PAPER-III
COMPUTER SCIENCE AND APPLICATIONS

Signature and Name of Invigilator

1. (Signature) ____________________________  (In words)
   (Name)  ____________________________
   Roll No. ____________________________

2. (Signature) ____________________________  (In figures as per admission card)
   (Name)  ____________________________
   Roll No. ____________________________

J 8 7 1 1

Time : 2 ½ hours]

[Maximum Marks : 200]

Number of Pages in this Booklet : 32

Number of Questions in this Booklet : 19

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.

PARIKHAYDIYAYEK LIYE NITIYA

1. Pahale purush ke upper nityat swast than anav rool number likhiye.
2. Purush pravah than nityat pravah ke pravash ke upper, pravash pravah ke naiche ya pravash ke baar mein dhiye hue ekak swast than hi likhiye.

Isko likhe koii aatsimtaa kaam ka uday yeh nahi karna hain.
3. Paryaya prabh kyon hota phal, prant-prantika aapka yeh de jaaye hoga. Pahale pion minaat aapki prant-prantika khale te aumaiki nisproniikrit johri ke liye dhiye jaaye, nisproniik joh pravah aatyakh aatyakh karne hain:
   (i) prant-prantika khale ke liye uske baad pion pada te thani kaam ki soli ko phael le. Khulii huiya h yehin steekee-soli ko prant-prantika phalne kar n de.
   (ii) kyuba purush par khade nishatnusar prant-prantika ke purush than pravash ke samajh ke achar ki jhat ke rak kar le ke yeh pade hain.
   Deshshil purushpratikka jansam prant-prantika kaha hain ya dukhara aap aaye hino ya samajh in n hain achar ki phal aapki jriottii prant-prantika phalne kar n de than jisse samh aume latakar aumekh swast than purush purushpratikka le le. Isko likhe aapka pion minaat dhiye jaaye hoga. Usake baad na to aapki prant-prantika phalne kar aapka yeh than samh dhiye jaaye hoga.
5. Uph prant-prantika ke anav ke vachh kaam (Rough caa) karte ke liye myachekan sheet se pahale ek pion dhiye hoga.
6. Yehi aap prant-prantikak prvat nityat swast ke anavva aapka anav, rool, naiche, pion, naiche ya koi bhi aumaik joose pravah pravah kar se, aumaik karte hain aumaik swast swast ka pravah karte hain, ya koi aumaik anupasth samh ka pravah karte hain, to pravah ke liye aumaik khale ke liye sankh hain.
7. Aapke prati samh hotane par prant-prantika nisproniik ke mdhmpad ke nisthatna aatyakh hain aur isse prati sameet ke baar aavake samh kar prant pravah ke bhaar n lekar jaaye hoga.
8. Kavayi nile/kalake swast pahna kahii ki dhisal kar de.
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 \((a + b)^k \uparrow (g - m) | f \times p - 5 \times t\) 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 \( R \).  

OR

Why is frequency modulation superior to amplitude modulation? Give comparative study between encoding and modulation.
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 → AACD
   A → aAb | λ
   C → aC | a
   D → aDa | bDb | λ

   Convert the grammar G into Chomsky Normal Form. (15)

4. Design Turing Machine which accepts language
   \( L = \{ a^n b^n c^n \mid n \geq 0 \} \) (15)
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\}. \hspace{1cm} (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. \hspace{1cm} (15)

4. Explain different components of a typical image processing system with a diagram.\hspace{15}\hspace{15}(15)

5. Mention various techniques of video files and explain any one technique in detail. \hspace{15}\hspace{15}(15)

Elective – III

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

\[
\begin{align*}
(x, y) & : (s, a) & (s, b) & (s, c) & (a, b) & (a, d) & (b, c) \\
f(x, y) & : & 5 & 6 & 0 & 0 & 5 & 1 \\
(x, y) & : (b, d) & (b, e) & (c, e) & (d, t) & (e, t) \\
f(x, y) & : & 2 & 3 & 1 & 7 & 4 \\
\end{align*}
\]

(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”. \hspace{15}\hspace{15}(3 \times 5 = 15)

4. Use revised simplex-method to solve the following linear programming problem :
Maximize \(Z = x_1 + 2x_2\)
Subject to the constraint : \(x_1 + x_2 \leq 3, \ x_1 + 2x_2 \leq 5 \)
\[3x_1 + x_2 \leq 6 \text{ and } x_1, x_2 \geq 0\] \hspace{15}\hspace{15}(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 :
\[x_1 + x_2 \leq 2, \ 2x_1 + 3x_2 \leq 12, \ x_1, x_2 \geq 0\] \hspace{15}\hspace{15}(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
\[ A(\lambda X_2 + (1 - \lambda)X_2) \geq \min (A(X_1), A(X_2)) \]
for all \( X_1, X_2 \in \text{IR} \) 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)
SECTION – III

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

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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.

\(5 \times 5 = 25\) 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.

16. Make Conceptual Design: (Entity-Relationship diagram)
17. Explain Logical Database Design: (Table Definition)

18. Logical Database design: (Sample Table Contents)
19. Explain Functional Dependency with diagram.
Space For Rough Work
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Total Marks Obtained (in words) ...........................................

(in figures) ..........................................

Signature & Name of the Coordinator ...................................

(Evaluation) Date .........................