of order  $n$ . (15)

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **CSE 105** (Structured Programming Language)

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. An analog clock has only two hands - hour and minute. The input for the program will be a set of 24 hour format time. For the given input the program should output all the input time and the angle created for that particular time in ascending order.

The input for the program will be given in the following order. The first line will contain an integer  $N$  where  $1 \leq N \leq 100$ . The next  $N$  lines will contain two integers  $hh(0 \leq hh \leq 23)$  and  $mm(0 \leq mm \leq 59)$  separated by a blank space indicating hour and minute of a particular time in 24 hours format. For the input set the program should provide  $N$  lines as output. Each line should contain three integers separated by single blank space. The first two numbers are the hour and minute of the input set and the last number (rounding to integer) is the angle between the hour and minute hands. These three numbers should appear in the ascending order of the angle between the hour and minute hands. If there are times with the same angle then the earlier time should appear first (00:00 is the earliest time and 23:59 is the latest time)

Sample input and output for the program may be:

Sample input	Sample output
4	0 0 0
3 0	23 59 6
9 0	3 0 90
23 59	9 0 90
0 0	

In the program sections there is one user defined structure named **Time**. This structure has three integer variables **hh**, **mm**, and **angle**; and one long integer value **sortingKey**. **Hh** and **mm** are used to store the hour value and minute value of the time. Variable **angle** holds the value of the angle  $\leq 180^\circ$  (acute and obtuse angle only) created by the hour and minute hands of the clock. Variable **sortingKey** holds a value that is used to sort the list of time according to the problem statement.

The program contains a function with prototype **void SortTime(int i)**. The description of the function is as follows–

CSE 105/CSE  
Contd... Q. No. 1

*Void SortTime(int i)*. This function basically combines three different numbers (*angle*, *hh* and *mm*) to get a value and set that value to the *sortingKey* variable of a particular element having index *i*. For example: if the *i*th element of the array *t[]* has *hh* = 16, *mm* = 55 and *angle* = 177 the function will combine the numbers 177, 16 (from *hh*) and 55 (from *mm*) to get the value 1771655 and then sets this value to the variable *sortingkey* of the *i*th element. When the total list is sorted in the ascending order of this *sortingKey* the list is eventually sorted in the ascending order of *angle* and then by time.

```
void main()
{
    long n,i,j, hour, totalMin;
    float hAngle, mAngle, angle;
    scanf("%ld", &n);
    for(i=0; i<n; i++){
        scanf("%ld%ld", &t[i].hh, &t[i].mm);
        hour=t[i].hh;
        if(  ){
            hour=t[i].hh-12;
        }
        totalMin = 
        hAngle=round(totalMin*0.5);
        mAngle=t[i].mm*6;
        if(hAngle>mAngle){
            t[i].angle=hAngle-mAngle;
        }
        else{
            t[i].angle=mAngle-hAngle;
        }
        if(t[i].angle>180){
            
        }
        SortTime(i);
    }
    Sort((void *)&t, n, sizeof(Time));
    for(i=0; i<n; i++){
        printf("%d %d %ld\n", t[i].hh, t[i].mm, t[i].angle);
    }
}
```

(a) Fill up the blank A, B and C. (12)

(b) Write down the structure defined in the problem description with 5 bits for hour, 6 bit for minute, 8 bit for angle and required minimum number of bits for *sortingKey*. Put *sortingKey* in a new word. Use *typedef* to redefine it to a name of *Time*. (7+2=9)

What is the value of *sizeof(Time)*?

(c) Write down the codes for the *Sort()* function which is referenced in the main function. (14)

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2. The function *putInt(int var)* accepts one argument and displays the value of *var* on monitor screen. There are total three functions of similar kind that displays three data types named integer, float and character. The argument *var* contains a value to be displayed. For an instance, the program code "*putChar(char c)*" displays the value of *c* on monitor screen, where *c* is of character type. Similarly, *putFloat(float x)* will display value of *x* on monitor screen with two digits after the decimal point. (20)

Using any of the above functions, write a C functions *print(const char \*str,...)* that will accept a *format* string and a number of variables, and then will display the contents of the variables on monitor screen.

Some sample input and output are given below–

Sample input	Sample output
<code>print("%d", A);</code>	12
<code>print("%c %f %d", ch, x, A);</code>	P 12.34 40
<code>print("%d %d %f %c", A, B, X, ch);</code>	23 11 45.23 D

(b) Write down a preprocessor named *pyramid(n)* which will print the number pyramid with *n* rows. (5+3=8)

For n = 3	For n = 4	For n = 5
1	1	1
212	212	212
32123	32123	32123
	4321234	4321234
		543212345

Why is a preprocessor faster than a function call?

(c) Write a C program that will display the details of program running configuration environments on the monitor screen. (7)

3. (a) Consider the following declaration: (10)

```
static float table [2][3][2] = {{{1.1, 1.2}, {1.3, 1.4}, {1.5, 1.6}}, {{2.1, 2.2}, {2.3, 2.4}, {2.5, 2.6}}}
```

The floating values are stored inside the memory addresses starting from 100 to 116 as given below (assume 2 bytes for floating points)

0 <sup>th</sup> 2D Array						1 <sup>st</sup> 2D Array					
1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	2.6
100	102	104	106	108	10A	10C	10E	110	112	114	116



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Contd... Q. No. 3(a)

Fill up the blank in the following table under title of "values of the given part".

Part of Command	Values of the given part
*(table+1)	
*(*(table +1) +1)	
*(*(table + 1))	
*** (table +1)	
*(*(table + 1) + 1)	

(b) (i) Write an appropriate declaration for the following situation: (5×2=10)

"Declare a pointer to a function that accepts an argument which is an array of pointers to integer quantities and returns a pointer to a character."

(ii) Explain the purpose of the following declaration.

```
float (*x[20])(int *a);
```

(c) Write a C program that will accept a file name as the command line argument and print the contents of the file to a printer. If the file name is not provided through the command line, then the program will ask for the file name, read the file name from the standard input device and then print the contents of the file to a printer. (15)

4. (a) A binary search tree, abbreviated to BST, is a binary tree where all the element in the left subtree of a node are less than or equal to the element at the node and all the element at the right subtree are higher than it. A BST can be stored in a 1D array where the root of the tree is stored at index 1. node(*i*) represent the element stored in the index *i*. Left child of node(*i*) is node (2\**i*) and the right child of node(*i*) is node(2\**i*+1). The value of an element -1 in an index means there is no element at that index. (10+10=20)

(i) Write a recursive C function that will insert a node in the given tree. If the tree does not exist, inserting a node means that the node become the root of tree. Use the following function prototype.

```
void BST_insert(int node, int x); //element x is to be inserted into the BST
```

(ii) The height of a node of the tree is defined as follows: the height of the root is zero. If a node is at a height of *n*, then its left and right child are at the height of *n + 1*. Write a recursive C function that will return the height of a given node.

(b) Write down the program for sorting a list of integers using the Merge Sort algorithm. (15)

SECTION – B

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

Please read carefully, some questions might have additional restrictions such as not allowing the use of any library functions except the I/O related ones.

5. (a) Assume **int x** has been declared and initialized to an unknown value. For each of the following, indicate if the expression always evaluates to true, or if it could sometimes be false. In the latter case, indicate a counter example by providing a value for x that falsifies the claim: (6)

- (i)  $(x \neq 0) \parallel (x == 0)$
- (ii)  $(x > 0) \parallel (x < 0)$
- (iii)  $((x >> 1) << 1) \parallel (x \& 1) == x$
- (iv)  $(x \wedge (\sim x)) == 0$

- (b) The ceiling of a fractional number is *the smallest integer greater than or equal to it*. For example, the ceiling of 3.12 is 4, whereas the ceiling of -3.12 is -3. Write a C program that will take a fractional number (float) as input and prints its ceiling. **You are not allowed to use any math library function.** (7)

- (c) Write down a program that will determine the summation of the following series: (10)

$$\log_2 2 + \log_2 4 + \log_2 8 + \dots + \log_2 n$$

Assume that  $n = 2^m$  for some integer  $m > 0$  and **m** will be input to your program. **You are not allowed to use any library function except the I/O related ones.**

- (d) *Twin primes* are a pair of prime numbers that differ by 2. For example, 3 and 5 are twin primes. Some more example of twin primes are (5, 7), (11, 13) etc. Write down a program to find all twin primes less than a positive number  $n (> 1)$  entered by the user.

Display the output as follows: (12)

(3, 5)  
(5, 7)  
...

6. (a) What is the output of the following code segment (write NO OUTPUT if you think there is an error in the program segment)? (5)

```
int i = 4, j = 5, k;  
k = i+++j;  
printf("%d %d %d", i, j, k);
```

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Contd... Q. No. 6

(b) Given two integers  $n$  and  $x$  as parameter where  $n > x$  and  $x > 1$ , write down a C function

(10)

```
int powerOfX (int n, int x);
```

that will check whether  $n = x^y$ , for some  $y \geq 0$ , i.e. the number  $n$  is a power of  $x$  or not and return the value of  $y$  if so. Suppose  $n = 125$  and  $x = 5$  then the function will return 3 because  $125 = 5^3$ . The function will return -1 if  $n$  cannot be expressed as a power of  $x$ .

(c) In mathematics, a **Fermat number** (named after the great mathematician *Pierre de Fermat* who first studied them) is a positive integer of the form.

(10)

$$F_t = 2^{(2^t)} + 1$$

where  $t$  is a nonnegative integer. The first few Fermat numbers are:

3, 5, 17, 257, 65537, 4294967297, 18446744073709551617, ...

Write down a program that will take an integer  $y$  as input and will determine whether the number is a Fermat number or not using the function `int powerOfX (int n, int x)` that you have developed in question 6(b).

(d) Write down a program to calculate  $\sqrt{x}$  where  $x$  is a positive double value.

(10)

7. (a) Misir Ali is a new C programmer and wrote the following code to determine the largest of three integers  $a$ ,  $b$ , and  $c$ :

(10)

```
if (a > b > c) max = a;  
else if (b > a > c) max = b;  
else max = c;
```

Do you think he is a good programmer? What will be the value of *max* if  $a = 20$ ,  $b = 10$ , and  $c = 5$ . Write a **one line statement** using conditional operator (`?:`) to find the maximum value of three numbers  $a$ ,  $b$ ,  $c$ . You may use as many conditional operators as needed but it has to be a single line statement.

(b) Complete the definition of the C function `maxCount` whose prototype is shown below. The function should return the number of times that the global maximum appears in the array list. The global maximum is defined to be the number in the array with the largest value. For example, in the list 3, 9, 7, 5, 9, 8, 2, 4, 9, the global maximum is 9 and it appears 3 times. The `maxCount` function returns 3 in this case. Assume that list has at least one element. The number of elements in the array is given in the variable `length`.

(12)

```
int maxCount (int list[], int length);
```

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Contd... Q. No. 7

(c) Write down a function **nonrepeated** whose prototype is shown below. The function will return the number of **non-repeated** elements in a **sorted** array  $a$ . The length of the array is  $n$ . Assume that the array has at least one element and the elements are sorted in the ascending order.

(13)

```
int nonrepeated (int a[],int n);
```

8. (a) The following code was written to interchange the value of  $a$  and  $b$ ;

(8)

```
a = a^ b;  
b = a^ b;  
a = a^ b;
```

Do you think the above code will work if  $a$  and  $b$  contain the same value? Why or why not, show with an example.

(b) Given a set of numbers where all elements occur even number of times except one number, find the odd occurring number using XOR operator (^). Assume that all numbers are integers and stored in an array of length  $n$  (where  $n$  is odd). Ask the user to enter the value of  $n$  and all numbers at the beginning of your program. For instance, if the set is {34, 52, 33, 52, 78, 78, 34, 33, 33}, the output will be 33.

(11)

(c) Consider the following two definitions of the same macro:

(8)

```
#define square_1(x) x * x  
#define square_2(x) (x) * (x)
```

Give an example here these two macros behave differently, and explain why `square_2` is probably a better definition?

(d) Consider the following macro:

(8)

```
#define max(a, b) ((a) > (b) ? (a) : (b))
```

is there any problem when we execute the following statement using the above macro?

```
int z = max(i++, j++);
```

Redefine the macro so that the above problem doesn't exist anymore. Assume that the macro will be applied only to integers.

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