Signature and Name of Invigilator

1. (Signature) _____

   (Name) _____

2. (Signature) _____

   (Name) _____

Roll No. ☐☐☐☐☐☐☐

(In figures as per admission card)

Roll No. _____

(In words)

Test Booklet No.

J–8706	PAPER–III

COMPUTER SCIENCE AND APPLICATIONS

Time : 2½ hours]   [Maximum Marks : 200

Number of Pages in this Booklet : 40   Number of Questions in this Booklet : 26

Instructions for the Candidates	परीक्षार्थियों के लिए निर्देश
1. Write your roll number in the space provided on the top of this page.	1. पहले पृष्ठ के ऊपर नियत स्थान पर अपना रोल नम्बर लिखिए।
2. Answers 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.**	2. लघु प्रश्न तथा निबंध प्रकार के प्रश्नों के उत्तर, प्रत्येक प्रश्न के नीचे या प्रश्नों के बाद में दिये हुये रिक्त स्थान पर ही लिखिये। **इसके लिए कोई अतिरिक्त कागज का उपयोग नहीं करना है।**
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 :	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) To have access to the Test 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.	(i) प्रश्न-पुस्तिका खोलने के लिए उसके कवर पेज पर लगी सील को फाड़ लें। खुली हुई या बिना स्टीकर-सील की पुस्तिका स्वीकार न करें।
(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.**	(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 अर्थात किसी भी प्रकार की त्रुटिपूर्ण पुस्तिका स्वीकार न करें तथा उसी समय उसे लौटाकर उसके स्थान पर दूसरी सही प्रश्न-पुस्तिका ले ले। 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. Read instructions given inside carefully.	4. अन्दर दिये गये निर्देशों को ध्यानपूर्वक पढ़ें।
5. One page is attached for Rough Work at the end of the booklet before the Evaluation Sheet.	5. उत्तर-पुस्तिका के अन्त में कच्चा काम (Rough Work) करने के लिए मूल्यांकन शीट से पहले एक पृष्ठ दिया हुआ है।
6. If you write your name 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, you will render yourself liable to disqualification.	6. यदि आप उत्तर-पुस्तिका पर अपना नाम या ऐसा कोई भी निशान जिससे आपकी पहचान हो सके, किसी भी भाग पर दर्शाते या अंकित करते हैं तो परीक्षा के लिये अयोग्य घोषित कर दिये जायेंगे।
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.	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. **Use only Blue/Black Ball point pen.**	8. केवल नीले / काले बाल प्वाईंट पैन का ही इस्तेमाल करें।
9. **Use of any calculator or log table etc. is prohibited.**	9. किसी भी प्रकार का संगणक (कैलकुलेटर) या लाग टेबल आदि का प्रयोग वर्जित है।
10. **There is NO negative marking.**	10. गलत उत्तर के लिए अंक नहीं काटे जायेंगे।

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.

SECTION - I

An ABC agency caters the service for various customers and maintains their warranty certificate details and maintenance contracts for TV sets.

The complete details of these customers viz. Customer Name, address, Warranty certificate no. and issue date, warranty period validity (date from - date to) and for product items (Picture Tube, Volume control, etc.) and Maintenance Contract Details.

If, in case of a customer's complaint, ABC agency sends their person within 2 days of the complaint being lodged to look into the problem and appropriate remedy is suggested. In case of warranty period validity, the customer problem is solved free of cost else a charge is levied for overcoming the problem. In case of warranty period being over, a customer is also given the option of maintenance contract for 2 years on a nominal charge. Maintenance contracts are renewed thereafter if the customer so desires.

As a system analyst, design the following :

1. Draw E - R Diagram.

2. Draw functional decomposition diagram.

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3. Give physical Data Flow Diagram.

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4. Give Input Screen Design.

5. Draw State Transition Diagram.

SECTION - II

Note : This section contains fifteen (15) questions each to be answered in about thirty (30) words. Each question carries five (5) marks.

(5x15=75 marks)

6. Implement the switching function F (ABC) = Σ(0, 1, 5, 7) using a 4 input multiplexer.

7. Write an 8085 assembly language program to pick the largest of three given numbers.

8. What is the time spent in scanning each row of pixels during screen refresh in a raster system with resolution of 640×480 and a refresh rate of 60 frames/second ?

9. A triangle ABC with vertices A (3, 4), B (7, 2), and C (5, 8) is on the screen. What is the transformation, if the triangle is to be magnified twice its size keeping A (3, 4) fixed ? Obtain the new vertices of the triangle.

10. Show that two - phase locking ensures the serializability.

11. What is the highest normal form of each of the following relation ?

(i) R_1 (A B C) with A$\rightarrow$B, A$\rightarrow$C, and C$\rightarrow$B

(ii) R_2 (A,B,C,D) with A$\rightarrow$BC, CD$\rightarrow$B

(iii) R_3 (A,B,C,D,E) with A$\rightarrow$BC, E$\rightarrow$CA, CD$\rightarrow$E

Find the candidate keys for each of these relations.

12. How is server crash handled in RPC (Remote Procedure Call) ?

13. What do you mean by binary exponential backoff ?

14. What do you understand by 'data-member' and 'member-function' of a class ?

15. What is thread ? How is it different from a process ?

16. What are the differences between simple paging and demand paging ?

17. What characteristics are common to traps, supervisory calls, and subroutine calls, but different in interrupts ?

18. Which of the two parameters a and b in a*KDLOC^b, has more evident impact on the values of effort in the basic COCOMO model ?

19. How are reliability and time of delivery co-related with the cost building the software ?

20. Consider the following weighted 2 - tree T.

Find the weighted path length P of the tree T.

SECTION - III

Note : This section contains five (5) Electives. The candidate has to choose one Elective and has to answer all the five questions from that Elective. Each question carries twelve (12) marks and is to be answered in about two hundred (200) words.

(12x5=60 marks)

Elective - I

21. Consider the following language

$L = \{ww^R / w \in \{0, 1\}^*\}$

(Note : w^R represents reversal of string w)

Construct a CFG to represent this language. Prove that $L = L(G)$, for the grammar G you have constructed.

22. Prove that following language are not regular using Pumping Lemma.

$L = \{0^i \, 1^i \mid i \geqslant 0\}$

23. Consider the grammar G (S) with

P : $S \rightarrow ABC \mid AB$

$A \rightarrow BS \mid b$

$B \rightarrow SA \mid a$

Convert this grammar into Greibach Normal Form (GNF).

24. Construct an automation M which accepts the language

$L(M) = \{a^r b^s : r > 0 \; s > 0\}$
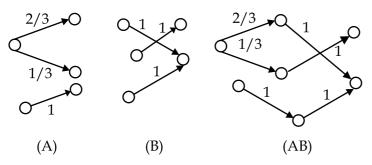
25. Design an Algorithm for obtaining minimum state equivalent DFA for given DFA.

OR

Elective - II

21. Consider a Discrete memoryless source with three output symbols with probabilities {0.5, 0.4, 0.1}.
    (a) Determine the Huffman code for this source and the efficiency.
    (b) Determine the Huffman code for this source taking two symbols at a time and find the efficiency η.

22. Determine the Lampel ziv code for the following bit stream
0100111100101000001010101100110000.

23. Consider the channels A, B and the Cascaded channel AB for the figure shown here :

    (A)   (B)   (AB)

   (a)   Find C_A the capacity of Channel A

   (b)   Find C_B the capacity of Channel B

   (c)   Cascade the two channels and determine the combined capacity C_{AB}.

   (d)   Explain the relation between C_A, C_B and C_{AB}.

24. How can Fourier transformation be used to perform image restoration?

25. Discuss fractral image compression technique and give its advantages.

OR

Elective - III

21. Solve the Linear Programming Problem by Simplex method :
Minimize $Z = 2x_1 - 3x_2 + 6x_3$
Subject to $3x_1 - 4x_2 - 6x_3 \leq 2$
$2x_1 + x_2 + 2x_3 \geq 11$
$x_1 + 3x_2 - 2x_3 \leq 5$
x_1 and $x_2 \geq 0$

22. Obtain the Kuhn Tucker's necessary and sufficient conditions for a solution of the following problem :
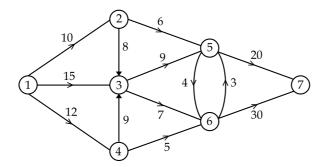
Minimize $f(x) = P^T X + \dfrac{1}{2} X^T C X$

Subject to $AX = b$
$X \geq 0$

Where C is a symmetric positive semi - definite matrix.

23. (a) Given node - arc chain notions of flow in a network. Prove that a flow f is maximal if and if only there is no flow augmenting path with respect to f.

(b) Find a maximal flow in the following network, where the numbers associated with the branches are the capacities in the direction shown.

24. (a) Show that if a linear programming problem has an optimal solution, then atleast one of the basic feasible solution will be optimal.

(b) Solve the following Transportation Problem :

		To 1	2	3	4	5	Supply
	A	1	2	0	0	0	3
	B	0	1	3	0	0	4
From	C	0	0	0	2	5	7
	Demand	2	3	3	4	6	

25. (a) Show that if $X_\ominus$ is a solution of the problem

Minimize $f(\ominus, X) = \ominus P^T X + \frac{1}{2} X^T C X$

$AX = b$

$X \geq 0$,

Where $\ominus$ is a parameter, T is transposition Then $P^T X_\ominus$ is monotonically non-increasing function of $\ominus$.

(b) Show that $(X^T B X)$ is a convex function of $X \in E_n$, where B is a real symmetric positive semi - definite.

OR

Elective - IV

21. State perceptron learning law. Write learning algorithm for perceptron network.

22. Distinguish between Hebbian learning and competitive learning.

23. Describe Back propagation algorithm in a Neural Network. Mention one of its applications.

24. What do you mean by fuzzy relation ? Illustrate fuzzy relation with simple example.

25. Define α - cut of a fuzzy set A. Illustrate α - cut set with an example.

OR

Elective - V

21. Explain three categories of files in UNIX.

22. What is the grep used for ? What are its various options ? Give the syntax of the grep command.

23. (a) What is the purpose of a nice command ?

(b) What are the advantages of cpio over tar ?

24. (a) Explain the Common Desktop Environment (CDE) of X window system.

(b) How does X solve the problem of running the same program on different displays with different characteristics ?

25. Explain the role of X in running X clients Remotely.

SECTION - IV

Note : This section consists of one question carrying (40) marks.

(40x1=40 marks)

26. (a) Consider the grammar G (S) with :

P : S→aAbc | BCf

A→C | e

B→Cd | c

C→df | e

Construct LR (I) sets of items and construct complete perge table.

(b) Give a method of transforming any given Context Free Grammar (CFG) in equivalent Pushdown Automation (PDA).

OR

(a) Solve the following travelling salesman problem using branch and bound algorithm :

$$\text{Cost matrix} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{cccc} 1 & 2 & 3 & 4 \\ \left[\begin{array}{cccc} - & 5 & 10 & 6 \\ 10 & - & 8 & 9 \\ 5 & 6 & - & 12 \\ 19 & 18 & 17 & - \end{array}\right] \end{array}$$

(b) Show that the average complexity of SIS (Straight Insertion Sort) is $O(N^2)$.

OR

(a) With a neat diagram, explain components and functions of Expert Systems.

(b) Write A* Search Algorithm. Mention advantages over any one search algorithm.

39

FOR OFFICE USE ONLY							
Marks Obtained							
Question Number	Marks Obtained	Question Number	Marks Obtained	Question Number	Marks Obtained	Question Number	Marks Obtained
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

Total Marks Obtained (in words) ....

(in figures) ....

Signature & Name of the Coordinator ....

(Evaluation)   Date ....