PAPER-III
COMPUTER SCIENCE AND APPLICATIONS

Signature and Name of Invigilator

1. (Signature) _____

   (Name) _____

2. (Signature) _____

   (Name) _____

Roll No. [ ][ ][ ][ ][ ][ ][ ][ ]

(In figures as per admission card)

Roll No._____

(In words)

J 8 7 1 1

Time : **2 ¹/₂ hours]**

[Maximum Marks : **200**

Number of Pages in this Booklet : **32**

Number of Questions in this Booklet : **19**

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Instructions for the Candidates

1. Write your roll number in the space provided on the top of this page.

2. Answer to short answer/essay type questions are to be given in the space provided below each question or after the questions in the Test Booklet itself.

   No Additional Sheets are to be used.

3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below :

   (i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.

   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**

4. Read instructions given inside carefully.

5. One page is attached for Rough Work at the end of the booklet before the Evaluation Sheet.

6. If you write your Name, Roll Number, Phone Number or put any mark on any part of the Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, you will render yourself liable to disqualification.

7. You have to return the test booklet to the invigilators at the end of the examination compulsorily and must not carry it with you outside the Examination Hall.

8. **Use only Blue/Black Ball point pen.**

9. Use of any calculator or log table etc., is prohibited.

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परीक्षार्थियों के लिए निर्देश

1. पहले पृष्ठ के ऊपर नियत स्थान पर अपना रोल नम्बर लिखिए ।

2. लघु प्रश्न तथा निबंध प्रकार के प्रश्नों के उत्तर, प्रत्येक प्रश्न के नीचे या प्रश्नों के बाद में दिये हुए रिक्त स्थान पर ही लिखिये । **इसके लिए कोई अतिरिक्त कागज का उपयोग नहीं करना है ।**

3. परीक्षा प्रारम्भ होने पर, प्रश्न-पुस्तिका आपको दे दी जायेगी । पहले पाँच मिनट आपको प्रश्न-पुस्तिका खोलने तथा उसकी निम्नलिखित जाँच के लिए दिये जायेंगे, जिसकी जाँच आपको अवश्य करनी है :

   (i) प्रश्न-पुस्तिका खोलने के लिए उसके कवर पेज पर लगी कागज की सील को फाड़ लें । खुली हुई या बिना स्टीकर-सील की पुस्तिका स्वीकार न करें ।

   (ii) कवर पृष्ठ पर छपे निर्देशानुसार प्रश्न-पुस्तिका के पृष्ठ तथा प्रश्नों की संख्या को अच्छी तरह चैक कर लें कि ये पूरे हैं । दोषपूर्ण पुस्तिका जिनमें पृष्ठ/प्रश्न कम हों या दुबारा आ गये हों या सीरियल में न हों अर्थात् किसी भी प्रकार की त्रुटिपूर्ण पुस्तिका स्वीकार न करें तथा उसी समय उसे लौटाकर उसके स्थान पर दूसरी सही प्रश्न-पुस्तिका ले लें । इसके लिए आपको पाँच मिनट दिये जायेंगे । उसके बाद न तो आपकी प्रश्न-पुस्तिका वापस ली जायेगी और न ही आपको अतिरिक्त समय दिया जायेगा ।

4. अन्दर दिये गये निर्देशों को ध्यानपूर्वक पढ़ें ।

5. उत्तर-पुस्तिका के अन्त में कच्चा काम (Rough Work) करने के लिए मूल्यांकन शीट से पहले एक पृष्ठ दिया हुआ है ।

6. यदि आप उत्तर-पुस्तिका पर नियत स्थान के अलावा अपना नाम, रोल नम्बर, फोन नम्बर या कोई भी ऐसा चिह्न जिससे आपकी पहचान हो सके, अंकित करते हैं अथवा अभद्र भाषा का प्रयोग करते हैं, या कोई अन्य अनुचित साधन का प्रयोग करते हैं, तो परीक्षा के लिये अयोग्य घोषित किये जा सकते हैं ।

7. आपको परीक्षा समाप्त होने पर उत्तर-पुस्तिका निरीक्षक महोदय को लौटाना आवश्यक है और इसे परीक्षा समाप्ति के बाद अपने साथ परीक्षा भवन से बाहर न लेकर जायें ।

8. **केवल नीले/काले बाल प्वाईंट पेन का ही इस्तेमाल करें ।**

9. किसी भी प्रकार का संगणक (कैलकुलेटर) या लॉग टेबल आदि का प्रयोग वर्जित है ।

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COMPUTER SCIENCE AND APPLICATIONS

PAPER – III

Note : This paper is of **two hundred (200)** marks containing **four (4)** sections. Candidates are required to attempt the questions contained in these sections according to the detailed instructions given therein.

**Answer to all questions must be written in English only.**

SECTION – I

Note : This section consists of **two** essay type questions of **twenty (20)** marks each, to be answered in about **five hundred (500)** words each. **(2 × 20 = 40 marks)**

1. (a) Design an algorithm to reverse a singly linear linked list without using any temporary memory location.
   (b) Construct a binary tree representing the infix expression $(a + b) \uparrow k \uparrow (g - m) | f * p - 5 * t$ and make it a post order threaded binary tree. **(10 + 10)**

OR

   (a) Give an $O(n^2)$ time algorithm to find the longest monotonically increasing subsequence of a sequence of n numbers.
   (b) Write Floyd-Warshall algorithm to solve the all-pairs shortest path problems on a directed graph G. Compute its time complexity. **(10 + 10)**
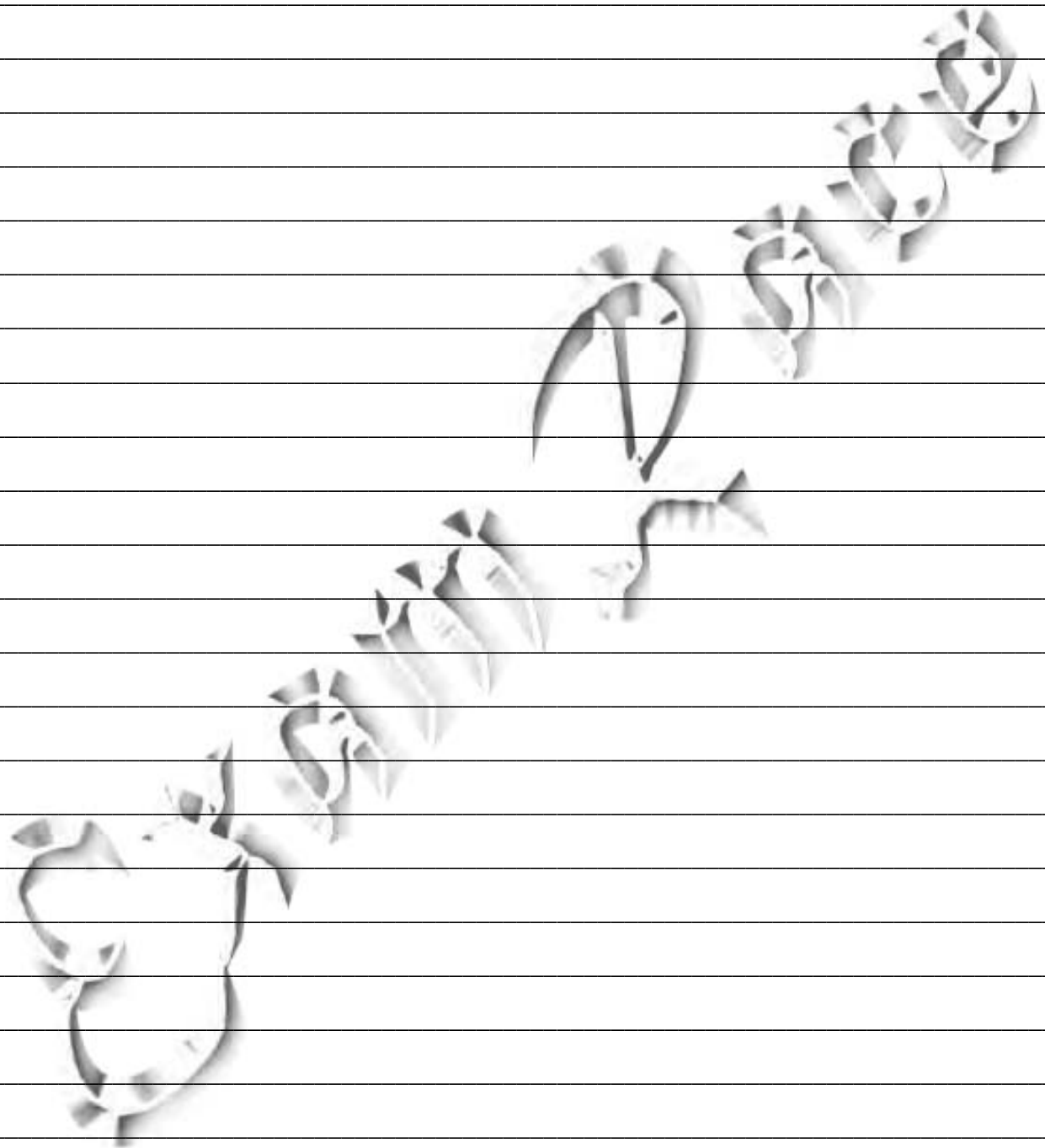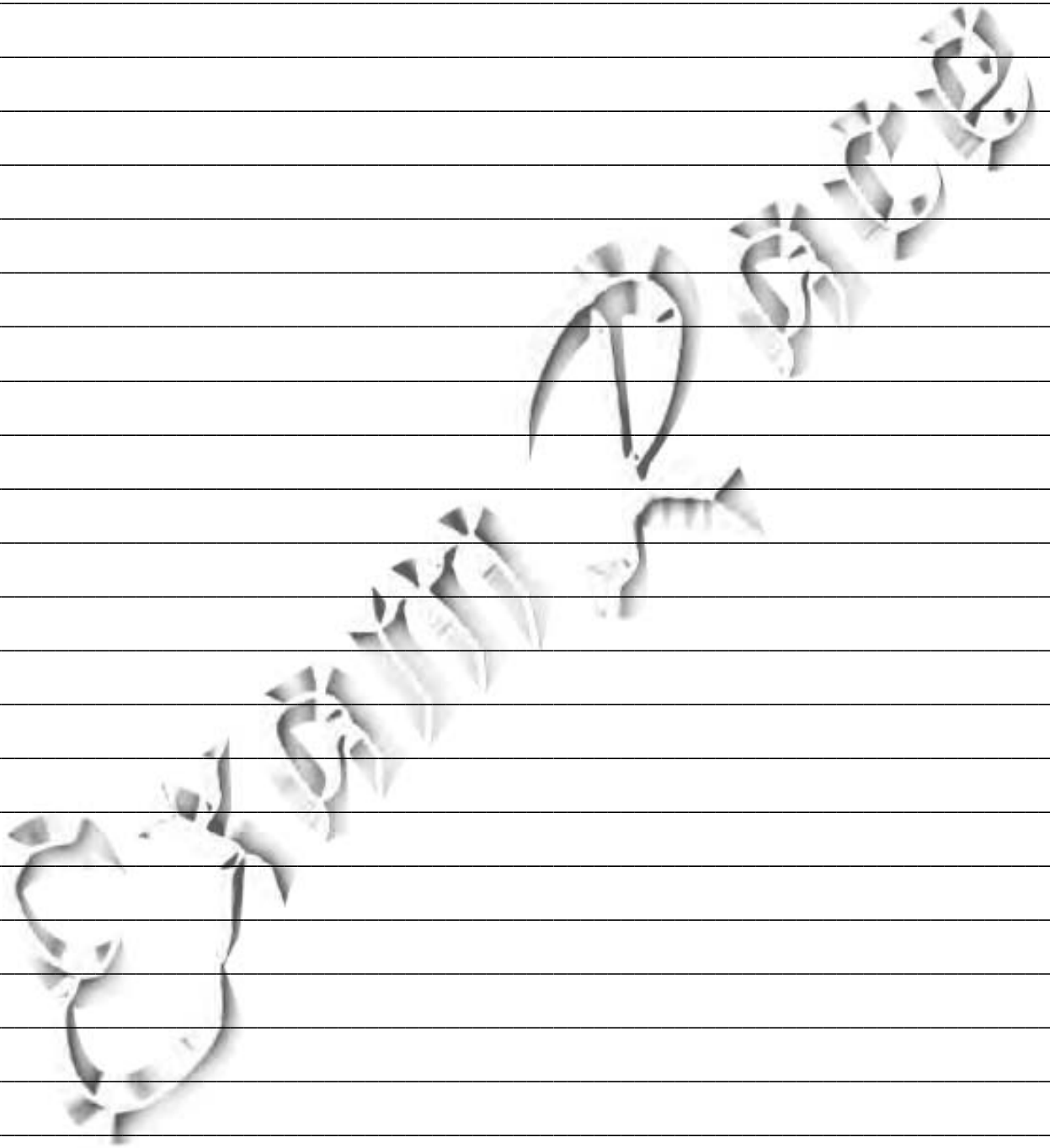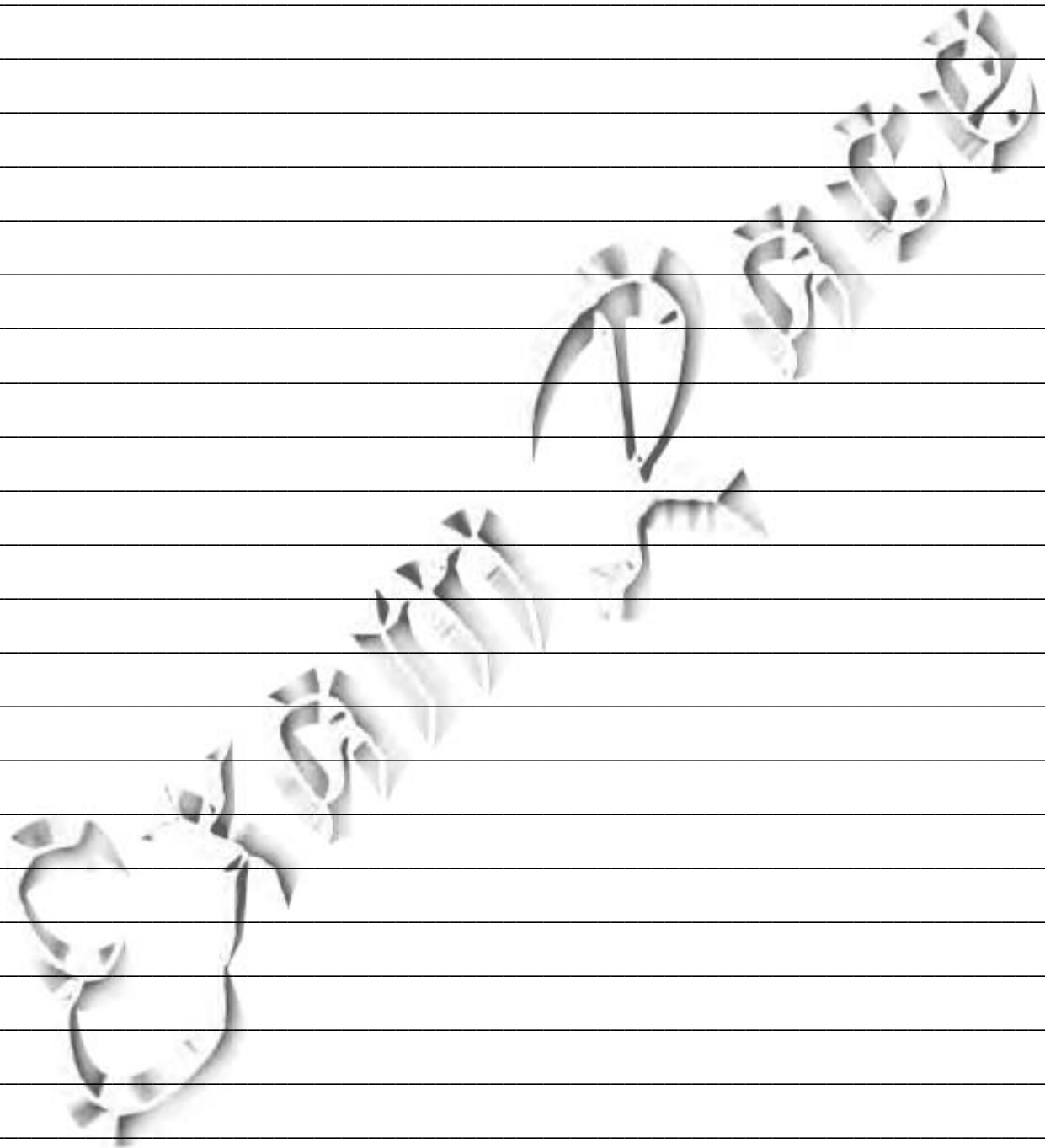
2. (a) Given the set of functional dependencies

$\{A \rightarrow BCD, CD \rightarrow E, E \rightarrow CD, D \rightarrow AH, ABH \rightarrow BD, DH \rightarrow BC\}$

Find the non-redundant cover.
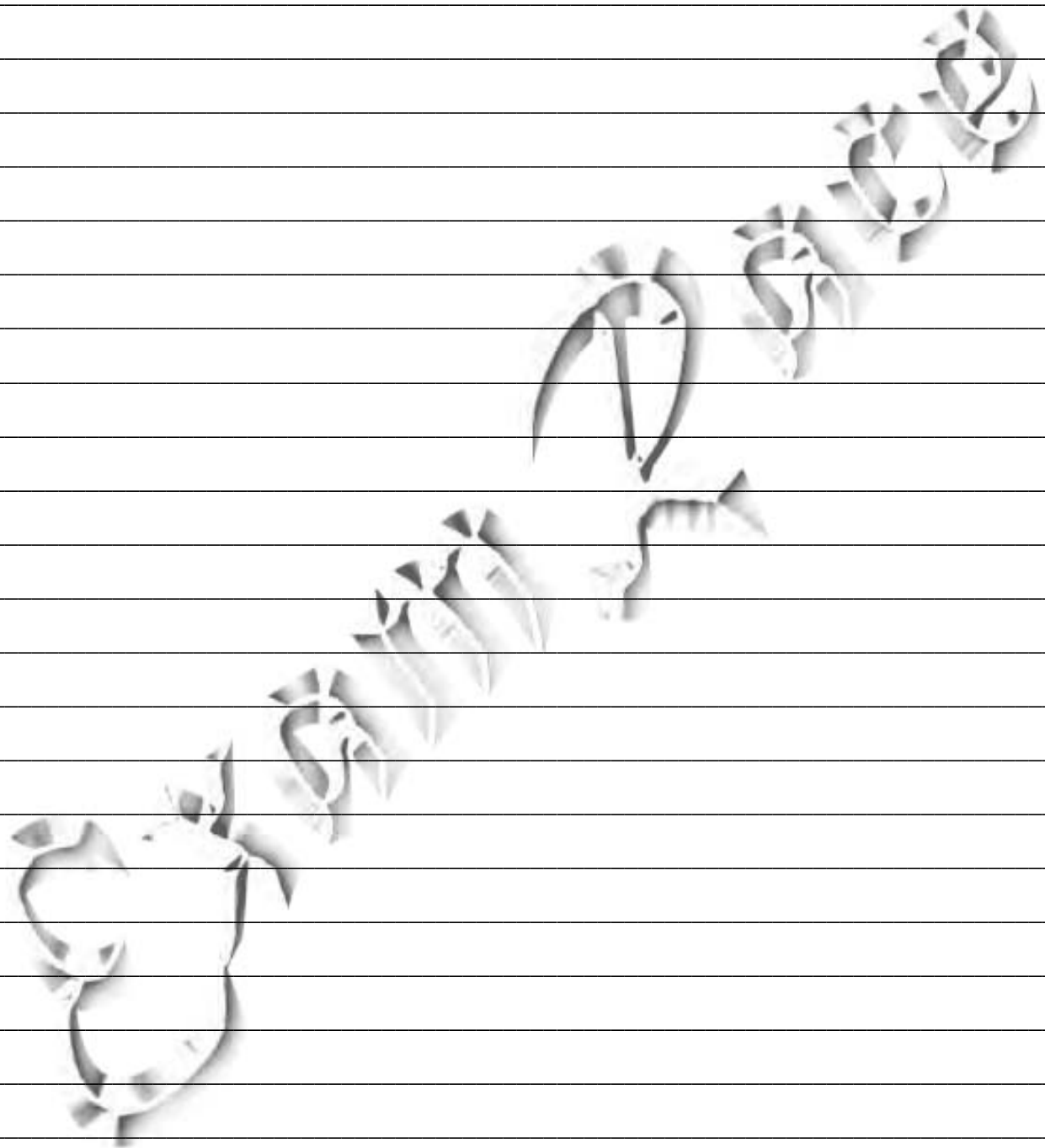
(b) Given the relation R(ABCDE) with the FD's

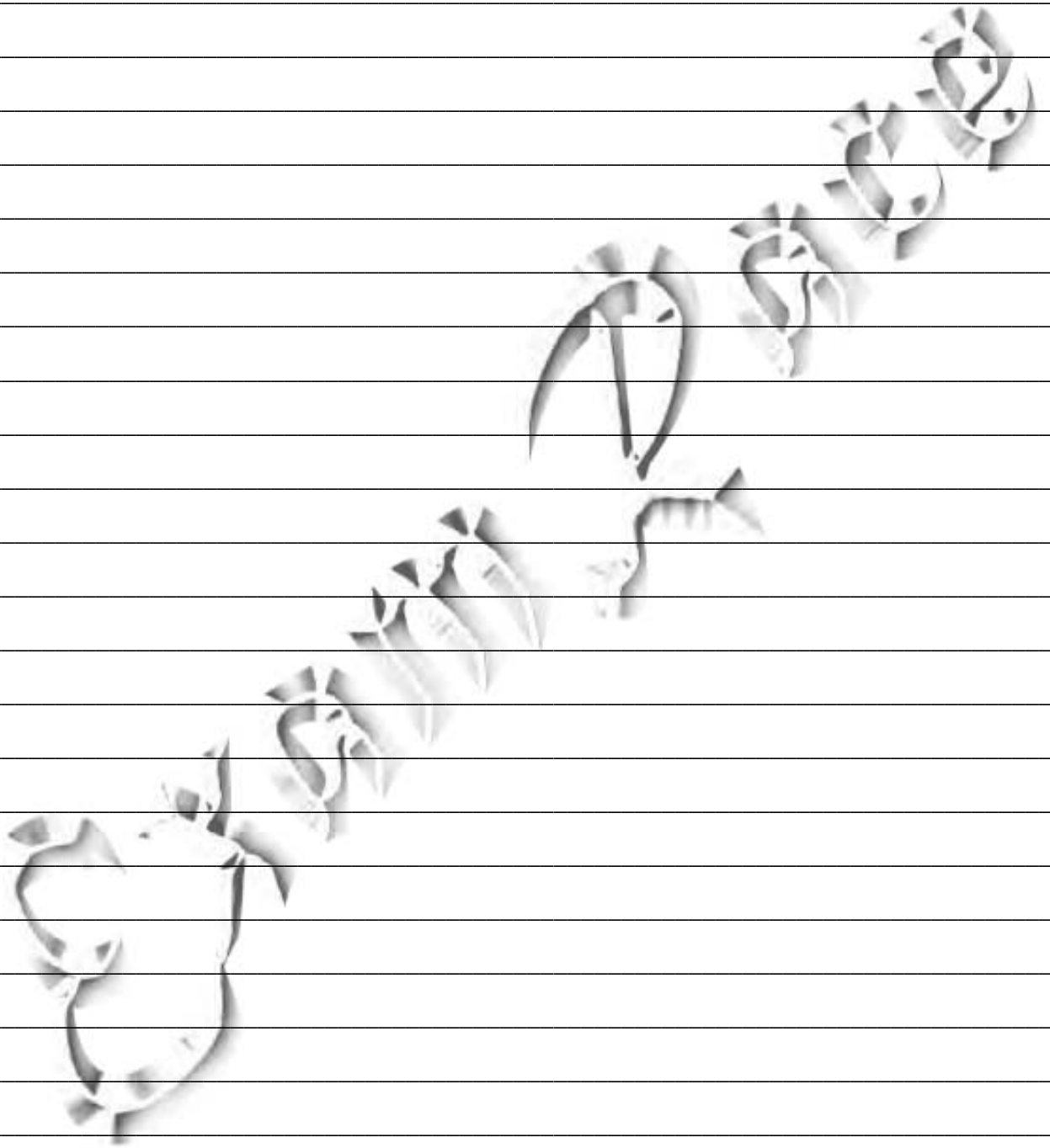$\{A \rightarrow BCDE, B \rightarrow ACDE, C \rightarrow ABDE\}$

Give the lossless decomposition of R. **(10 + 10)**
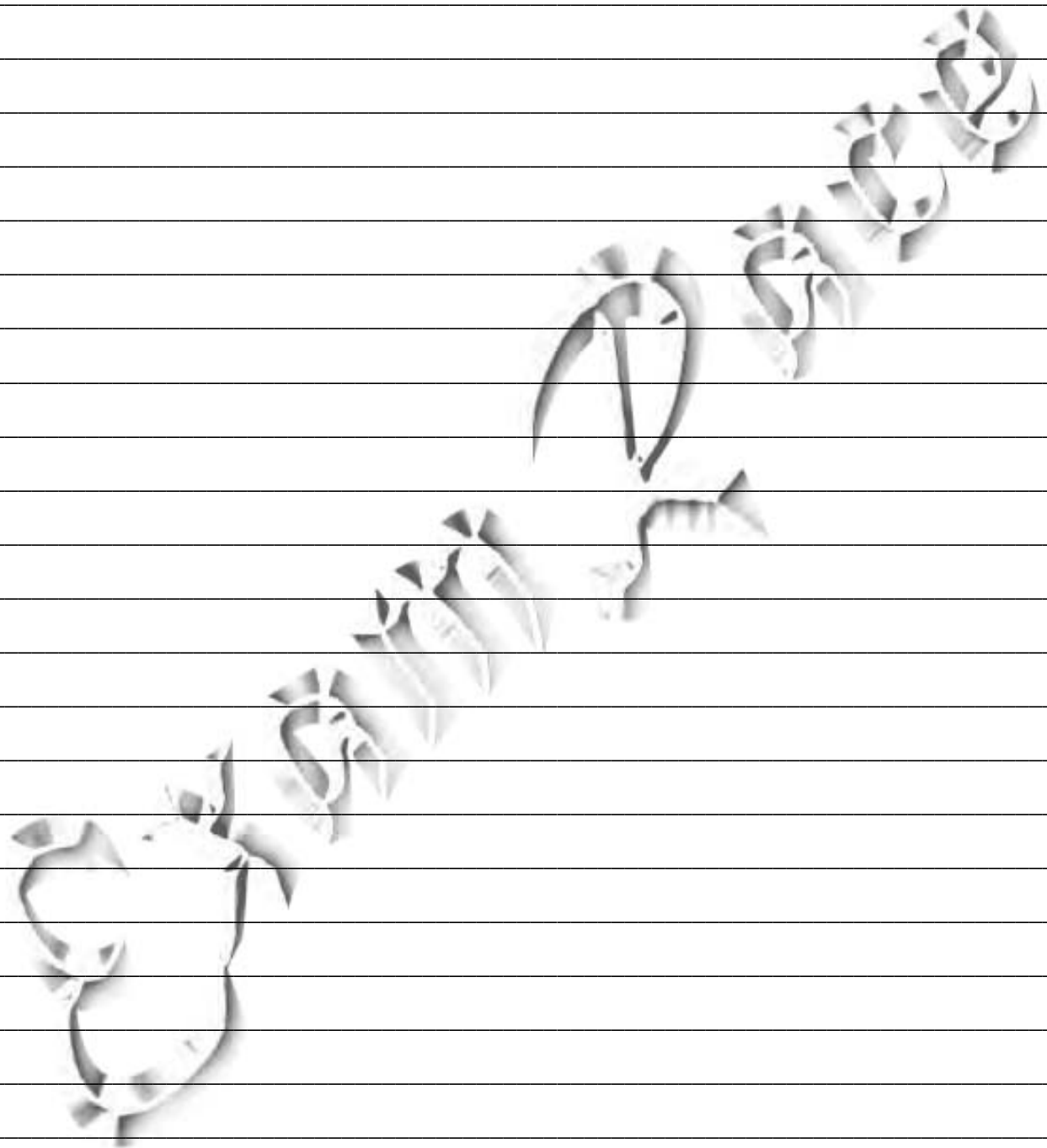
OR

Why is frequency modulation superior to amplitude modulation ? Give comparative study between encoding and modulation. **(20)**

SECTION – II

Note : This section contains **three (3)** questions from each of the electives/specializations. The candidate has to choose only **one** elective/specialization and answer all the three questions contained therein. Each question carries **fifteen (15)** marks and is to be answered in about **three hundred (300)** words. **(3 × 15 = 45 marks)**

Elective – I

3. Let G be the grammar with productions

$S \rightarrow AACD$

$A \rightarrow aAb \mid \lambda$

$C \rightarrow aC \mid a$

$D \rightarrow aDa \mid bDb \mid \lambda$ **(15)**

Convert the grammar G into Chomsky Normal Form.

4. Design Turing Machine which accepts language **(15)**

$L = \{a^n b^n c^n \mid n \geq 0\}$

5. Give deterministic finite automata accepting the set of strings of length five or more in which the fourth symbol from the right end is different from the left most symbol defined over the alphabet {a, b}. **(15)**

Elective – II

3. Describe the construction of a typical parity check matrix for Hamming code over GF(2) give its code words and error correction capability. **(15)**

4. Explain different components of a typical image processing system with a diagram. **(15)**

5. Mention various techniques of video files and explain any one technique in detail. **(15)**

Elective – III

3. The diagram represents a network and the numbers on the arcs are their capacities. A flow is defined as follows :

(x, y) :	(s, a)	(s, b)	(s, c)	(a, b)	(a, d)	(b, c)
$f(x, y)$:	5	6	0	0	5	1

| (x, y) :	(b, d)	(b, e)	(c, e)	(d, t)	(e, t)
$f(x, y)$:	2	3	1	7	4
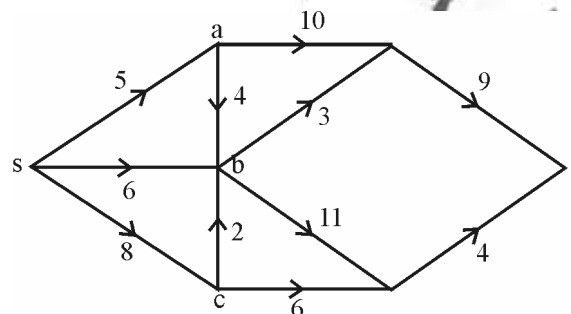
(i)   What is the value of f ?
(ii) Find an f–augmented path and compute the value of augmented flow.
(iii) Find the cut, which can justify the statement "Max flow = Minimum Cut".

(3 × 5 = 15)

4. Use revised simplex-method to solve the following linear programming problem :

Maximize $Z = x_1 + 2x_2$

Subject to the constraint : $x_1 + x_2 \le 3, x_1 + 2x_2 \le 5$

$$3x_1 + x_2 \le 6 \text{ and } x_1, x_2 \ge 0$$ **(15)**

5. Derive the Kuhn Tucker conditions for the following quadratic programming problem and find the value of x_1, x_2 and x_3.

Maximize $Z = -x_1^2 - x_2^2 - x_3^2 + 4x_1 + 6x_2$ subject to the constraints :

$$x_1 + x_2 \le 2, 2x_1 + 3x_2 \le 12, x_1, x_2 \ge 0$$ **(15)**

Elective – IV

3. Explain the concept of feed forward Neural Network with an example. **(15)**

4. How unsupervised learning is different from supervised learning ? Which is more complex ? Justify with an example. **(15)**

5. Prove that fuzzy set A on, IR is convex if and only if
$$A(\lambda X_2 + (1 - \lambda)X_2) \geq \min (A(X_1), A(X_2) \text{ for all } X_1, X_2 \in IR \text{ and all } \lambda[0, 1]$$
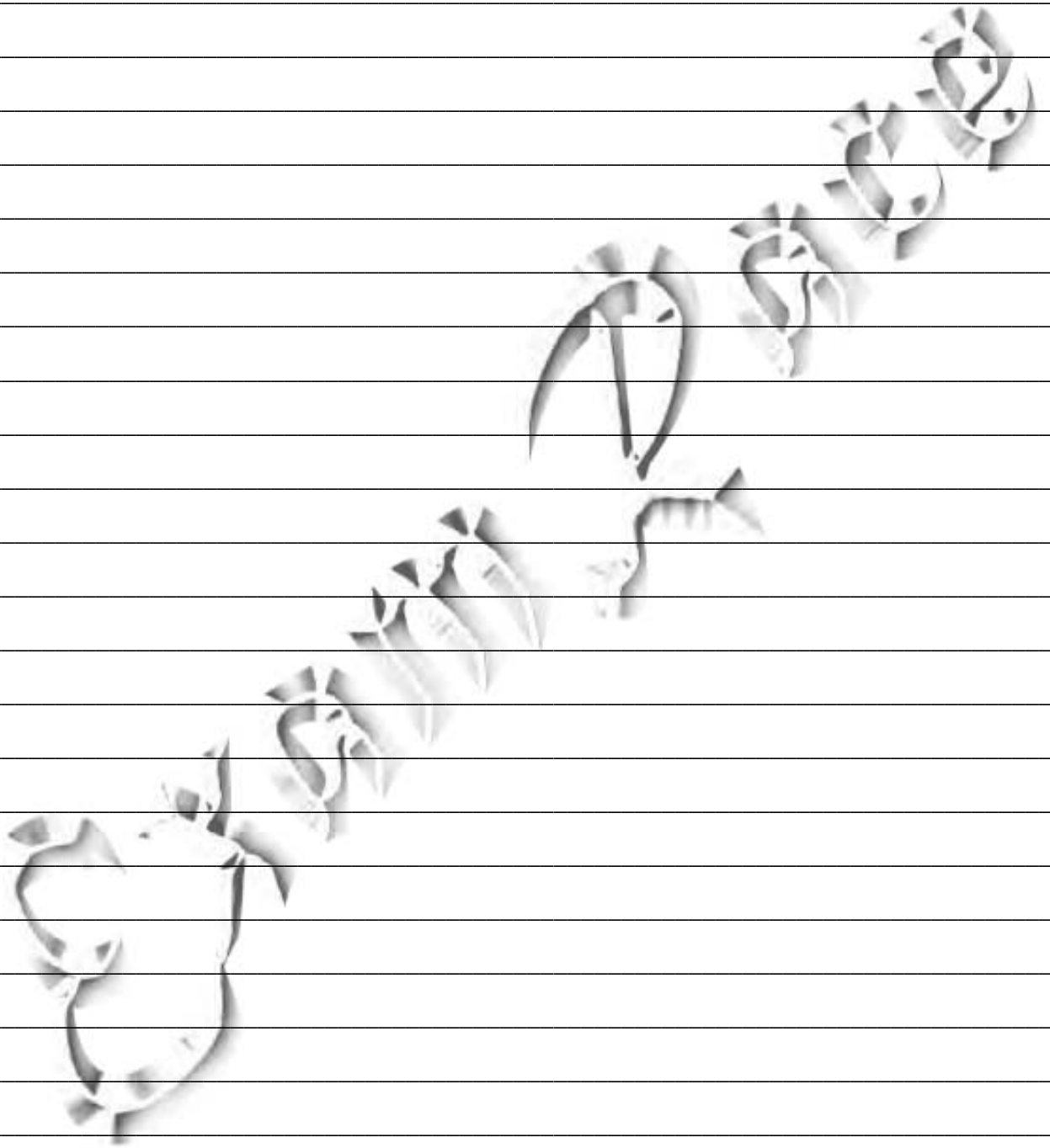where min denotes the minimum operator. **(15)**
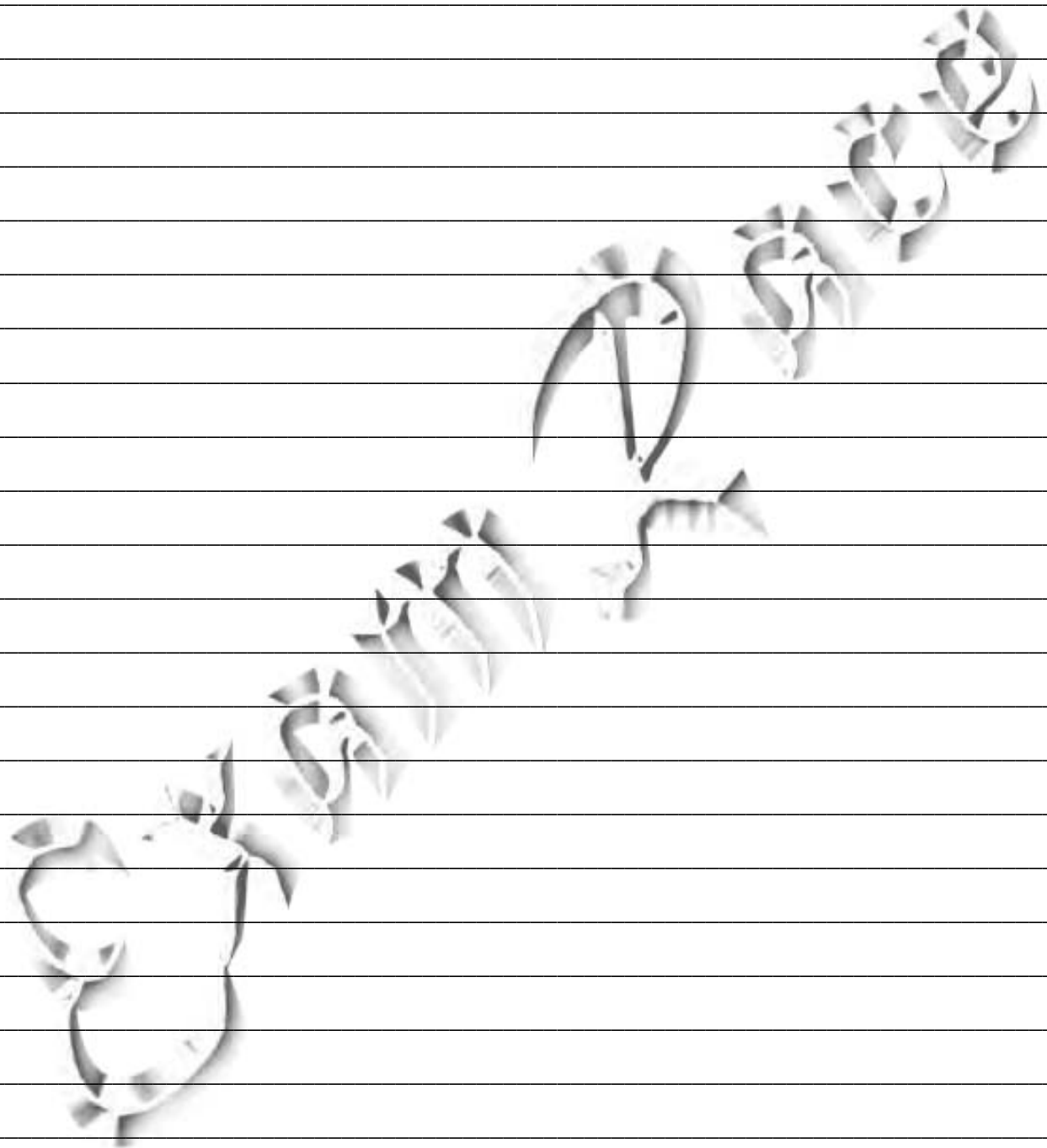
Elective – V

3. List out any 8 features of UNIX and explain any two of them. **(15)**

4. What is syntax of "create" system call in UNIX ? Write an algorithm for creating a file. **(15)**

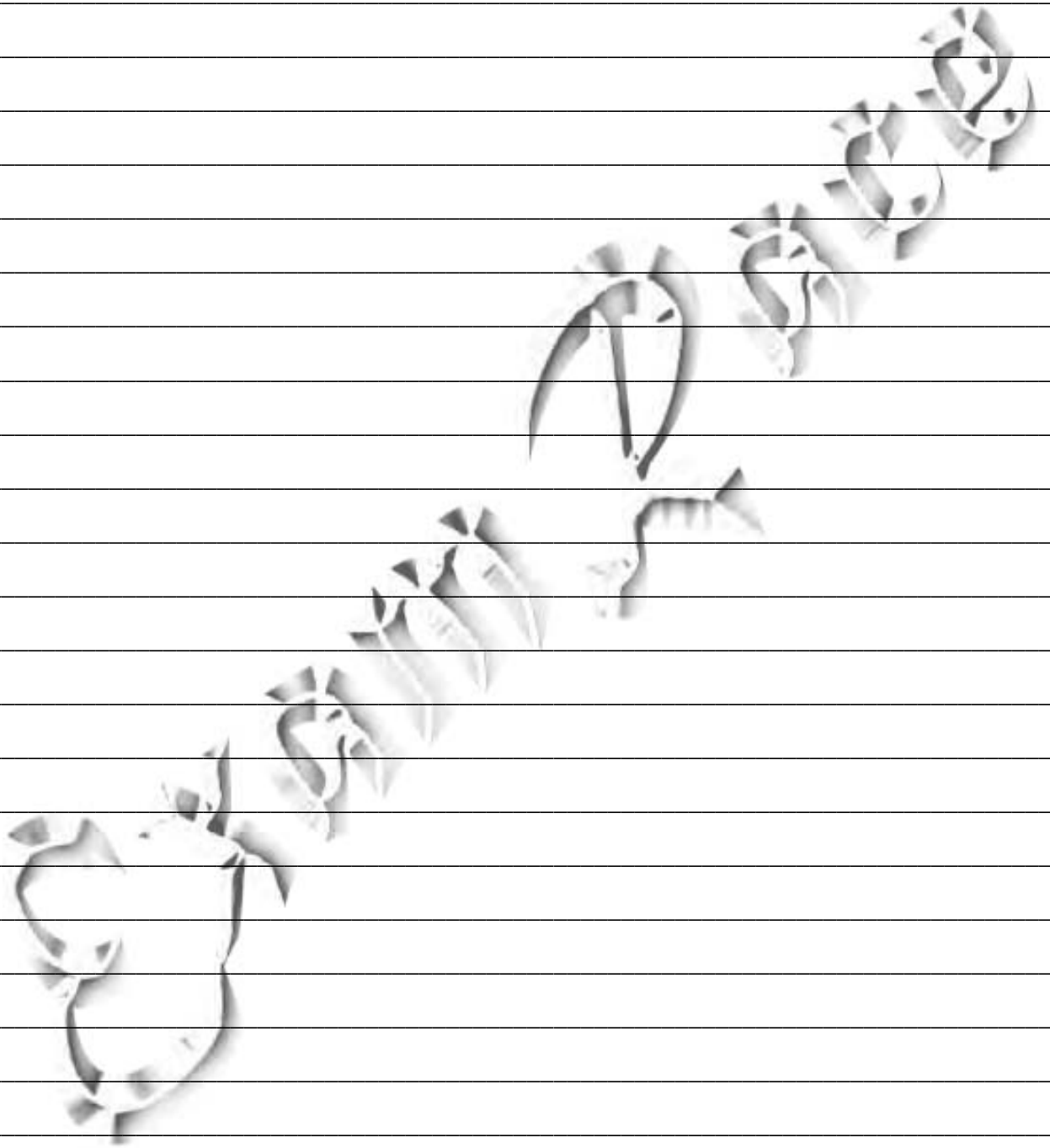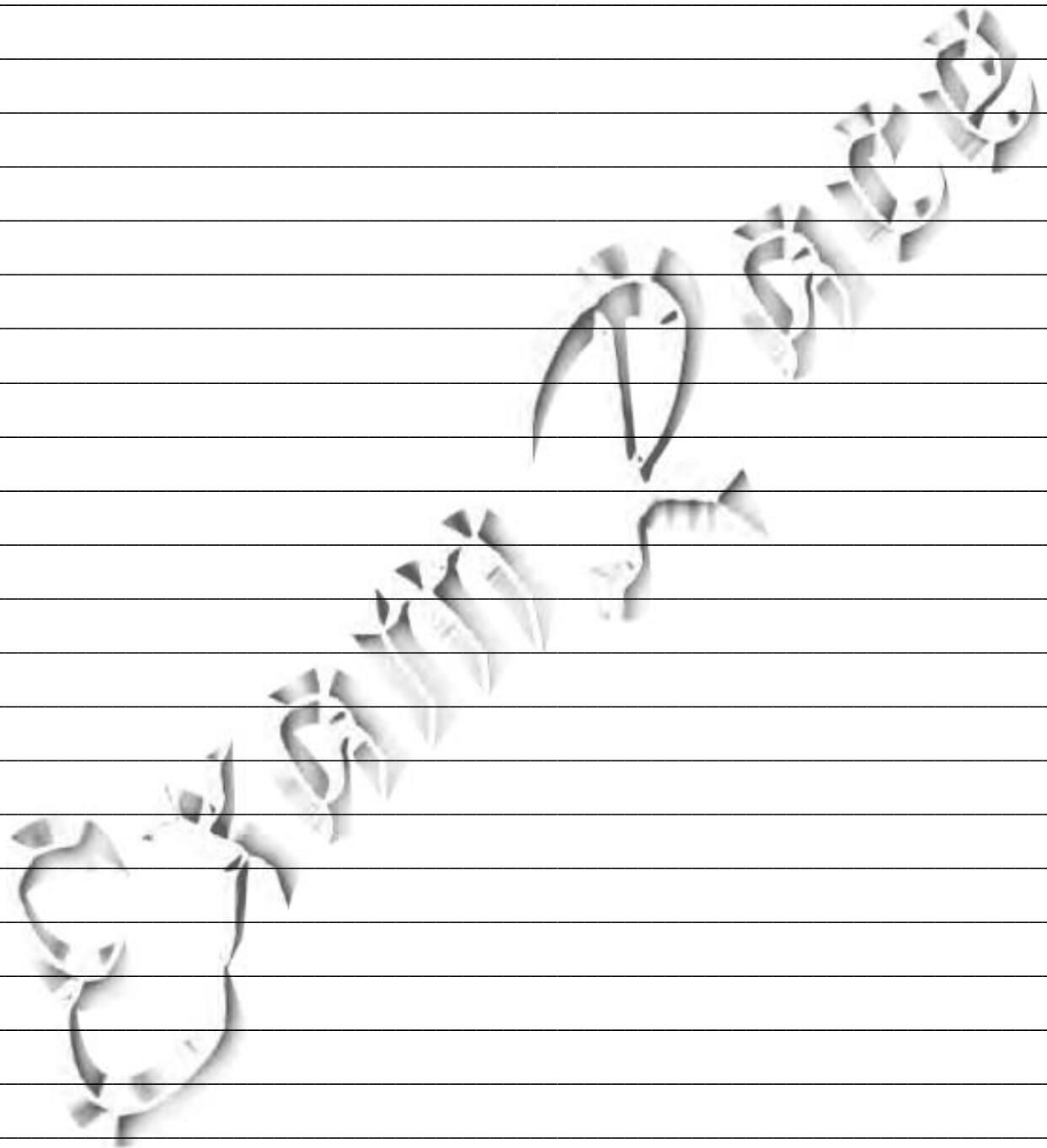5. How object library, dynamic linking library and import library works in WINDOWS environment ? **(15)**

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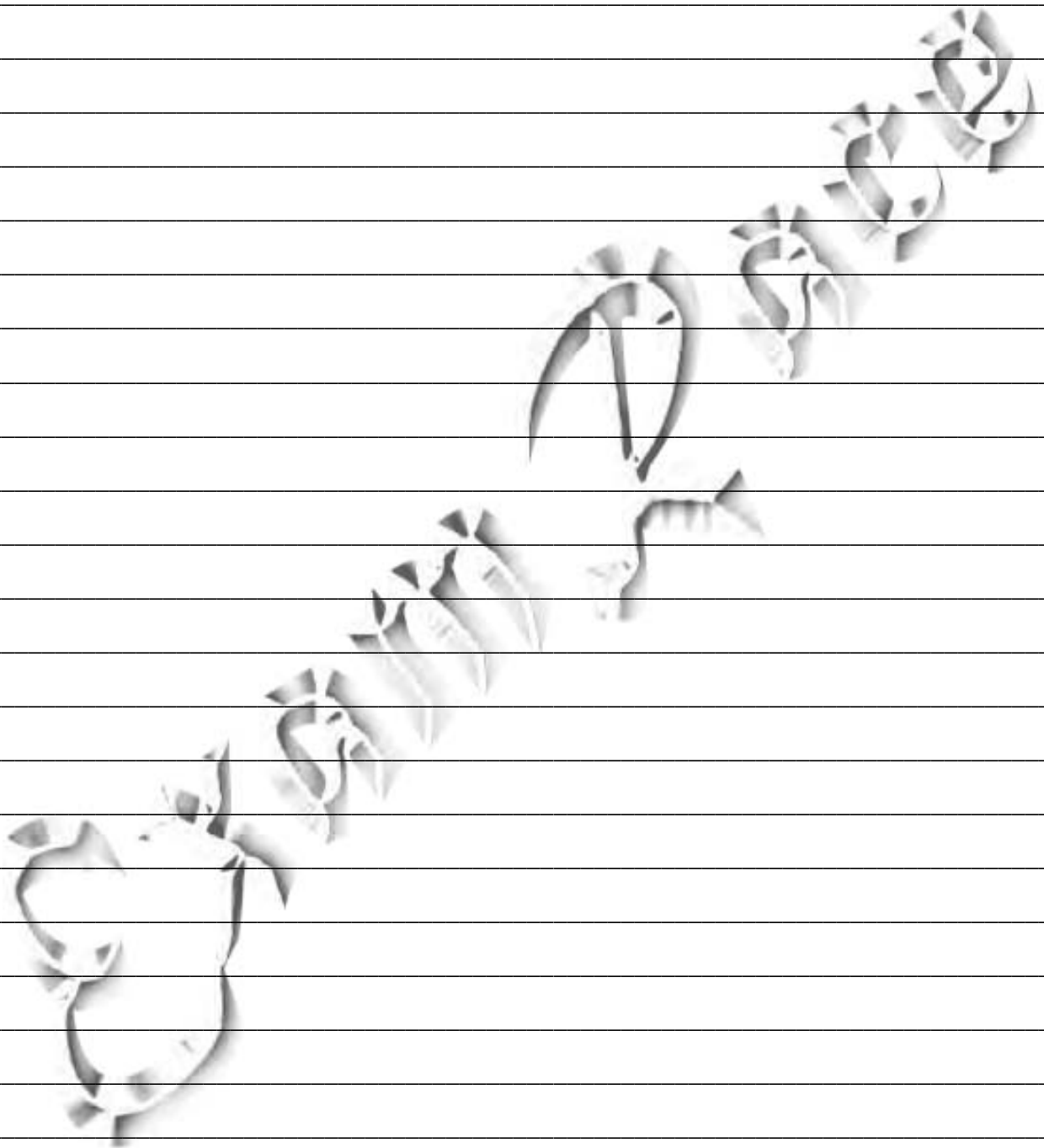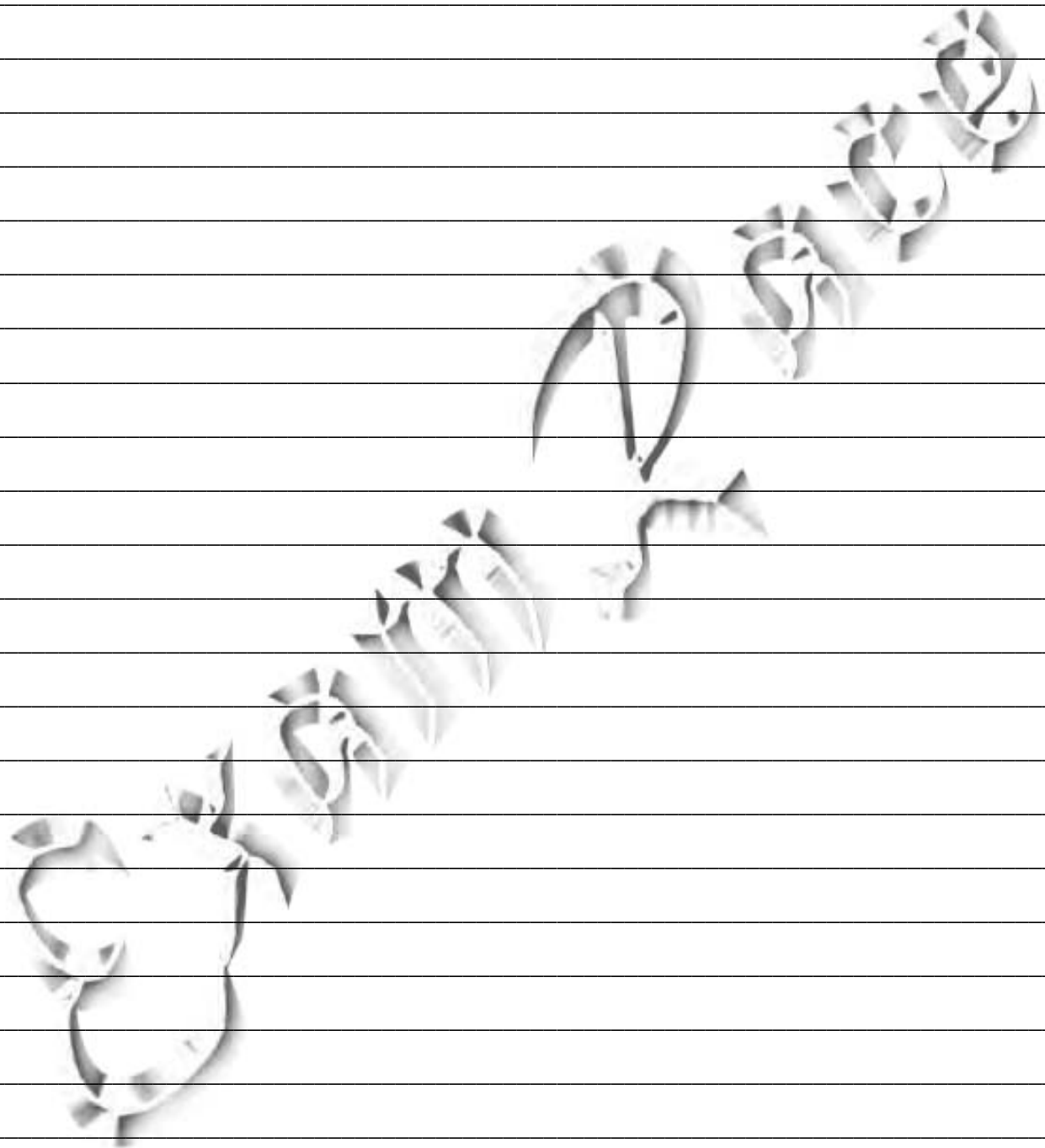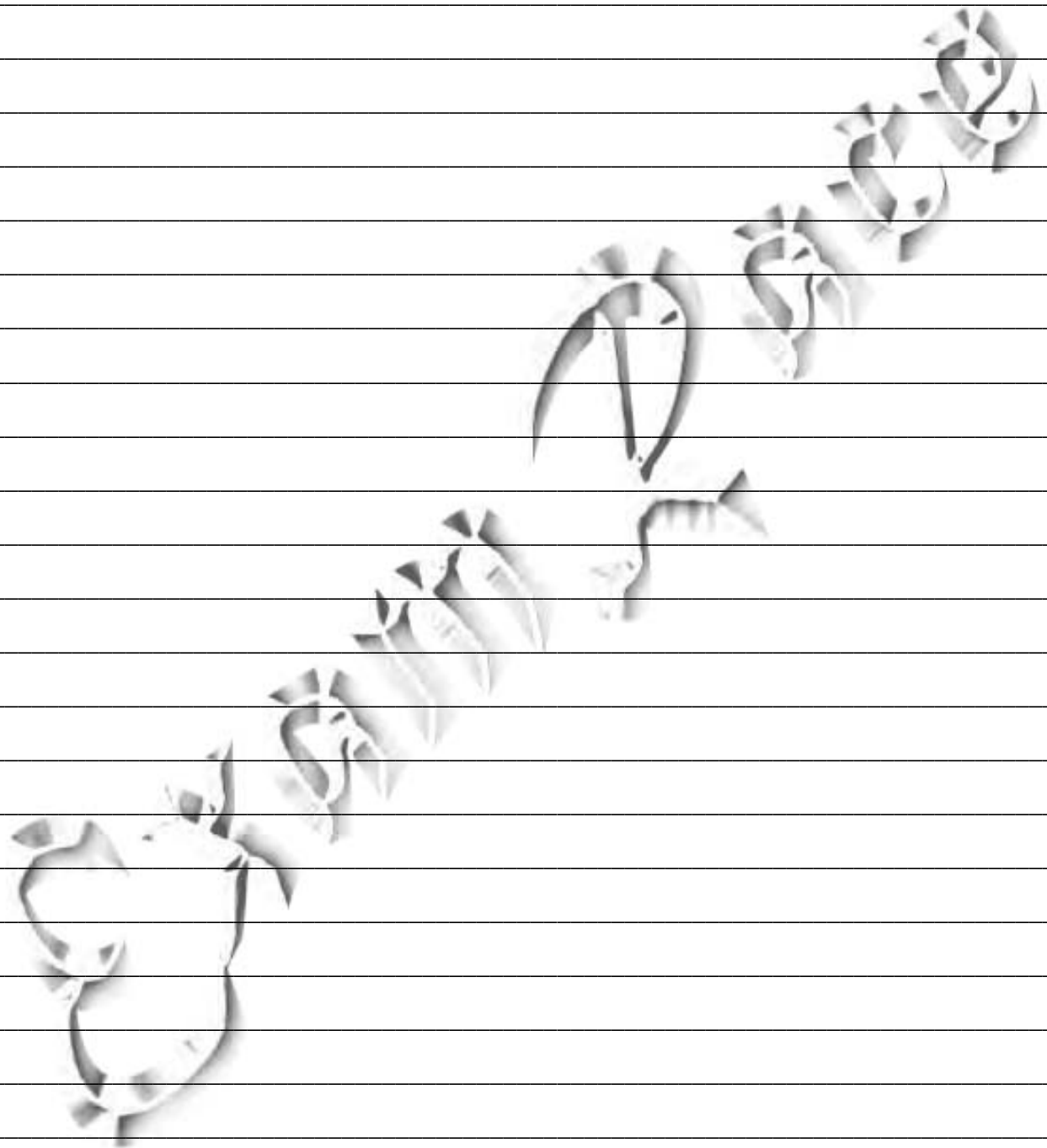
SECTION – III

Note : This section contains **nine (9)** questions of **ten (10)** marks, each to be answered in about **fifty (50)** words. **(9 × 10 = 90 marks)**

6. Construct a logic circuit diagram for the exclusive – OR function using only NOR gates. **(10)**

7. Consider the following graph-based locking protocol, which allows only exclusive lock modes, and which operates on data graphs that are in the form of a rooted directed acyclic graph :

   – A transition can lock any vertex first.

   – To lock any other vertex, the transaction must be holding a lock on the majority of the parents of the vertex.

   Show that the protocol ensures serializability and dead lock freedom. **(10)**

8. Explain terms Aspect Ratio, Refresh Rate and Resolution of a Graphics Display System. **(10)**

9. Let w = {11, 13, 24, 7} and m = 31. Find all possible subsets of w that sum to m. Draw the portion of the state space tree that is generated. **(10)**

10. Explain under what circumstances asynchronous and synchronous transmission technique are employed. Why asynchronous communications require additional standard stop bits ? What is wrong with letting the first-bit in a transmission act as a start bit and last one act as a stop bit ? **(10)**

11. Write an algorithm to compute maximum and minimum of a given set of n elements. **(10)**

12. Discuss any two constraints imposed while designing an object model. **(10)**

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13. Define the role of "prototyping" and "4GT" paradigm in software engineering. **(10)**

14.   Discuss characteristics of deadlock in an operating system.   **(10)**

SECTION – IV

Note : This section contains **five (5)** questions of **five (5)** marks each based on the following passage. Each question should be answered in about **thirty (30)** words.

(5 × 5 = 25 marks)

M/s Greenlay Bank has just ventured into a retail banking system with the following function (sub processes) at the beginning :

– Saving Bank accounts
– Current Bank accounts
– Fixed deposits
– Loans
– Demat Account

With reference to above, answer the following questions :

15. Explain Requirement Definition & Analysis.

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16. Make Conceptual Design : (Entity-Relationship diagram)

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17. Explain Logical Database Design : (Table Definition)

18. Logical Database design : (Sample Table Contents)

19. Explain Functional Dependency with diagram.

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Space For Rough Work