

2012 CA

Test Paper Code: CA

Time: 3 Hours

Max. Marks: 300

INSTRUCTIONS**A. General:**

1. This Booklet is your Question Paper. It contains **20** pages and has 100 questions.
2. The Question Booklet **Code** is printed on the right-hand top corner of this page.
3. The Question Booklet contains blank spaces for your rough work. No additional sheets will be provided for rough work.
4. **Clip board, log tables, slide rule, calculator, cellular phone or any other electronic gadget in any form are NOT allowed.**
5. Write your **Name** and **Registration Number** in the space provided at the bottom.
6. All answers are to be marked only on the machine gradable Objective Response Sheet (**ORS**) provided along with this booklet, as per the instructions therein.
7. The Question Booklet along with the Objective Response Sheet (**ORS**) must be handed over to the Invigilator before leaving the examination hall.
8. Refer to **Special Instruction/Useful Data** on reverse of this sheet.

B. Filling-in the ORS:

9. Write your Registration Number in the boxes provided on the upper left-hand-side of the **ORS** and darken the appropriate bubble under each digit of your Registration Number using a **HB pencil**.
10. Ensure that the **code** on the **Question Booklet** and the **code** on the **ORS** are the same. If the codes do not match, report to the Invigilator immediately.
11. On the lower-left-hand-side of the **ORS**, write your Name, Registration Number, and Name of the Test Centre and put your signature in the appropriate box with ball-point pen. Do not write these anywhere else.

C. Marking of Answers on the ORS:

12. Each question has **4 choices** for its answer: (A), (B), (C) and (D). Only **ONE** of them is the correct answer.
13. On the right-hand-side of **ORS**, for each question number, darken with a **HB Pencil ONLY** one bubble corresponding to what you consider to be the most appropriate answer, from among the four choices.
14. There will be **negative marking** for wrong answers.

MARKING SCHEME:

- (a) For each correct answer, you will be awarded **3 (Three)** marks.
- (b) For each wrong answer, you will be awarded **-1 (Negative one)** mark.
- (c) Multiple answers to a question will be treated as a wrong answer.
- (d) For each un-attempted question, you will be awarded **0 (Zero)** mark.

Name						
Registration Number						

Special Instructions/ Useful Data

\mathbb{N} denotes the set of natural numbers $\{1, 2, 3, \dots\}$

\mathbb{Z} denotes the set of integers

\mathbb{Q} denotes the set of rational numbers

\mathbb{R} denotes the set of real numbers

\mathbb{C} denotes the set of complex numbers

$A \setminus B = \{x \in A \mid x \notin B\}$ for two sets A and B

LPP denotes Linear Programming Problem

Max f denotes the maximum of f

Min f denotes the minimum of f

x' denotes the complement of a Boolean variable x

f' denotes the first derivative of a function f

f_x denotes the partial derivative of $\frac{\partial f}{\partial x}$ of f

f_y denotes the partial derivative of $\frac{\partial f}{\partial y}$ of f

∇f denotes the gradient of a function f

For all C programs, assume that all standard library functions are accessible.

Q.1 Who created the first free email service on the Internet?

- (A) B. W. Kernighan (B) Bill Gates
(C) N. Karmakar (D) Sabeer Bhatia

Q.2 Let $S = \{x \in \mathbb{Q} \mid x^2 \in \{1, 20, 21\}\}$. Then the number of elements in the set S is

- (A) 1 (B) 2 (C) 4 (D) 6

Q.3 The rank of the matrix $\begin{bmatrix} 1 & 2 & 4 & 1 & -2 \\ 2 & 3 & 7 & 1 & -2 \\ 1 & 0 & 2 & -1 & 2 \\ 1 & -1 & 1 & -2 & 4 \end{bmatrix}$ is

- (A) 1 (B) 2 (C) 3 (D) 4

Q.4 Mega FLOPS stands for

- (A) 10^9 floating point operations per second
(B) 10^5 fixed point operations per second
(C) 10^6 floating point operations per second
(D) 10^{12} fixed point operations per second

Q.5 The set $S = \{(x, y) \in \mathbb{R}^2 \mid x \notin \mathbb{Q} \text{ or } y \notin \mathbb{Z}\}$ is

- (A) $(\mathbb{R} \setminus \mathbb{Q}) \times (\mathbb{R} \setminus \mathbb{Z})$ (B) $(\mathbb{R} \times \mathbb{R}) \times (\mathbb{Q} \setminus \mathbb{Z})$ (C) $(\mathbb{R} \setminus \mathbb{Q}) \times \mathbb{R}$ (D) $\mathbb{R} \times (\mathbb{R} \setminus \mathbb{Z})$

Q.6 The number $20^6 - 13^6$ is divisible by

- (A) 11 (B) 5 (C) 13 (D) 6

Q.7 The inverse of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 8 & 2 \end{bmatrix}$ is

- (A) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & -1 & 0 \\ -7 & -5 & -1 \end{bmatrix}$
(C) $\begin{bmatrix} 10 & -6 & -1 \\ -2 & 1 & 0 \\ -7 & 5 & 1 \end{bmatrix}$

- (B) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & -1 & 0 \\ -7 & -5 & 1 \end{bmatrix}$
(D) $\begin{bmatrix} 10 & -6 & 1 \\ -2 & 1 & 0 \\ -7 & 5 & -1 \end{bmatrix}$

- Q.8 Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = x^2 + 4x + 5$. Then which of the following statements is TRUE?
- (A) f is one-one. (B) f is on-to.
 (C) f is one-one and on-to. (D) f is neither one-one nor on-to.
- Q.9 The number of distinct 3 digit numbers greater than 100 where no digit repeats itself is
- (A) 504 (B) 648 (C) 326 (D) 210
- Q.10 The digit at the unit place of the number 19^{25} is
- (A) 1 (B) 3 (C) 5 (D) 9
- Q.11 The differential equation
- $$\frac{dy}{dx} + (\tan x) y = \cos x, \quad x \in \left(\frac{\pi}{2}, \frac{\pi}{2}\right)$$
- has the solution
- (A) $y = (x + c) \cos x$ (B) $y = (x + c) \sec x$
 (C) $y = (x + c) \sin x$ (D) $y = (x + c) \operatorname{cosec} x$
- Q.12 Consider the function $f(x) = -x^4 + 2x^3 - 1$. What is the absolute truncation error for evaluation of $f'(x)$ at $x = 0.5$ by the first order forward difference scheme using a step size, $h = 0.5$?
- (A) $\frac{5}{8}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{8}{5}$
- Q.13 Consider the following LPP
- $$\text{Max } f = 5x + 12y$$
- subject to
- $$\begin{aligned} x + 5y &\leq 50, \\ 6x + 3y &\leq 36, \\ x \leq 5, x \geq 0, y &\geq 0 \end{aligned}$$
- The number of extreme points of the feasible region are
- (A) 4 (B) 5 (C) 6 (D) 7
- Q.14 Solution of the initial value problem
- $$(2 \cos y + 3x) dx - x \sin y dy = 0, \quad y(1) = 0$$
- is
- (A) $x^2 \cos y + y^3 = 1$ (B) $x^2 \sin y + y^3 = 0$
 (C) $x^2 \cos y + x^3 = 2$ (D) $y^2 \sin x + y^3 = 0$

Q.15 Let α be a real number and $G = \{z \in \mathbb{C} \setminus \{0\} \mid |z| = \alpha\}$. Then G is a group under multiplication of complex numbers if

- (A) $\alpha = 0$ (B) $\alpha < 1$ (C) $\alpha > 1$ (D) $\alpha \neq 1$

Q.16 Order the following processors in the increasing order of speed.

M1: 486, M2: 8085, M3: Dual core, M4: Pentium III

- (A) M1 M2 M3 M4 (B) M2 M1 M4 M3 (C) M1 M2 M4 M3 (D) M1 M3 M4 M2

Q.17 Which of the following statements is TRUE?

- (A) There exists a field with 1000 elements.
 (B) There exists a field with 100 elements.
 (C) There exists a field with 500 elements.
 (D) There exists a field with 9 elements

Q.18 A particular solution of the differential equation

$$\frac{d^5 y}{dx^5} - 3 \frac{d^4 y}{dx^4} + 3 \frac{d^3 y}{dx^3} - \frac{d^2 y}{dx^2} = 2e^x$$

is

- (A) $\frac{1}{3}x^3 e^x$ (B) $\frac{1}{2}x^3 e^x$ (C) $\frac{1}{6}x^3 e^x$ (D) $\frac{2}{3}x^3 e^x$

Q.19 For an LPP, if the constraints are

$$\begin{aligned} x + y &\leq 3, \\ x + 3y &\leq 5, \\ y &\geq 0, x \geq 0 \end{aligned}$$

then which one of the following point is NOT a feasible point?

- (A) (3,0) (B) (1,2) (C) (2,4) (D) $\left(0, \frac{5}{3}\right)$

Q.20 The volume of the tetrahedron bounded by the planes $z = 0, x = 0, y = 0$ and $y + z - x = 1$ is

- (A) $\frac{1}{6}$ (B) 6 (C) 1 (D) $\frac{1}{3}$

Q.21 Aadar Unique Identification (UID) number is of

- (A) 10 digits (B) 12 digits (C) 14 digits (D) 16 digits

Q.22 The general solution of the nonhomogeneous differential equation

$$\frac{d^2 y}{dx^2} + \frac{dy}{dx} - 12y = 150 \cos 3x$$

is

- (A) $c_1 e^{-3x} + c_2 e^{4x} - 7 \cos 3x - \sin 3x$
- (B) $c_1 e^{3x} + c_2 e^{-4x} - 7 \cos 3x + \sin 3x$
- (C) $c_1 e^{3x} + c_2 e^{-4x} + 7 \cos 3x + \sin 3x$
- (D) $c_1 e^{3x} + c_2 e^{-4x} - 7 \cos 3x - \sin 3x$

Q.23 Which of the following is/are main memory of a computer?

P: RAM, Q: Hard disk, R: CDROM, S: Pen drive

- (A) P and Q only
- (B) Q only
- (C) P only
- (D) P, R, and S only

Q.24 The boundary value problem

$$\frac{d^2 y}{dx^2} + \pi^2 y = 0, \quad y(0) = 0, \quad y(1) = 0$$

has

- (A) two solutions
- (B) no solution
- (C) unique solution
- (D) infinitely many solutions

Q.25 Suppose $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = \hat{i} + \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} + 3\hat{k}$. Then $\vec{a} \times (\vec{b} \times \vec{c})$ is

- (A) $8\hat{i} + 4\hat{j}$
- (B) $8\hat{i} - 4\hat{j}$
- (C) $8\hat{i} + 8\hat{j}$
- (D) $8\hat{i} - 8\hat{j}$

Q.26 The Newton-Raphson method is used to find a real root of $f(x) = x^3 - x + 1 = 0$ with initial approximation $x_0 = 1$. Then the second approximation x_2 is

- (A) $\frac{1}{2}$
- (B) $\frac{5}{8}$
- (C) 2
- (D) 3

Q.27 SMS stands for

- (A) Short Message Service
- (B) Secured Message Service
- (C) Short Mail Service
- (D) Secured mail Service

Q.28 What is the probability of getting an even number or a number less than 5, in tossing a fair die?

- (A) $\frac{2}{3}$
- (B) $\frac{1}{3}$
- (C) $\frac{5}{6}$
- (D) $\frac{1}{6}$

Q.29 Rabindranath Tagore won the Nobel prize in Literature for his book entitled

- (A) War and Peace (B) Malgudi Days
(C) Gitanjali (D) Durgeshnandini

Q.30 Which company is the leader in computer networking?

- (A) Wipro (B) Cisco (C) Oracle (D) TCS

Q.31 For the table

x	0	1	2	3
$f(x)$	1	2	9	28

the divided difference $f[1,2,3]$ is

- (A) 6 (B) 13 (C) 3 (D) 1

Q.32 Which one of the following is equivalent to 8 Giga bytes?

- (A) 2^{23} bytes (B) 2^{33} bytes (C) 2^{43} bytes (D) 2^{53} bytes

Q.33 The decimal value of $(327)_8 \times (25)_8$ is

- (A) 5625 (B) 8175 (C) 3267 (D) 4515

Q.34 The value of the integral $\int_0^2 (1+5x-100x^2) dx$ by Simpson's $\frac{1}{3}$ rd rule is

- (A) -288 (B) $-\frac{764}{3}$ (C) 288 (D) 289

Q.35 Which one of the following stands for LAN?

- (A) Local Area Network (B) Logical Area Network
(C) Large Area Network (D) Least Area Network

Q.36 The Boolean expression $(x + y) (x + y')$ is equivalent to

- (A) $x + y$ (B) y (C) xy (D) x

Q.37 ISP stands for

- (A) Internet Security Protocol (B) Intelligent Service Package
(C) Internet Service Provider (D) Intelligent Service Provider

- Q.38 Let $f(x, y) = \cos(xy) + x \cos y$. Then the value of $f_x(2, \pi/2) + f_y(2, \pi/2)$ is
 (A) 0 (B) -2 (C) 2 (D) 4
- Q.39 If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{c} = 4\hat{i} - 3\hat{j} + 2\hat{k}$, then the projection of $\vec{a} + \vec{b}$ on the vector \vec{b} is
 (A) $\frac{20}{3}$ (B) 20 (C) $\frac{20}{9}$ (D) $\frac{8}{3}$
- Q.40 For what value of α , the vectors $2\hat{i} + \hat{j} + \hat{k}$, $\alpha\hat{i} + 2\hat{j} + 2\hat{k}$ and $\hat{i} + \hat{j} - \hat{k}$ are coplanar?
 (A) 1 (B) 2 (C) 4 (D) 8
- Q.41 The next term in the sequence of ternary number 10, 20, 100, 110, ... is
 (A) 120 (B) 111 (C) 112 (D) 101
- Q.42 The 9's complement of 123456789 is
 (A) 876543211 (B) 876543210 (C) 987654321 (D) 012345678
- Q.43 What is the largest unsigned integer that can be expressed with n bits?
 (A) 2^{n-1} (B) $2^n - 1$ (C) $2^n + 1$ (D) 2^{n+1}
- Q.44 Suppose $f(x) = x^3 + 2x^2 + x + 1$. Then the polynomial that interpolates the value of f at $x = -1, 0, 1$ is
 (A) $4x^2 + 4x + 1$ (B) $x^2 + x + 1$
 (C) $2x^2 + 2x + 1$ (D) $3x^2 + 3x + 1$
- Q.45 A search engine is
 (A) a machine (B) a web site
 (C) a movie (D) a map used for driving

Q.46 The Lagrange form of the interpolating polynomial that fits the data

x	0	1	2
$f(x)$	1	2	5

is

- (A) $\frac{1}{2}(x-1)(x-2) - 2x(x+2) + \frac{5}{2}x(x-1)$
 (B) $\frac{1}{2}(x-1)(x-2) + 2x(x+2) + \frac{5}{2}x(x-1)$
 (C) $2(x-1)(x-2) + \frac{1}{2}x(x+2) + \frac{2}{5}x(x-1)$
 (D) $2(x-1)(x-2) - \frac{1}{2}x(x+2) + \frac{2}{5}x(x-1)$

Q.47 The function $f(x, y) = xy$ defined on $x^2 + y^2 \leq 1$ has

- (A) both maximum and minimum values
 (B) only maximum value
 (C) only minimum value
 (D) neither maximum nor minimum value

Q.48 The area of the region enclosed by the parabola $x^2 = 4ay$ and the line $x = 2a$ with x -axis is

- (A) $\frac{4}{3}a^2$ (B) $\frac{3}{2}a^2$ (C) $\frac{3}{4}a^2$ (D) $\frac{2}{3}a^2$

Q.49 Consider the system of linear equations

$$\begin{aligned} x - 2y + z &= 3 \\ 2x + \alpha z &= -2 \\ -2x + 2y + \alpha z &= 1 \end{aligned}$$

In order to have unique solution to this linear system of equations the value of α should not be equal to

- (A) $\frac{2}{3}$ (B) $\frac{2}{3}$ (C) $\frac{4}{3}$ (D) $-\frac{4}{3}$

Q.50 The quadratic approximation of $f(x, y) = \cos x \cos y$ about the point $(0, 0)$ is

- (A) $1 + \frac{1}{2}(x^2 - y^2)$ (B) $1 + \frac{1}{2}(x^2 + y^2)$
 (C) $1 - \frac{1}{2}(x^2 - y^2)$ (D) $1 - \frac{1}{2}(x^2 + y^2)$

Q.51 Consider the following two lists:

List I

- 1: Mouse
 2: Modem
 3: Pen drive
 4: Opera

List II

- P: Input device
 Q: External memory
 R: Web browser
 S: Network device

The correct match is

- (A) $1 \rightarrow R, 2 \rightarrow S, 3 \rightarrow P, 4 \rightarrow Q$ (B) $1 \rightarrow P, 2 \rightarrow S, 3 \rightarrow Q, 4 \rightarrow R$
 (C) $1 \rightarrow S, 2 \rightarrow R, 3 \rightarrow Q, 4 \rightarrow P$ (D) $1 \rightarrow P, 2 \rightarrow Q, 3 \rightarrow S, 4 \rightarrow R$

Q.52

The matrix $\begin{bmatrix} -1 & 2 & 2 \\ 2 & 2 & -1 \\ 2 & -1 & 2 \end{bmatrix}$ has

- (A) all positive eigenvalues
 (B) all negative eigenvalues
 (C) some positive eigenvalues and some negative eigenvalues
 (D) one zero eigenvalue

Q.53 An integrating factor of the differential equation

$$2 \sinh x \cos y \, dx - \cosh x \sin y \, dy = 0$$

is

- (A) $\cosh x$ (B) $\sinh x$ (C) $\sin x$ (D) $\cos x$

Q.54 The random variable X follows the Poisson distribution with variance 4. The mean of this Poisson distribution is

- (A) 2 (B) 4 (C) 16 (D) 8

Q.55 Two balls are drawn in succession from a box containing 30 red, 20 white, 10 blue and 15 orange balls; replacement being made after each draw. The probability that neither is orange is

- (A) $\frac{16}{25}$ (B) $\frac{9}{25}$ (C) $\frac{1}{25}$ (D) $\frac{24}{25}$

Q.56 Let the function f has the values f_0, f_1, f_2 at equidistant nodal points x_0, x_1, x_2 where $x_i = x_0 + ih, i = 1, 2$. Then, the divided difference $f[x_0, x_1, x_2]$ is equal to

- (A) $\frac{\nabla f_2}{2h}$ (B) $\frac{\Delta f_0}{2h}$ (C) $\frac{\Delta^2 f_0}{2h^2}$ (D) $\frac{\nabla f_1}{2h}$

Q.57 Let $\sigma = (1, 3, 5, 7, 9, 10)(2, 4, 6, 8)$ be a permutation in S_{10} . Then the smallest positive integer m such that $\sigma^m = Id$, the identity permutation, is

- (A) 24 (B) 6 (C) 4 (D) 12

Q.58 Consider the following two lists:

List I

- 1: TFT
- 2: RAM
- 3: ROM
- 4: CRT

List II

- P: Visual display unit
- Q: Volatile memory
- R: Non-volatile memory
- S: Non-writable memory

The correct match is

- (A) 1 → P, 2 → Q, 3 → S, 4 → R (B) 1 → P, 2 → R, 3 → Q, 4 → S
 (C) 1 → S, 2 → Q, 3 → S, 4 → P (D) 1 → P, 2 → Q, 3 → S, 4 → P

Q.59 A base 12 number system is called duodecimal. It uses the symbols 0, 1, 2, ..., 9, A, and B, where A and B are the symbols used to represent 10 and 11 respectively. What is the duodecimal equivalent of the decimal number 1594?

- (A) A09 (B) A0A (C) B0A (D) B0B

Q.60 A particular solution of the differential equation

$$\frac{d^2 y}{dx^2} - \frac{dy}{dx} = x e^x$$

is

- (A) $-\frac{x^2}{2}e^x + (x-1)e^{-x}$ (B) $-\frac{x^2}{2}e^{-x} + (x-1)e^{-x}$
 (C) $\frac{x^2}{2}e^x - (x-1)e^x$ (D) $\frac{x^2}{2}e^{-x} - (x-1)e^{-x}$

Q.61 The equation for the tangent plane to the surface $2x^3y - xz^2 = -3$ at the point $(1, -1, 1)$ is

- (A) $7x - 2y + 2z = 11$ (B) $2x - 7y + 2z = 11$
 (C) $2x + 7y - 2z = 11$ (D) $7x + 2y - 2z = 11$

Q.62 The minimum distance from the origin to the plane $x + 3y - z = 11$ in \mathbb{R}^3 is
 (A) 10 (B) 1 (C) $\sqrt{11}$ (D) 11

Q.63 Let σ be a 6-cycle in S_{12} . Then σ^i is also 6-cycle if the value of i is
 (A) 2 (B) 3 (C) 5 (D) 12

Q.64 The book entitled, 'The Discovery of India' was written by
 (A) Abul Kalam Azad (B) Jawaharlal Nehru
 (C) Rajendra Prasad (D) Sarvepalli Radhakrishnan

Q.65 Consider the following two lists:

List I

- 1: Functional programming
- 2: Logical programming
- 3: Procedural programming
- 4: Object oriented programming

List II

- P: C language
- Q: Prolog
- R: C++
- S: Lisp

Which one of the following is correct match?

- (A) $1 \rightarrow P, 2 \rightarrow Q, 3 \rightarrow S, 4 \rightarrow R$
- (B) $1 \rightarrow P, 2 \rightarrow Q, 3 \rightarrow R, 4 \rightarrow S$
- (C) $1 \rightarrow P, 2 \rightarrow R, 3 \rightarrow S, 4 \rightarrow Q$
- (D) $1 \rightarrow S, 2 \rightarrow Q, 3 \rightarrow P, 4 \rightarrow R$

Q.66 What is the octal equivalent of the hexadecimal number ABC?
 (A) 5674 (B) 5314 (C) 5275 (D) 5274

Q.67 The fourth order linear differential equation having $e^{-x}, xe^{-x}, \cos 2x, \sin 2x$ as solutions is

- (A) $\frac{d^4 y}{dx^4} + 2\frac{d^3 y}{dx^3} + 5\frac{d^2 y}{dx^2} + 8\frac{dy}{dx} + 4y = 0$
- (B) $\frac{d^4 y}{dx^4} + 2\frac{d^3 y}{dx^3} + 8\frac{d^2 y}{dx^2} + 5\frac{dy}{dx} + 4y = 0$
- (C) $\frac{d^4 y}{dx^4} + 2\frac{d^3 y}{dx^3} + 3\frac{d^2 y}{dx^2} + 4\frac{dy}{dx} + 2y = 0$
- (D) $\frac{d^4 y}{dx^4} + 2\frac{d^3 y}{dx^3} + 4\frac{d^2 y}{dx^2} + 3\frac{dy}{dx} + 2y = 0$

Q.68 The probability of getting a total of 9 at least once in two tosses of a pair of fair dice is
 (A) $\frac{600}{729}$ (B) $\frac{128}{729}$ (C) $\frac{601}{729}$ (D) $\frac{64}{81}$

Q.69 If the matrix $\begin{bmatrix} a & b \\ b & 2 \end{bmatrix}$ has eigenvalues 1 and 3, then the value of (a, b) is

- (A) (1, 2) (B) (2, 1) (C) (-1, 2) (D) (-2, 1)

Q.70 The value of the integral $\int_0^9 \frac{dy}{\sqrt{y}\sqrt{1+\sqrt{y}}}$ is

- (A) 4 (B) $4(\sqrt{10}-1)$ (C) 8 (D) 12

Q.71 The truth table of a binary operator \odot is given below:

x	y	$x \odot y$
0	0	0
0	1	0
1	0	1
1	1	0

Which one of the following is equivalent to $x \odot y$?

- (A) $x'y'$ (B) xy (C) $x'y$ (D) xy'

Q.72 Suppose $\vec{a} + \vec{b} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{a} - \vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$ represent diagonals of a parallelogram whose sides are \vec{a} and \vec{b} . Then the area of the triangle formed by the sides \vec{a} , \vec{b} and $\vec{a} + \vec{b}$ is

- (A) $\frac{1}{4}\sqrt{189}$ (B) $\frac{1}{4}\sqrt{198}$ (C) $\frac{1}{4}\sqrt{179}$ (D) $\frac{1}{4}\sqrt{197}$

Q.73 What is the characteristic equation of the T flip-flop, if Q and Q^+ denote the output during the current and next clock cycle?

- (A) $Q^+ = T + Q$ (B) $Q^+ = T'Q' + TQ$
 (C) $Q^+ = TQ' + T'Q$ (D) $Q^+ = T' + Q'$

Q.74 The integral $\int_{-1}^1 f(x) dx$ where f is continuous on $[-1, 1]$, is approximated by the formula

$$\int_{-1}^1 f(x) dx \approx \alpha f\left(-\frac{1}{\sqrt{2}}\right) + \beta f\left(\frac{1}{\sqrt{2}}\right).$$

Suppose the approximation is exact for all polynomials of degree ≤ 1 . Then the value of α is

- (A) -1 (B) 1 (C) $\frac{1}{\sqrt{2}}$ (D) $-\frac{1}{\sqrt{2}}$

Q.75 Let $g(x) = \frac{1}{1-x+x^2}$ and $a_0 + a_1x + a_2x^2 + a_3x^3 + \dots$ be the Taylor series of the function g around 0. Then the value of a_3 is

- (A) 0 (B) 1 (C) -1 (D) 3

Q.76 Which of the following is/are forbidden input(s) for SR flip-flop?

P: S = 1, R = 1 Q: S = 0, R = 0

- (A) P only (B) Q only (C) both P and Q (D) neither P nor Q

Q.77 The iteration formula

$$x_{n+1} = x_n - (\cos x_n)(\sin x_n) + R \cos x_n$$

where R is a positive constant, is used to find a real root of some function $f(x)$. What is $f(x)$, assuming the iteration method is convergent with an initial approximation x_0 ?

- (A) $\tan x - R$ (B) $\cot x - R$ (C) $\sin x - R$ (D) $\cos x - R$

Q.78 The area of the surface generated by rotating the hypocycloid

$$x = a \cos^3 \theta, \quad y = a \sin^3 \theta, \quad 0 \leq \theta \leq \pi$$

about y -axis is

- (A) $\frac{12}{5} \pi a^2$ (B) $\frac{5}{12} \pi a^2$ (C) $\frac{6}{5} \pi a^2$ (D) $\frac{5}{6} \pi a^2$

Q.79 What is the output of a JK flip-flop during next clock cycle, when $J = 1$, $K = 1$? Assume, Q is the output during the current clock cycle.

- (A) 1 (B) 0 (C) Q (D) Q'

Q.80 What are the values of the variables i , j , and k after execution of the following program segment?

```
int i=1, j=2, k=3;
i += j += k;
```

- (A) $i=3, j=5, k=6$ (B) $i=3, j=6, k=5$
 (C) $i=6, j=3, k=5$ (D) $i=6, j=5, k=3$

Q.81 What is the content of the array after execution of the following program segment?

```
int a[] = {1, 2, 3, 4}, i;
for (i=1; i<4; ++i) a[i] = a[i] + a[i-1];
```

- (A) {0, 1, 2, 3} (B) {1, 2, 3, 4}
 (C) {1, 3, 6, 10} (D) {4, 3, 2, 1}

Q.82

The eigenvectors of the matrix $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ are

(A) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

(B) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$

(C) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$

(D) $\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$

Q.83 Consider the following C function:

```
void fun2(int n) {  
    while (n > 0) {  
        printf("%d", n%10);  
        n = n/10;  
    }  
}
```

What is the output of fun2(475)?

- (A) 475 (B) 543 (C) 754 (D) 574

Q.84 Consider the following algorithm:

```
(1) for i = 1 to p do  
(2)     for j = 1 to q do  
(3)         for k = 1 to r do  
(4)             c[i,j] = c[i,j] + a[i,k] * b[k,j];
```

How many times line (4) is executed?

- (A) 3 (B) p + q + r (C) pqr (D) ijk

Q.85 Consider the following C function:

```
int fun1(int n) {
    int x=0;
    while (n > 1) {
        n = n/2;
        ++x;
    }
    return (x);
}
```

What is the return value of fun1(31)?

- (A) 3 (B) 4 (C) 5 (D) 6

Q.86 Let A be a 3×3 matrix whose sum of the diagonal elements is $\frac{1}{2}$ and the determinant is $-\frac{1}{2}$.

If 1 is an eigenvalue of A , then the eigenvalues of $(A^{-1})^2$ are

- (A) 1,1,4 (B) $\frac{1}{4}, 1, 1$ (C) 1,1,2 (D) $\frac{1}{2}, 1, 1$

Q.87 Let $S_1 = \{(x, y, z) \in \mathbb{R}^3 \mid x + y + z = 0\}$ and $S_2 = \{(x, y, z) \in \mathbb{R}^3 \mid x^2 + y^2 - z^2 \leq 1\}$. Then the set $S_1 \cap S_2$ is

- (A) convex but not bounded.
 (B) bounded but not convex.
 (C) bounded and convex.
 (D) neither bounded nor convex.

Q.88 The number of different Boolean functions with 3 inputs and 4 outputs is

- (A) 64 (B) 127 (C) 128 (D) 144

Q.89 What is the output of the following program fragment?

```
int x = 123, y = -123, z = 0;
if (x) { if (z) printf("aaa\n"); }
else if (y) printf("bbb\n");
else printf("ccc\n");
```

- (A) aaa (B) bbb (C) ccc (D) outputs nothing

Q.90 The solution of the following LPP

$$\begin{aligned} \text{Max } f &= x + 5y \\ \text{subject to} \\ 2x + y &\geq 10, \\ 4x + 3y &\leq 24, \\ y &\leq 2x, y \geq 0 \end{aligned}$$

is

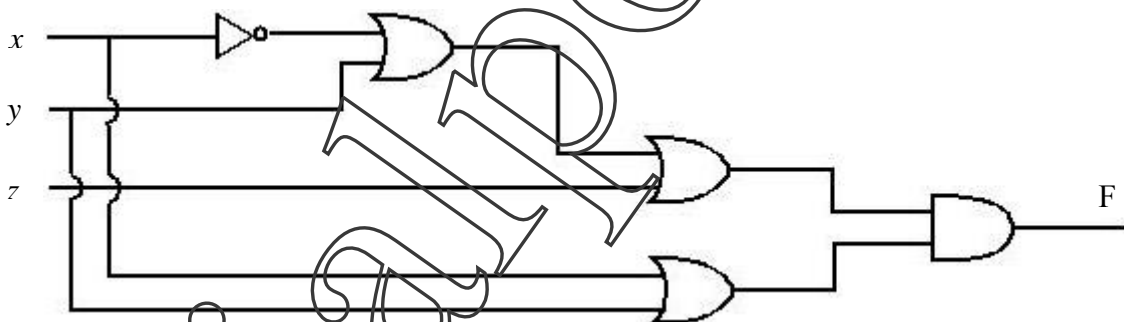
- (A) 27.5 (B) 26.4 (C) 23 (D) 6

Q.91

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be the function defined by $f(x) = \begin{cases} x^2 & \text{if } x \in \mathbb{Q} \\ x & \text{if } x \notin \mathbb{Q} \end{cases}$. Then the function f is

- (A) differentiable on \mathbb{R} .
 (B) differentiable only at 0.
 (C) differentiable only at 1.
 (D) is continuous at 0 but NOT differentiable at 0.

Q.92 Consider the following logic circuit:



What is the output F?

- (A) $x + yz$ (B) $y + xz$ (C) $z + xy$ (D) $x + y + z$

Q.93 Suppose ϕ_1 and ϕ_2 are two linearly independent solutions of the differential equation

$$\frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = 0$$

where a_1 and a_2 are constants. Then ϕ_1 and ϕ_2 have

- (A) odd number of common zeros
 (B) exactly one common zero
 (C) no common zeros
 (D) at most two common zeros

Q.94 Which one is equivalent to $xyz + xyz' + xy'z + xy'z'$?

- (A) x (B) x' (C) $y + z$ (D) yz

Q.95 In the following segment of C program

```
int x;
scanf("%d", &x);
if(x&1)printf("%s", STAMENT);
```

STAMENT represents a missing string. Which one of the following is an appropriate string?

- (A) "x is a prime number" (B) "x is an even number"
(C) "x is an odd number" (D) "the value of x is 1"

Q.96 Let $W_1 = \{(x, y, z, w) \in \mathbb{R}^4 \mid x + y + z = 0 \text{ and } 6x + 7y + 8z = 0\}$ and $W_2 = \{(x, y, z, w) \in \mathbb{R}^4 \mid x + 2y + 3z = 0 \text{ and } 2x + 3y + 4z = 0\}$. Then the dimension of the subspace $W_1 + W_2$ is

- (A) 1 (B) 2 (C) 4 (D) 3

Q.97 The composite Trapezoidal rule is used to compute $\int_0^1 e^{-x} dx$ with an error of at most $\frac{1}{12} \times 10^{-2}$. How many points should be used?

- (A) 11 (B) 9 (C) 8 (D) 7

Q.98 Consider the following C function:

```
float f(float x)
{ float sum=1.0, term=1.;
  int n=1;
  while(n<50)
  { term=x*term/n;
    sum+=term;
    n++;
  }
  return sum;
}
```

The return value of the function $f(1.0)$ is the approximate value of

- (A) 0.0 (B) $\sin(1.0)$ (C) $\cos(1.0)$ (D) e

Q.99 The length of the one arc of the cycloid

$$x = a(t - \sin t), \quad y = a(1 - \cos t)$$

is

(A) $8a$

(B) $4a$

(C) $4\sqrt{2} a$

(D) $2\sqrt{2} a$

Q.100 Consider the following C function:

```
void f(int x,int y)
{ int d;
  if(x>0)
  { d=x%y;
    f(x/y,y);
    printf("%d",d);
  }
  else return;
}
```

The output for $f(100, 16)$ is

(A) 11

(B) 64

(C) 82

(D) 110

End of the paper

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