COMPUTER SCIENCE AND APPLICATIONS

Signature of Invigilators

1. .....

2. .....

PAPER–III

OCT–11/19

Roll No. ☐☐☐☐☐
(In figures as in Admit Card)

Roll. No. .....

.....
(in words)

Name of the Areas/Section (if any).....

Time Allowed : 2-1/2 hours] **[Maximum Marks : 200**

Instructions for the Candidates

1. Write your Roll Number in the space provided on the top of this page.
2. Write name of your Elective/Section if any.
3. Answer to short answer/essay type questions are to be written in the space provided below each question or after the questions in test booklet itself. No additional sheets are to be used.
4. Read instructions given inside carefully.
5. Last page is attached at the end of the test booklet for rough work.
6. If you write your name or put any special mark on any part of the test booklet which may disclose in any way your identity, you will render yourself liable to disqualification.
7. Use of calculator or any other Electronic Devices is prohibited.
8. There is no negative marking.
9. You should return the test booklet to the invigilator at the end of the examination and should not carry any paper outside the examination hall.

પરીક્ષાર્થીઓ માટે સૂચનાઓ :

૧. આ પૃષ્ઠના ઉપલા ભાગે આપેલી જગ્યામાં તમારી ક્રમાંક સંખ્યા (રોલ નંબર) લખો.

૨. તમે જે વિકલ્પનો ઉત્તર આપો તેનો સ્પષ્ટ નિર્દેશ કરો.

૩. ટૂંકનોંધ કે નિબંધ પ્રકારના પ્રશ્નોના ઉત્તર દરેક પ્રશ્નની નીચે આપેલી જગ્યામાં જ લખો. વધારાના કોઈ કાગળનો ઉપયોગ કરશો નહીં.

૪. અંદર આપેલી સૂચનાઓ ધ્યાનથી વાંચો.

૫. આ ઉત્તર પોથીમાં અંતે આપેલું પૃષ્ઠ કાચા કામ માટે છે.

૬. આ ઉત્તર પોથીમાં કયાંય પણ તમારી ઓળખ કરાવી દે એવી રીતે તમારું નામ કે કોઈ ચોકકસ નિશાની કરી હશે તો તમને આ પરીક્ષા માટે ગેરલાયક ગણવામાં આવશે.

૭. કેલકયુલેટર અથવા ઈલેકટ્રોનિકસ સાધનોનો ઉપયોગ કરવો નહીં.

૮. નકારાત્મક ગુણાંક પદ્ધતિ નથી.

૯. પ્રશ્નપત્ર લખાઈ રહે એટલે આ ઉત્તર પોથી તમારા નિરીક્ષકને આપી દેવી. પરીક્ષાખંડની બહાર કોઈ પણ પ્રશ્નપત્ર લઈ જવું નહીં.

FOR OFFICE USE ONLY
MARKS OBTAINED

Question Number	Marks Obtained	Question Number	Marks Obtained
1.		11.	
2.		12.	
3.		13.	
4.		14.	
5.		15.	
6.		16.	
7.		17.	
8.		18.	
9.		19.	
10.			

Total Marks obtained .....

Signature of the co-ordinator .....
(Evaluation)

SEAL

COMPUTER SCIENCE AND APPLICATIONS

PAPER–III

Note : This paper contains four Sections. You are required to attempt *all* of them.

SECTION I

Note : This section contains *two* questions **1** and **2**. Answer both questions in **500** words each. (2×20=40 marks)

1. (A) How can one show that a given language (e.g. all strings of the form $0^n\ 1^n$) is not regular ? Explain the main idea of the pumping lemma. 10

   (B) Give well-chosen examples to distinguish between recursive and recursively enumerable languages. Explain the main difference. 10

   OR

   (A) What is the Address Resolution Protocol (ARP) and how does it work ? 10

   (B) How is congestion control implemented in TCP/IP ? 10

2. Write short notes on the following : 20

(*i*) Functional programming

(*ii*) Logic programming

(*iii*) Imperative or procedural programming

(*iv*) Object-oriented programming.

OR

Write short notes (with examples or applications) on the following : 20

(*i*) Resolution in propositional logic

(*ii*) A* search

(*iii*) Expert systems

(*iv*) Decision support systems.

SECTION II

Note : Choose any *one* elective from I to V and answer all the questions (Q. **3** to Q. **5**) of the same in **300** words each. (3×15=45)

(Elective I)

3. Describe the Chomsky hierarchy of languages and also show the rules (syntax) of the grammars for generating these languages. 15

4. Prove whether the following statements are true or false (use counter-examples where appropriate) :

   (A) The union of two regular languages is regular. 5

   (B) A concatenation of regular languages need not be regular. 5

   (C) The intersection of two regular languages is regular. 5

5. (A) Write the grammar for the language of palindromes over the alphabet {a, b, c, d, e}. 5

   (B) Write the grammar for the language $\{a^n b^n \mid n \text{ is a positive integer}\}$. 5

   (C) Define ambiguous grammars and illustrate with an example. 5

OR

(Elective II)

3. Describe channel capacity. Under what condition the channel capacity will be maximum ? Define the efficiency of a noise-free system. 15

4. LZ77 is a type of Dictionary-based compression method. What kind of dictionary does it use ? What are the pros and cons of Dictionary-based compression methods vis-a-vis Statistical compression methods ? 15

5. Explain what is Huffman coding and specify why it is called a prefix code. Design a Huffman code for a source that puts out letters from an alphabet $A = \{a_1, a_2, a_3, a_4, a_5\}$ with probabilities $P(a_1) = P(a_3) = 0.2$, $P(a_2) = 0.4$, $P(a_4) = P(a_5) = 0.1$. 15

OR

(Elective III)

3. Write down the rules for transforming primal Linear Programming (LP) problem into Dual. Under what conditions is it advantageous to first write the dual of a given LP problem and solve it rather than solving the primal problem. Justify your answer. 15

4. Explain Vogel's Approximation Method (VAM) for solving Transportation problems. How is it better than North-West corner Method and the Least Cost Method ? 15

5. Describe Network Flow problem. State Max-Flow Min-Cut theorem. 15

OR

(Elective IV)

3. Consider the following functions on n Boolean variables.

majority $(X_1, X_2, ..., X_n) = 1$ if at least half the X_i's are 1, 0 otherwise

parity $(X_1, X_2, ..., X_n) = 1$ if the sum of all X_i's is odd, 0 otherwise

Can these be implemented using simple perceptrons with n input nodes and 1 ouput node ? If yes, show the network for the case n = 3. If not, show how it can be done using minimum number of hidden layers for the case n = 3. 15

4. Consider a 2-layer feed forward neural network with n inputs $X_1,....X_n$ with $X_0 = -1$ being the bias input. There are J neurons in the hidden layer generating outputs $Z_1, Z_2, ... Z_J$ with $Z_0 = -1$ as the bias input. There are L neurons in the output layer generating final outputs $Y_1, Y_2, ... Y_L$.The activation function for the neurons is the logistic function :

$$f(x) = 1/(1 + e^{-x}).$$

The training set for the network is made up of pairs $(\vec{x}_k, \vec{d}_k)$ specifying the input-output correspondence to be learnt.

(A) Draw a diagram to represent this architecture.

(B) Starting with the error signal $E(\vec{w}) = \frac{1}{2}\sum_{l=1}^{L} \left(d_l - Y_l\right)^2$ for the current weight vector $\vec{w}$, derive a rule for the updation Δw_{ij} of the weights of the output layer. 15

5. Given two fuzzy sets A and B :

$A = 0.0/-2 + 0.3/-1 + 0.6/0 + 1.0/1 + 0.6/2 + 0.3/3 + 0.0/4$

$B = 0.1/-2 + 0.4/-1 + 0.7/0 + 1.0/1 + 0.5/2 + 0.2/3 + 0.0/4$

Using standard definitions for fuzzy union, intersection and complement :

(A) Calculate the union of the set A and set B.

(B) Calculate the intersection of the set A and set B.

(C) Calculate the complement of the union of A and B. 15

OR

(Elective V)

3. Explain windows kernel synchronization Semaphores objects giving example. 15

4. (A) Explain Braced regular expression giving example of filtering utility that support it. 10

(B) Write a program to append text into a given file. Use appropriate system calls. 5

5. Write a shell script to count number of characters and words in an input string. Do not use wc command. 15

Q. No. 3. Elective .....

Q. No. 4. Elective .....

Q. No. 5. Elective .....

SECTION III

Note : Answer the following questions in **50** words each. Attempt *all* questions. (9×10=90)

6. Explain two different hazards that can happen during pipelining of instructions in a microprocessor. 10

7. What are polymorphic functions in programming languages and why are they useful ? 10

8. What is Software Maintenance ? Discuss different types of maintenance. 10

9. Consider the following snapshot of a system :

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	1	2	1	5	2	0
P_1	1	0	0	0	1	7	5	0				
P_2	1	3	5	4	2	3	5	6				
P_3	0	6	3	2	0	6	5	2				
P_4	0	0	1	4	0	6	5	6				

If a request from process P_1 arrives for (0, 4, 2, 0), then explain whether the request will be granted immediately or not ? 10

10. Explain how TCP detects packet loss and how it adjusts the transmission window size to achieve congestion control. 10

11. What is Heuristic (A*) search ? What property does an admissible heuristic satisfy ? 10

12. (A) What are the steps involved in Java Applet deployment ? 5

(B) What is multiple inheritance ? What are its advantages and disadvantages ? 5

13. (A) List down the differences and similarities between the following algorithm design techniques :

(*i*) Dynamic Programming and Divide and Conquer

(*ii*) Backtracking and Branch and Bound. 5

(B) Arrange nodes that contain the letters A, C, E, F, L, V, and Z into two binary search trees : one that has maximum height and one that has minimum height. 5

14. Briefly describe two-phase locking protocol that ensures serializability. 10

SECTION IV

Note : Attempt all the *five* questions (**15** to **19**) in **30** words each. (5×5=25)

15. Suppose that a client performs an intermixed sequence of (stack) push and pop operations. The push operations push the integers 0 through 9 in order on to the stack; the pop operations print out the return value. Which of the following sequence(s) of print values could not occur and why ? For valid sequences, give the push and pop operations which simulate the printed values.

(A) 4 3 2 1 0 9 8 7 6 5
(B) 2 1 4 3 6 5 8 7 9 0
(C) 0 4 6 5 3 8 1 7 2 9
(D) 4 6 8 7 5 3 2 9 0 1. 5

16. Represent the following statement using First-order predicate logic :
You can fool some of the persons all the time, all the persons some of the time, but not all the persons all the time. 5

17. What is meant by Verification and Validation in the context of software quality assurance ? Write down the major activities under each one. 5

18. Draw an FA recognizing the following language :
$(0 + 1)^* (1 + 00) (0 + 1)^*$. 5

19. Consider a triangle ABC having coordinates A(4, 1), B(5, 2), and C(4, 3). Rotate it by an angle of 90 degree about point A. Write down the transformation matrix and give the coordinates of the rotated triangle. 5

ROUGH WORK

ROUGH WORK

SEAL