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–8708

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

1. Write your roll number in the space provided on the top of this page.
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.
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 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.
   (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 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.
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.**
10. **There is NO negative marking.**

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 हुये 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 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 अर्थात 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 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. 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 पैन का ही इस्तेमाल करें।**
9. **किसी भी प्रकार का संगणक (कैलकुलेटर) या लाग टेबल आदि का प्रयोग वर्जित है।**
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

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

(5x5=25 Marks)

Consider the following C code to compute the roots of a quadratic equation : $ax^2 + bx + c = 0$

```
#include<stdio.h>
/* print the roots of the quadratic equations with comments */
main ()
{
int          a, b, c, discr, root1, root2 ;
scanf("%d %d %d", &a, &b, &c);
discr = b*b-4*a*c;
root1 = ( - b + sqrt(discr) ) / (2*a);
root2 = ( - b - sqrt(discr) ) / (2*a);
printf("%d %d", root1,root2);
}
```

1. For the quadratic equation $2x^2 + 3x + 1 = 0$

a. What are the values of the roots printed by the above program ?

b. What happens when $a = 0$?

c. What are the actual roots of the equation ?

2. Modify the program to work properly for real roots, when coefficients are still integers.

3. Modify the program to compute (real as well as) complex roots when the coefficients are real.

4. Modify the program as follows :

a. Write a function to compute the roots of a quadratic equation in standard form i.e. $x^2 + bx + c = 0$.

b. Modify the given program to compute the roots of a quadratic equation in non-standard form i.e. $ax^2 + bx + c = 0$ using the function of part (a).

5. Modify the given program to run continuously two times. If the user provides the same input consecutively, your program must report that together with the roots without computing the roots again.

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. Given an array S of n integers, design an algorithm to find out whether there exists a pair of integers in S whose sum is equal to a given integer x.

7. Construct a DFA (Deterministic Finite Automaton) accepting the following language :

$L = \{w \in \{a, b\}^* : \text{each } 'a' \text{ in } w \text{ is immediately followed by a } 'b'\}$

8. Write a recursive function in C or C++ to compute the number of nodes in a binary tree.

9. Write a CFG (Context Free Grammar) for the following language :

$\left\{a^n\ b^n\ c^m\ d^m : n \geq 0, m \geq 0,\right\}$

10. Assuming that logical 1 is available, show that INHIBIT gate is a universal building block.

11. Implement the switching function $F = \sum (0, 1, 5, 6)$ using a 4 input multiplexer.

12. Explain the meaning of message switched and packet switched networks. Give their key differences also.

13. Describe Belady's anomaly.

14. Why is it that hill climbing techniques have a limited use in AI ?

15. Distinguish between a software process model and a software process.

16. State the functions of BIOS in a PC.

17. State the major advantages and disadvantages of Network Data Model with a suitable example.

18. Give an example program in C++ to show that it is possible for a derived class to inherit two or more base classes.

19. What is function overloading in C++? Give an example program using function overloading.

20. Define postfix notation of a general expression E.

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)

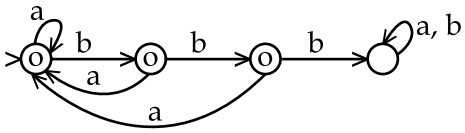
Elective - I

21. Is the following language regular ?

$L = \{a^m b^n : m \geq 0, n \geq 0\}$

Justify your answer.

22. Give the language accepted by the following automaton :



23. Show that the class of regular languages is closed under :

a. union

b. complementation

c. intersection

24. Design a push down automaton for the following language :

$L = \{wow^R : w \in \{a, b\}^*, w^R \text{ is the reverse of the string } w\}$

25. Design a Turing machine S which transforms the string $\underline{b}w\underline{b}$ into the string $w\underline{b}$

where w contains no blanks, b represents a blank and $\underline{b}$ shows the position of the head of the tape. Give the diagrammatic representation of S.

Elective - II

21. Show that the communication entropy is maximum when the symbols emitted by a source are equiprobable.

22. When is a code said to be instantaneously decodable ? Give an example of a code which is not instantaneously decodable.

23. Explain the meaning of block codes, convolution codes and turbo codes.

24. With the help of a suitable example, explain how run length encoding enables us to compress an image.

25. Compute the discrete Fourier Transform of the vector (0, 1, 2, 3).

Elective - III

21. Show that the set of all feasible solutions to a linear programming problem is a convex set.

22. Show that the matrix of a transportation problem is uni-modular.

23. State and explain Max-flow Min-cut theorem.

24. State the relative merits of Dijkstra's and Moore's shortest path algorithms. Can these algorithms be used when edges are permitted to have negative weights ?

25. Is a linear function both convex and concave ? Justify your answer.

Elective - IV

21. Show that the function $\Phi(v) = v / \left(\sqrt{(1+v^2)}\right)$ is an odd sigmoid function.

22. A neuron j receives inputs from four other neurons whose activity levels are 10, -20, 4 and -2. The respective synaptic weights of neuron j are 0.8, 0.2, -1.0 and -0.9. Calculate the output of the neuron j if the neuron is linear. The bias applied to the neuron is zero.

23. Describe the following learning rules :

a. Memory based learning

b. Boltzmann learning

24. Explain the significance of the following statement : "Multi-valued fuzziness corresponds to degrees of indeterminacy or ambiguity, partial occurrence of events or relations".

25. State and explain fuzzy modus tollens inference rule.

Elective - V

21. If a UNIX file has protection mode 755 (octal), what can the owner, owner's group and everyone else do to the file ?

22. Describe the advantages of OPEN systems. Does a common UNIX standard for OPEN systems exist ?

23. Describe the commands a system administrator has to use in UNIX.

24. What are the four different versions of Windows 2000 ?

25. Why is it that in Windows 2000, the current priority is always greater than or equal to the base priority ?

SECTION - IV

Note : This section consists of one question carrying (40) marks to be answered in about one thousand (1000) words on any of the following topics.

(40x1=40 marks)

26. (a) With reference to 8085, give examples of one byte, two bytes and three bytes instructions.

(b) State the advantage of 16 bit microprocessors over 8 bit microprocessors.

(c) Write an 8085 assembly language program to evaluate the expression

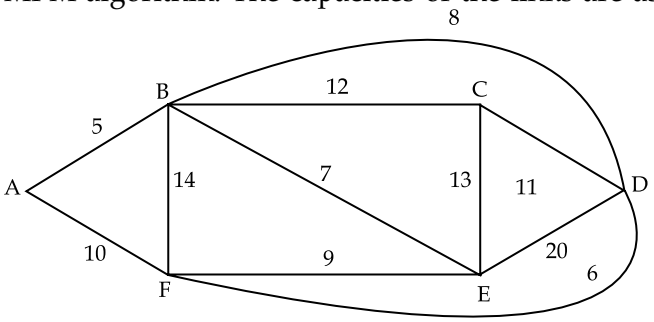
(a*b)/(c*d) + (e*f)/(g*h)

Where a, b, c, d, e, f, g and h are one byte integers. Use subroutines for multiplication and division. Your program must test for overflow conditions.

OR

(a) When is a flow in a network said to be feasible ?

(b) For the following network, find the maximum flow from source to sink using MPM algorithm. The capacities of the links are as indicated :



(c) With reference to average behaviour and worst case behaviour, what is the complexity of Ford and Fulkerson's algorithm ?

OR

(a) Explain the meaning of 'critical section' and 'mutual exclusion'.

(b) Distinguish between a 'virus' and a 'worm'.

(c) State Dijkstra's dining philospher's problem and solve it by using semaphores.

OR

(a) When is a system said to be under determined ?

(b) Show that a half space is a convex set.

(c) Solve the following problem by the original simplex method :

Minimize : $x + y + z$

Subject to :

$$x - u - 2w = 5$$
$$y + 2u - 3v + w = 3$$
$$z + 2u - 5v + 6w = 5$$

$$x, y, z, u, v, w \geq 0$$

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 .....