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Old GATE Questions along with Key from 1991-2014
in CS & IT Department
(Questions of other Departments are also added for Combined Syllabus)

Index

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Index- Engineering Mathematics

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Linear Algebra

1) The determinant of the matrix
$$\begin{bmatrix} 2 & 0 & 0 & 0 \\ 8 & 1 & 7 & 2 \\ 2 & 0 & 2 & 0 \\ 9 & 0 & 6 & 1 \end{bmatrix}$$ is

1 Marks GATE-CSE/IT-2000( )

[A] 4 [B] 0
[C] 15 [D] 20

2) Consider the following set of equations:
x + 2y = 5
4x + 8y = 12
3x + 6y + 3z = 15
This set

1 Marks GATE-CSE/IT-1998( )

[A] has unique solution [B] has no solutions
[C] has finite number of solutions [D] has infinite number of solutions

3) Let a= (a_{ij}j) be an n-rowed square matrix and I_{12} be the matrix obtained by interchanging the first and second rows of the n-rowed Identify matrix. Then AI_{12} is such that its first

2 Marks GATE-CSE/IT-1997( )

[A] row is the same as its second row [B] row is the same as the second row of A
[C] column is the same as the second column of A [D] row is all zero

4) Let Ax = b be a system of linear equations where A is an m × n matrix and b is a m × 1 column vector and X is a n × 1 column vector of unknows. Which of the following is false?

1 Marks GATE-CSE/IT-1996( )

[A] The system has a solution if and only if, both A and the augmented matrix [A b] have the same rank.
[B] If m <n and b is the zero vector, then the system has infinitely many solutions.
[C] If m = n and b is non-zero vector, then the system has a unique solution.
[D] The system will have only a trivial solution when m = n, b is the zero vector and rank (A) = n.

5) The matrices $\begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$ and $\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ commute under multiplication

2 Marks GATE-CSE/IT-1996( )

[A] if a = b or θ = nπ, is an integer [B] always
[C] never [D] if a cos θ ≠ b sin θ

6)_The rank of the following (_n _+ _1)_× (_n _+ _1)_matrix, where a is a real number is
$$\begin{bmatrix} 1 & a & a^2 & \dots & a^n \\ 1 & a & a^2 & \dots & a^n \\ 1 & a & a^2 & \dots & a^n \\ .. & .. & .. & .. & .. \\ 1 & a & a^2 & .. & a^n \end{bmatrix}$$
_

1 Marks GATE-CSE/IT-1995( )

[A] 1 [B] 2
[C] n [D] Depends on the value of a

7) A unit vector perpendicular to both the vectors a = 2i − 2 j + k and b = 1 + j − 2k is:

2 Marks GATE-CSE/IT-1995( )

[A] $\frac{1}{\sqrt{3}}$ (i+j+k) [B] 1 / 3 (i+j-k)
[C] 1 /3 (i-j-k) [D] $\frac{1}{\sqrt{3}}$ (i+j-k)

8) Let A and B be real symmetric matrices of size n × n . Then which one of the following is true?

1 Marks GATE-CSE/IT-1994( )

[A] $AA^T = I$ [B] $A = -A^T$
[C] AB = BA [D] $(AB)^T = BA$

Linear Algebra

9) Therankof matrix $\begin{bmatrix} 0 & 0 & -3 \\ 9 & 3 & 5 \\ 3 & 1 & 1 \end{bmatrix}$ is

1 Marks GATE-CSE/IT-1994( )

[A] 0 [B] 1
[C] 2 [D] 3

10)In a compact single dimensional array representation for lower triangular matrices (i.e all the elements above the diagonal are zero) of size n × n, non zero elements (i.e elements of the lower triangle) of each row are stored one after another, starting from the first row, the index of the (i, j)th triangular matrix in this new representation is: element

1 Marks GATE-CSE/IT-1994( )

[A] i+j [B] i+j-1
[C] j+ i(i-1)/2 [D] i+j(j-1)/2

11)The eigen vector(s) of the matrix
$\begin{bmatrix} 0 & 0 & \alpha \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$, $\alpha \neq 0$ is (are)

1 Marks GATE-CSE/IT-1993( )

[A] (0,0,α) [B] (α, 0 , 0)
[C] (0,0,1) [D] (0,α,0)

12)Consider the following system of linear equations

$$\begin{bmatrix} 2 & 1 & -4 \\ 4 & 3 & -12 \\ 1 & 2 & -8 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \alpha \\ 5 \\ 7 \end{bmatrix}$$

Notice that the second and the third columns of the coefficient matrix are linearly dependent . For how many values of α, does this system of equations have infinity many solutions?

2 Marks GATE-CSE/IT-2003( )

[A] 0 [B] 1
[C] 2 [D] Infinity many

13) The eigen vector(s) of the matrix $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}, a \neq 0$, is/are

2 Marks GATE-ECE/TCE-1993( )

[A] $(0, 0, \alpha)$ [B] $(\alpha, 0, 0)$
[C] $(0, 0, 1)$ [D] $(0, \alpha, 0)$

14) The matrix $[A] = \begin{bmatrix} 2 & 1 \\ 4 & -1 \end{bmatrix}$ is decomposed into a product of a lower triangular matrix [L] and an upper triangular matrix [U]. The properly decomposed [L] and [U] matrices respectively are

2 Marks GATE-EEE-2011( )

[A] $\begin{bmatrix} 1 & 0 \\ 4 & -1 \end{bmatrix}$ and $\begin{bmatrix} 1 & 1 \\ 0 & -2 \end{bmatrix}$ [B] $\begin{bmatrix} 2 & 0 \\ 4 & -1 \end{bmatrix}$ and $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$
[C] $\begin{bmatrix} 1 & 0 \\ 4 & 1 \end{bmatrix}$ and $\begin{bmatrix} 2 & 1 \\ 0 & -1 \end{bmatrix}$ [D] $\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ 0 & -3 \end{bmatrix}$

15) A Matrix has eigenvalues -1 and -2. The corresponding eigenvectors are $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ and $\begin{bmatrix} 1 \\ -2 \end{bmatrix}$ respectively. The matrix is

2 Marks GATE-EEE-2013( )

[A] $\begin{bmatrix} 1 & 1 \\ -1 & -2 \end{bmatrix}$ [B] $\begin{bmatrix} 1 & 2 \\ -2 & -4 \end{bmatrix}$
[C] $\begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix}$ [D] $\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$

16)Roots of the algebraic equation $X^3 + X^2 + X + 1 = 0$ are

1 Marks GATE-EEE-2011( )

[A] $X^3 + X^2 + X + 1 = 0$ [B] (-1, -j, +j)
[C] $(+1, -1, +1)$ [D] $(0, 0, 0)$

17) A cubic polynomial with real coefficients

2 Marks GATE-EEE-2009( )

[A] can possibly have no extrema and no zero crossings
[B] may have up to three extrema and up to 2 zero crossings
[C] cannot have more than two extrema and more than three zero crossings
[D] will always have an equal number of extrema and zero crossings

18) The trace and determinant of a 2 ´ 2 matrix are known to be -2 and -35 respectively. Its eigen values are

2 Marks GATE-EEE-2009( )

[A] -30 and -5
[B] -37 and -1
[C] -7 and 5
[D] 17.5 and -2

19)The determinant of the matrix $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 100 & 1 & 0 & 0 \\ 100 & 200 & 1 & 0 \\ 100 & 200 & 300 & 1 \end{bmatrix}$ is

2 Marks GATE-EEE-2002( )

[A] 100
[B] 200
[C] 1
[D] 300

20)A set of linear equations is represented by the matrix equation Ax=b. the necessary condition for the existence of a solution for this system is:

2 Marks GATE-EEE-1998( )

[A] A must be invertible
[B] b must be linearly depended on the columns of A
[C] b must be linearly independent of the columns of A
[D] None of the above

21) The vector $\begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$ is an eigen vector of $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ .One of the given values A is

2 Marks GATE-EEE-1998( )

[A] 1
[B] 2
[C] 5
[D] -1

22) $A = \begin{bmatrix} 2 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ -1 & 0 & 0 & 4 \end{bmatrix}$ sum of the eigen values of the matrix A is:

2 Marks GATE-EEE-1998( )

[A] 10
[B] -10
[C] 24
[D] 22

23) $A = \begin{bmatrix} 5 & 0 & 2 \\ 0 & 3 & 0 \\ 2 & 0 & 1 \end{bmatrix}$. The inverse of A is:

2 Marks GATE-EEE-1998( )

[A] $\begin{bmatrix} 1 & 0 & -2 \\ 0 & \frac{1}{3} & 0 \\ -2 & 0 & 5 \end{bmatrix}$
[B] $\begin{bmatrix} 5 & 0 & 2 \\ 0 & \frac{-1}{3} & 0 \\ 2 & 0 & 1 \end{bmatrix}$
[C] $\begin{bmatrix} \frac{1}{5} & 0 & \frac{1}{2} \\ 0 & \frac{1}{3} & 0 \\ \frac{1}{2} & 0 & 1 \end{bmatrix}$
[D] $\begin{bmatrix} \frac{1}{5} & 0 & \frac{-1}{2} \\ 0 & \frac{1}{3} & 0 \\ \frac{-1}{2} & 0 & 1 \end{bmatrix}$

24)A square matrix IS called singular, if its

2 Marks GATE-EEE-1997( )

[A] determinan t is unity
[B] determinant is zero
[C] determinantt is infinity
[D] rank is unity

25) The inverse of the matrix $S = \begin{bmatrix} 1 & -1 & 0 \\ 1 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ IS

2 Marks GATE-EEE-1995( )

[A] $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 1 & 1 \end{bmatrix}$
[B] $\begin{bmatrix} 0 & 1 & 1 \\ -1 & -1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$

[C] $\begin{bmatrix} 2 & 2 & -2 \\ -2 & 2 & -2 \\ 0 & 2 & 2 \end{bmatrix}$ [D] $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} \\ \frac{-1}{2} & \frac{1}{2} & \frac{-1}{2} \\ 0 & 0 & 1 \end{bmatrix}$

26)A 5×7matrix has all its entries equal to -a.the rank of the matrix is

2 Marks GATE-EEE-1994( )

[A] 7 [B] 5
[C] 1 [D] zero

27) The eigen values of the matrix $\begin{bmatrix} a & 1 \\ a & 1 \end{bmatrix}$are

2 Marks GATE-EEE-1994( )

[A] (a+1),0 [B] a,0
[C] (a-1),0 [D] 0,0

28) The inverse of the matrix $\begin{bmatrix} 3+2i & i \\ -i & 3-2i \end{bmatrix}$is

2 Marks GATE-CE-2010( )

[A] $\frac{1}{12}\begin{bmatrix} 3+2i & -i \\ i & 3-2i \end{bmatrix}$ [B] $\frac{1}{12}\begin{bmatrix} 3-2i & -i \\ i & 3+2i \end{bmatrix}$
[C] $\frac{1}{14}\begin{bmatrix} 3+2i & -i \\ i & 3-2i \end{bmatrix}$ [D] $\frac{1}{14}\begin{bmatrix} 3-2i & -i \\ i & 3+2i \end{bmatrix}$

29) The eigenvalues of matrix $\begin{bmatrix} 9 & 5 \\ 5 & 8 \end{bmatrix}$are

2 Marks GATE-CE-2012( )

[A] -2.42 and 6.86 [B] 3.48 and 13.53
[C] 4.70 and 6.86 [D] 6.86 and 9.50

30)[A] is a square matrix which is neither symmetric nor skew-symmetric and [A]T is its transpose. The sum and difference of these matrices are defined as [S] = [A] + [A]T and [D] = [A] - [A]T , respectively. Which of the following statements is TRUE?

1 Marks GATE-CE-2011( )

[A] Both [S] and [D] are symmetric [B] Both [S] and [D] are skew-symmetric
[C] [S] is skew-symmetric and [D] is symmetric [D] [S] is symmetric and [D] is skew-symmetric

31)If $\vec{a}$and $\vec{b}$ are two arbitrary vectors. with magnitudes a and b, respectively, $\left|\vec{a} \times \vec{b}\right|^2$ will be equal to

2 Marks GATE-CE-2011( )

[A] $a^2b^2 - (\vec{a}.\vec{b})^2$ [B] $ab - \vec{a}.\vec{b}$
[C] $a^2b^2 + (\vec{a}.\vec{b})^2$ [D] $ab + \vec{a}.\vec{b}$

32)A square matrix B is skew-symmetric if

1 Marks GATE-CE-2009( )

[A] $B^T = -B$ [B] $B^T = B$
[C] $B^{-1} = B$ [D] $B^{-1} = B^T$

33)For a scalar function $f(x,y,z) = x^2 + 3y^2 + 2z^2$, the gradient at the point P (1, 2, -1) is

1 Marks GATE-CE-2009( )

[A] $2\vec{i} + 6\vec{j} + 4\vec{k}$ [B] $2\vec{i} + 12\vec{j} - 4\vec{k}$
[C] $2\vec{i} + 12\vec{j} + 4\vec{k}$ [D] $\sqrt{56}$

34)Solution for the system defined by the set of equations 4y+3z=8; 2x-z=2; and 3x+2y=5 is

1 Marks GATE-CE-2006( )

[A] x=0; y=1; z=4/3 [B] x=0; y=1/2; z=2
[C] x=1; y=1/2; z=2 [D] nonexistent

35)The product of matrices $(PQ)^{-1}P$is

1 Marks GATE-CE-2008( )

[A] P^{-1} [B] Q^{-1}
[C] $P^{-1}Q^{-1}$ [D] PQP^{-1}

36)For a scalar function $f(x,y,z) = x^2 + 3y^2 + 2z^2$, the directional derivative at the point P (1, 2, -1) in the direction of a vector $\vec{i} - \vec{j} + 2\vec{k}$ is

2 Marks GATE-CE-2009( )

[A] -18 [B] $-3\sqrt{6}$
[C] $3\sqrt{6}$ [D] 18

Linear Algebra

37) For a given matrix $\begin{bmatrix} 2 & -2 & 3 \\ -2 & -1 & 6 \\ 1 & 2 & 0 \end{bmatrix}$, one of the eigenvalues is 3.The other two eigenvalues are

2 Marks GATE-CE-2006( )

[A] 2,- 5 [B] 3, -5
[C] 2, 5 [D] 3, 5

38) The directional derivative of f(x ,y, z) = $2x^2 + 3y^2 + z^2$ at the point P: (2, 1, 3) in the direction of the vector a =i-2 k is

2 Marks GATE-CE-2006( )

[A] -2.785 [B] - 2.145
[C] - 1.789 [D] 1.000

39) The Eigen values of the matrix $[p] = \begin{bmatrix} 4 & 5 \\ 2 & -5 \end{bmatrix}$ are

2 Marks GATE-CE-2008( )

[A] -7 and 8 [B] -6 and 5
[C] 3 and 4 [D] 1 and 2

40) Consider the matrices $X_{(4,3)}$, $Z_{(2,3)}$ and $Y_{(4,3)}$.
The order of $[P(X^TY)^{-1}P^T]^T$ will be

1 Marks GATE-CE-2005( )

[A] (2×2) [B] (3×3)
[C] (4×3) [D] (3×4)

41) Consider a non-homogeneous system of linear equations representing mathematically an over-determined system. Such a system will be

1 Marks GATE-CE-2005( )

[A] consistent having a unique solution [B] consistent having a many solutions
[C] inconsistent having a unique solution [D] inconsistent having no solution

42) The following simultaneou s equations
x+yz=3
x+2y+3z=4
x+4y+kz=6
will NOT have a uniqu e solution fork equal to

2 Marks GATE-CE-2008( )

[A] 0 [B] 30
[C] 6 [D] 7

43) The inner (dot) product of two vectors $\overline{P}$ and $\overline{Q}$ is zero. The angle (degrees) between the two vectors is

2 Marks GATE-CE-2008( )

[A] 0 [B] 5
[C] 90 [D] 120

44) The minimum and the maximum eigen values of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ are -2 and 6, respectively. What is the other eigen value?

1 Marks GATE-CE-2007( )

[A] 5 [B] 3
[C] 1 [D] -1

45) For what values of α and β the following simultaneous equations have an infinite number of solutions?
$x + y + z = 5;$ $x + 3y + +3z = 9; x + 2y + +\alpha z = \beta;$

2 Marks GATE-CE-2007( )

[A] 2,7 [B] 3,8
[C] 8,3 [D] 72

46) A velocity vector is given as
$\vec{v} = 5xy\vec{i} + 2y^2\vec{j} + 3yz^2\vec{k}$ The divergence of this velocity vector at (1,1,1) is

2 Marks GATE-CE-2007( )

[A] 9 [B] 10
[C] 14 [D] 15

Linear Algebra

47) The inverse of the 2 x 2 matrix $\begin{bmatrix} 1 & 2 \\ 5 & 7 \end{bmatrix}$ is

2 Marks GATE-CE-2007( )

[A] $\frac{1}{3}\begin{bmatrix} -7 & 2 \\ 5 & -1 \end{bmatrix}$
[B] $\frac{1}{3}\begin{bmatrix} 7 & 2 \\ 5 & 1 \end{bmatrix}$
[C] $\frac{1}{3}\begin{bmatrix} 7 & -2 \\ -5 & 1 \end{bmatrix}$
[D] $\frac{1}{3}\begin{bmatrix} -7 & -2 \\ -5 & -1 \end{bmatrix}$

48) Given that one root of the equation $x^3-10x^2+31x-30=0$ is 5, the other two roots are

2 Marks GATE-CE-2007( )

[A] 2 and 3
[B] 2 and 4
[C] 3 and 4
[D] -2 and -3

49) If A and Bare two ma trices and if AB exists, then BA exists

2 Marks GATE-CE-1997( )

[A] if A has as many rows as B has columns
[B] only if both A and B are square matrices
[C] only if A and B are skew matrices
[D] only if both A and B are symmetric

50) If the determinant of the matrix $\begin{bmatrix} 1 & 3 & 2 \\ 0 & 5 & -6 \\ 2 & 7 & 8 \end{bmatrix}$ is 26,then the determinant of the matrix $\begin{bmatrix} 2 & 7 & 8 \\ 0 & 5 & -6 \\ 1 & 3 & 2 \end{bmatrix}$ is

2 Marks GATE-CE-1997( )

[A] -26
[B] 26
[C] 0
[D] 52

51) Real matrix $[A]_{3\times1}$, $[B]_{3\times3}$, $[C]_{3\times5}$, $[D]_{5\times3}$, $[E]_{5\times5}$ and $[F]_{5\times1}$ are given. Matrices [B] and [E] are symmetric.
Following statements are made with respect to these matrices.
I. Matrix product $[F]^T[C]^T[B][C][F]$ is a scalar
II. Matrix product $[D]^T[F][D]$ is always symmetric
With reference to above statements, which of the following applies?

1 Marks GATE-CE-2004( )

[A] Statement I is true but II is false
[B] Statement I is false but II is true
[C] Both the statements are true
[D] Both the statements are false

52) The eigenvalues of the matrix $\begin{bmatrix} 4 & -2 \\ -2 & 1 \end{bmatrix}$

2 Marks GATE-CE-2004( )

[A] are 1 and 4
[B] are -1 and 2
[C] are 0 and 5
[D] cannot be determined

53) Consider the system of equations
$A_{(m\times n)}X_{(-1xt)} = 1_{(n\times1)}$, where, 1is a scalar.
Let (l_i, X_i) be an eigen-pair of an eigen value and its corresponding eigen vector for real matrix A. Let I be a (n' n) unit matrix. Which one of the following statement is NOT correct?

2 Marks GATE-CE-2005( )

[A] For a homogeneous $n \times n$ system of linear equations, (A-lI) x= 0 having a nontrivial solution, the rank of (A-lI) is less than n.
[B] For matrix A^m, m being a positive integer, (λ_i^m, X_i^m) will be the eigen-pair for all i
[C] If $A^T = A^{-1}$, then $[1_i] = 1$ for all i
[D] If $A^T = A$, then 1_i is for all i

54) Given Matrix $[A] = \begin{bmatrix} 4 & 2 & 1 & 3 \\ 6 & 3 & 4 & 7 \\ 2 & 1 & 0 & 1 \end{bmatrix}$, the rank of the matrix is

1 Marks GATE-CE-2003( )

[A] 4
[B] 3
[C] 2
[D] 1

55) Determinant of the following matrix is $\begin{bmatrix} 5 & 3 & 2 \\ 1 & 2 & 6 \\ 3 & 5 & 10 \end{bmatrix}$

2 Marks GATE-CE-2001( )

[A] -76
[B] -28
[C] +28
[D] +72

56) If,A, B, C are square matrices of the same order, $(ABC)^{-1}$ is equal to

1 Marks GATE-CE-2000( )

[A] $C^{-1}A^{-1}B^{-1}$
[B] $C^{-1}B^{-1}A^{-1}$
[C] $A^{-1}B^{-1}C^{-1}$
[D] $A^{-1}C^{-1}B^{-1}$

57)The product $[P][Q]^T$ of the following two matrices [P] and [Q] is
$[P]=\begin{bmatrix}2 & 3\\4 & 5\end{bmatrix}$; $[Q]=\begin{bmatrix}4 & 8\\9 & 2\end{bmatrix}$

2 Marks GATE-CE-2001( )

[A] $\begin{bmatrix}32 & 24\\56 & 46\end{bmatrix}$
[B] $\begin{bmatrix}46 & 56\\24 & 32\end{bmatrix}$
[C] $\begin{bmatrix}35 & 22\\61 & 42\end{bmatrix}$
[D] $\begin{bmatrix}32 & 56\\24 & 46\end{bmatrix}$

58) The given values of the matrix $\begin{bmatrix}5 & 3\\2 & 9\end{bmatrix}$ are

2 Marks GATE-CE-2001( )

[A] (5.13, 9.42)
[B] (3.85, 2.93)
[C] (9.00, 5.00)
[D] (10.16, 3.84)

59)Consider the following two statements:
I. The maximum number of linearly independent column vectors of a matrix A is called the rank of A.
II. If A is an $n \times n$ square matrix, it will be non singular is rank A = n.
With reference to the above statements, which of the following applies ?

1 Marks GATE-CE-2000( )

[A] Both the statements are false
[B] Both the statements are true
[C] I is true but II is false
[D] I is false but II is true.

60)If A is any n x n matrix and k is a scalar, $|kA| = \alpha |A|$ where α is

2 Marks GATE-CE-1999( )

[A] k/n
[B] k^n
[C] n^k
[D] kn

61) Inverse of matrix $\begin{bmatrix}0 & 1 & 0\\0 & 0 & 1\\1 & 0 & 0\end{bmatrix}$ is

1 Marks GATE-CE-1997( )

[A] $\begin{bmatrix}0 & 1 & 1\\1 & 0 & 0\\0 & 1 & 0\end{bmatrix}$
[B] $\begin{bmatrix}1 & 0 & 0\\0 & 0 & 1\\0 & 1 & 0\end{bmatrix}$
[C] $\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}$
[D] $\begin{bmatrix}0 & 0 & 1\\0 & 1 & 0\\1 & 0 & 0\end{bmatrix}$

62)If A is a real square matrix,then AA^T is

1 Marks GATE-CE-1998( )

[A] Unsymmetric
[B] always symmetric
[C] Skew-symmetric
[D] Some times symmetric

63)In matrix algebra AS = AT (A, 5, T, a re matrices of appropriate order) implies S=T only if

1 Marks GATE-CE-1998( )

[A] A is symmetric
[B] A is singular
[C] A is non singular
[D] A is skew symmetric

64)The real symmetric matrix C corresponding to the Quadratic form $Q = 4x_1x_2 - 5x_{22}.\ is$

2 Marks GATE-CE-1998( )

[A] $\begin{bmatrix}1 & 2\\2 & -5\end{bmatrix}$
[B] $\begin{bmatrix}2 & 0\\0 & -5\end{bmatrix}$
[C] $\begin{bmatrix}1 & 1\\1 & -2\end{bmatrix}$
[D] $\begin{bmatrix}0 & 2\\1 & -5\end{bmatrix}$

65) One pair of eigen vectors corresponding to the two eigenvalues of the matrix $\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}$ is

2 Marks GATE-EIN/IN-2013( )

[A] $\begin{bmatrix}j\\1\end{bmatrix},\begin{bmatrix}1\\-j\end{bmatrix}$
[B] $\begin{bmatrix}0\\1\end{bmatrix},\begin{bmatrix}-1\\0\end{bmatrix}$
[C] $\begin{bmatrix}1\\j\end{bmatrix},\begin{bmatrix}0\\1\end{bmatrix}$
[D] $\begin{bmatrix}1\\j\end{bmatrix},\begin{bmatrix}j\\1\end{bmatrix}$

66) Given that $A=\begin{bmatrix}-5 & -3\\2 & 0\end{bmatrix}$ and $I=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$,the value of A^3 is

2 Marks GATE-EIN/IN-2012( )

[A] 15A+12I [B] 19A+30I
[C] 17A+15I [D] 17A+21I

67)The eigen values of a (2x2) matrix X are -2 and -3. The eigenvalues of matrix $(X+I)^{-1}$ (X+5I) are

2 Marks GATE-EIN/IN-2009( )

[A] -3,-4 [B] -1,-2
[C] -1,-3 [D] -2,-4

68) The matrix $P = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$ rotates a vector about the axis $\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ by an angle of

2 Marks GATE-EIN/IN-2009( )

[A] 30^0 [B] 60^0
[C] 90^0 [D] 120^0

69) The rank of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 4 & 6 & 8 \end{bmatrix}$, is

1 Marks GATE-EIN/IN-2000( )

[A] 0 [B] 1
[C] 2 [D] 3

70)For a singular matrix.

2 Marks GATE-EIN/IN-2000( )

[A] Atleast one eigen value would be at the origin [B] All eigen values would be at the origin
[C] No eigen value would be at the origin. [D] None

71)Identify which one of the following is an eigenvector of the matrix

$$A = \begin{bmatrix} 1 & 0 \\ -1 & -2 \end{bmatrix}$$

1 Marks GATE-EIN/IN-2005( )

[A] $\begin{bmatrix} -1 & 1 \end{bmatrix}^T$ [B] $\begin{bmatrix} 3 & -1 \end{bmatrix}^T$
[C] $\begin{bmatrix} 1 & -1 \end{bmatrix}^T$ [D] $\begin{bmatrix} -2 & 1 \end{bmatrix}^T$

72)For a given 2×2 matrix A, it is observed that

$A \begin{bmatrix} 1 \\ -1 \end{bmatrix} = -\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ and $A \begin{bmatrix} 1 \\ -2 \end{bmatrix} = -2 \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

Then matrix A is

2 Marks GATE-EIN/IN-2006( )

[A] $A = \begin{bmatrix} 2 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ -1 & -2 \end{bmatrix}$ [B] $A = \begin{bmatrix} 1 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ -1 & -1 \end{bmatrix}$
[C] $A = \begin{bmatrix} 1 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} 2 & 1 \\ -1 & -1 \end{bmatrix}$ [D] $A = \begin{bmatrix} 0 & -2 \\ 1 & -3 \end{bmatrix}$

73)Let $A = [a_{ij}], 1 \le i, j \le n$, with $n \ge 3$ and $a_{ij} = i.j$.Then the rank of A is

2 Marks GATE-EIN/IN-2007( )

[A] 0 [B] 1
[C] n-1 [D] n

74)Rank of the matrix given below is

$$\begin{bmatrix} 3 & 2 & -9 \\ -6 & -4 & 18 \\ 12 & 8 & -36 \end{bmatrix}$$

1 Marks GATE-ME-1999( )

[A] 1 [B] 2
[C] 3 [D] $\sqrt{2}$

75) Given the matrix $\begin{bmatrix} -4 & 2 \\ 4 & 3 \end{bmatrix}$, the eigen vector is

2 Marks GATE-ECE/TCE-2005( )

[A] $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$ [B] $\begin{bmatrix} 4 \\ 3 \end{bmatrix}$
[C] $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ [D] $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$

Linear Algebra

76) Let $A = \begin{bmatrix} 2 & -0.1 \\ 0 & 3 \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1/2 & a \\ 0 & b \end{bmatrix}$. Then (a+b) =

2 Marks GATE-ECE/TCE-2005( )

[A] 7/20 [B] 3/20

[C] 19/20 [D] 11/20

77) Given an orthogonal matrix $A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & 1 & -1 \end{bmatrix}$, then the value of $[AA^T]^{-1}$is

2 Marks GATE-ECE/TCE-2005( )

[A] $\begin{bmatrix} \frac{1}{4} & 0 & 0 & 0 \\ 0 & \frac{1}{4} & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \end{bmatrix}$ [B] $\begin{bmatrix} \frac{1}{2} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{2} & 0 \\ 0 & 0 & 0 & \frac{1}{2} \end{bmatrix}$

[C] $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ [D] $\begin{bmatrix} \frac{1}{4} & 0 & 0 & 0 \\ 0 & \frac{1}{4} & 0 & 0 \\ 0 & 0 & \frac{1}{4} & 0 \\ 0 & 0 & 0 & \frac{1}{4} \end{bmatrix}$

78) The rank of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$is

2 Marks GATE-ECE/TCE-2006( )

[A] 0 [B] 1

[C] 2 [D] 3

79) The Eigen values and the corresponding Eigen vectors of a 2 x 2 matrix are given by

Eigen value Eigen vector

$\lambda_1 = 8$ $V_1 \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

$\lambda_2 = 4$ $V_2 \begin{bmatrix} 1 \\ -1 \end{bmatrix}$

The matrix is

2 Marks GATE-ECE/TCE-2006( )

[A] $\begin{bmatrix} 6 & 2 \\ 2 & 6 \end{bmatrix}$ [B] $\begin{bmatrix} 4 & 6 \\ 6 & 4 \end{bmatrix}$

[C] $\begin{bmatrix} 2 & 4 \\ 4 & 2 \end{bmatrix}$ [D] $\begin{bmatrix} 4 & 8 \\ 8 & 4 \end{bmatrix}$

80) For the matrix $\begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$ the given value corresponding to the eigen vector $\begin{bmatrix} 101 \\ 101 \end{bmatrix}$ is

2 Marks GATE-ECE/TCE-2006( )

[A] 2 [B] 4

[C] 6 [D] 8

81) It is given that $X_1, X_2 \dots X_M$ are M non-zero orthogonal vectors. The dimension of the vector space spanned by the 2M vectors $X_1, X_2 \dots X_M, -X_1, -X_2 \dots\dots -X_M$ is

2 Marks GATE-ECE/TCE-2007( )

[A] 2M [B] M + 1

[C] M [D] dependent on the choice of $X_1, X_2 \dots X_M$

82) All the four entries of the 2 x 2 matrix $P = \begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix}$ are nonzero, and one of its eigen values is zero. Which of the following statements is true?

2 Marks GATE-ECE/TCE-2008( )

[A] $P_{11}P_{22} - P_{12}P_{21} = 1$ [B] $P_{11}P_{22} - P_{12}P_{21} = -1$

[C] $P_{11}P_{22} - P_{12}P_{21} = 0$ [D] $P_{11}P_{22} + P_{12}P_{21} = 0$

Linear Algebra

83)The system of linear equations

4x+ 2y = 7

2x+y = 6

has

2 Marks GATE-ECE/TCE-2008( )

[A] A unique solution
[B] No solution
[C] An infinite number of solutions
[D] Exactly two distinct solutions

84) Consider the matrix $P = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ The value of e^P is

2 Marks GATE-ECE/TCE-2008( )

[A] $\begin{bmatrix} 2e^{-2} - 3e^{-1} & e^{-1} - e^{-2} \\ 2e^{-2} - 2e^{-1} & 5e^{-2} - e^{-1} \end{bmatrix}$
[B] $\begin{bmatrix} e^{-1} + e^{-2} & 2e^{-2} - e^{-1} \\ 2e^{-1} - 4e^{-2} & 3e^{-1} + 2e^{-2} \end{bmatrix}$
[C] $\begin{bmatrix} 5e^{-2} - e^{-1} & 3e^{-1} - e^{-2} \\ 2e^{-2} - 6e^{-1} & 4e^{-2} + e^{-1} \end{bmatrix}$
[D] $\begin{bmatrix} 2e^{-1} - e^{-2} & e^{-1} - e^{-2} \\ -2e^{-1} + 2e^{-2} & -e^{-1} + 2e^{-2} \end{bmatrix}$

85) The eigen values of the following matrix are $\begin{bmatrix} -1 & 3 & 5 \\ -3 & -1 & 6 \\ 0 & 0 & 3 \end{bmatrix}$

2 Marks GATE-ECE/TCE-2009( )

[A] 3, 3 + 5j, 6-j
[B] -6, + 5j, 3 + j, 3-j
[C] 3 + j, 3-j, 5 + j
[D] 3, -1 + 3j, -1-3j

86)In the matrix equation Px = q, which of the following is a necessary condition for the existence of at least one solution for the unknown vector x

2 Marks GATE-EEE-2005( )

[A] Augmented matrix [Pq] must have the same rank as matrix P
[B] Vector q must have only non-zero elements
[C] Matrix P must be singular
[D] Matrix P must be square

87) For the matrix P = $\begin{bmatrix} 3 & -2 & 2 \\ 0 & -2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ one of the eigen values is equal to -2. which of the following is an eigen vector?

2 Marks GATE-ECE/TCE-2005( )

[A] $\begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix}$
[B] $\begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix}$
[C] $\begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix}$
[D] $\begin{bmatrix} 2 \\ 5 \\ 0 \end{bmatrix}$

88) If R = $\begin{bmatrix} 1 & 0 & -1 \\ 2 & 1 & -1 \\ 2 & 3 & 2 \end{bmatrix}$,then top row of $R^{-1}$is

2 Marks GATE-EEE-2005( )

[A] [5 6 4]
[B] [5 -3 1]
[C] [2 0 -1]
[D] [2 -1 1/2]

89) $x = [x_1\ x_2 \ldots x_n]^T$ is an n-tuple nonzero vector. The n x n matrix $V = xx^T$

2 Marks GATE-EEE-2007( )

[A] Has rank zero
[B] Has rank 1
[C] Is orthogonal
[D] Has rank n

90)A loaded dice has following probability distribution of occurrences

Dice value	1	2	3	4	5	6
Probability	¼	1/8	1/8	1/8	1/8	1/4

If three identical dice as the above are thrown, the probability of occurrence of values 1, 5 and 6 on the three dice is

2 Marks GATE-EEE-2007( )

[A] Same as that of occurrence of 3, 4, 5
[B] Same as that of occurrence of 1,2,5
[C] 1/128
[D] 5/8

91)Let x and y be two vectors in a 3 dimensional space and <x,y> denote their dot product. Then the determinant

$$\det\begin{bmatrix} <x,x> & <x,y> \\ <y,x> & <y,y> \end{bmatrix}$$

2 Marks GATE-EEE-2007( )

[A] Is zero when x and y are linearly independent
[B] Is positive when x and y are linearly independent
[C] Is non-zero for all non-zero x and y
[D] Is zero only when either x or y is zero

92)The linear operation L(x) is defined by the cross product L(x) = b x X where $b = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix}^T$ and $x = \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}^T$ are three dimensional vectors. The 3 x 3 matrix M of this operation satisfies

$$L(x) = M\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}.$$

Then the eigen value of M are

2 Marks GATE-EEE-2007( )

[A] 0 + 1, -1
[B] 1, -1, 1
[C] i, -i, 1
[D] i, -i, 0

93)The characteristic equation of a (3 x3) matrix P is defined as $a(\lambda) = |\lambda I - P| = \lambda^3 + \lambda^2 + 2\lambda + 1 = 0$

If I denotes identity matrix then the inverse of matrix P will be

2 Marks GATE-EEE-2008( )

[A] $(P^2 + P + 2i)$
[B] $(P^2 + P + i)$
[C] $-(P^2 + P + i)$
[D] $-(P^2 + P + 2i)$

94)If the rank of a (5 x 6) matrix Q is 4 then which one of the following statements is correct?

2 Marks GATE-EEE-2008( )

[A] Q will have four linearly independent rows and four linearly independent columns
[B] Q will have for linearly independent rows and five linearly independent columns
[C] QQ^T will be invertible
[D] Q^TQ will be invertible

95)A is m x n full rank matrix with m >n and I is an identity matrix. Let matrix $A' = (A^TA)^{-1}A^T$. Then which one of the following statement is False?

2 Marks GATE-EEE-2008( )

[A] $AA'A = A$
[B] $(AA')^2 = AA'$
[C] $AA' = I$
[D] $AA'A = A$

96) Let P be a 2 X 2 real orthogonal matrix and $\vec{X}$ is a real vector $[x_1, x_2]^T$ with length $\|\vec{X}\| = (x_1^2 + x_2^2)^{1/2}$. Then which of one of the following statement is correct ?

2 Marks GATE-EEE-2008( )

[A] $\|P\vec{X}\| \le \|\vec{X}\|$ where at least one vector satisfies $\|P\vec{X}\| < \|\vec{X}\|$
[B] $\|P\vec{X}\| \le \|\vec{X}\|$ for all vectors $\vec{X}$
[C] $\|P\vec{X}\| \ge \|\vec{X}\|$ where at least one vector satisfies $\|P\vec{X}\| > \|\vec{X}\|$
[D] No relationship can be established between $\|\vec{X}\|$ and $\|P\vec{X}\|$

97) The equation $\begin{bmatrix} 2 & -2 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ has

1 Marks GATE-EEE-2013( )

[A] no solution
[B] only one solution $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$
[C] non-zero unique solution
[D] multiple solutions

98) A polynomial $f(x) = a_4x^4 + a_3x^3 + a_2x^2 + a_1x - a_0$ with all coefficients positive has

1 Marks GATE-ECE/TCE-2013( )

[A] No real roots
[B] No negative real root
[C] Odd number of real roots
[D] At least one positive and one negative real root

99) Let A be an $m \times n$ matrix and B an $n \times m$ matrix It is given that determinant $(I_m + AB)$= determinant $(I_n + BA)$, where I_k is the $k \times k$ identity matrix . Using the above property, the determinant of the matrix of the given below is

$$\begin{bmatrix} 2 & 1 & 1 & 1 \\ 1 & 2 & 1 & 1 \\ 1 & 1 & 2 & 1 \\ 1 & 1 & 1 & 2 \end{bmatrix}$$

2 Marks GATE-ECE/TCE-2013( )

[A] 2
[B] 5
[C] 8
[D] 16

100) Which one of the following does NOT equal $\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$?

1 Marks GATE-CSE/IT-2013( )

[A] $\begin{vmatrix} 1 & x(x+1) & x+1 \\ 1 & y(y+1) & y+1 \\ 1 & z(z+1) & z+1 \end{vmatrix}$
[B] $\begin{vmatrix} 1 & x+1 & x^2+1 \\ 1 & y+1 & y^2+1 \\ 1 & z+1 & Z^2+1 \end{vmatrix}$
[C] $\begin{vmatrix} 0 & x-y & x^2-y^2 \\ 0 & y-z & y^2-z^2 \\ 1 & z & z^2 \end{vmatrix}$
[D] $\begin{vmatrix} 2 & x+y & x^2+y^2 \\ 2 & y+z & y^2+z^2 \\ 1 & z & z^2 \end{vmatrix}$

101) Let A be the 2 x 2 matrix with elements a_{11} = a_{12} = a_{21}= + 1 and a_{22} =-1. Then a_{22}= -1. Then the eigen values of the matrix A^{19} are

1 Marks GATE-CSE/IT-2012( )

[A] 1024 and -1024
[B] 1024$\sqrt{2}$ and -1024$\sqrt{2}$
[C] 4$\sqrt{2}$ and -4$\sqrt{2}$
[D] 512$\sqrt{2}$ and -512$\sqrt{2}$

102) Given that $A = \begin{bmatrix} -5 & -3 \\ 2 & 0 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, the value of A^3 is

2 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] $15A + 12I$
[B] $19A + 30I$
[C] $17A + 15I$
[D] $17A + 21I$

103) The two vectors [1,1,1] and $[1, a, a^2]$, where $a = \left(-\frac{1}{2} + j\frac{\sqrt{3}}{2}\right)$, are

2 Marks GATE-EEE-2011( )

[A] Orthonormal
[B] Orthogonal
[C] Parallel
[D] collinear

104) The eigen values of a skew-symmetric matrix are

1 Marks GATE-ECE/TCE-2010( )

[A] Always zero
[B] Always pure imaginary
[C] Either zero or pure imaginary
[D] Always real

105) Consider the matrix as given below.

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 7 \\ 0 & 0 & 3 \end{bmatrix}$$

Which one of the following provides the CORRECT values of eigenvalues of the matrix?

2 Marks GATE-CSE/IT-2011( )

[A] 1,4,3
[B] 3,7,3
[C] 7,3,2
[D] 1,2,3

Linear Algebra

106) An eigenvector of $P = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 2 & 2 \\ 0 & 0 & 3 \end{pmatrix}$ is

2 Marks GATE-EEE-2010( )

[A] [-1 1 1] [B] [1 2 1]
[C] [1 -1 2] [D] [2 1 -1]

107) For the set of equations, $x_1 + 2x_2 + x_3 + 4x_4 = 2$ and $3x_1 + 6x_2 + 3x_3 + 12x_4 = 6$.
The following statement is true

2 Marks GATE-EEE-2010( )

[A] Only the trivial solution $x_1 = x_2 = 3x_3 = x_4 = 0$ exists [B] There are no solutions
[C] A unique non-trivial solution exists [D] Multiple non-trivial solutions exist

108) Consider the following matrix
A = $\begin{bmatrix} 2 & 3 \\ x & y \end{bmatrix}$
If the eigenvalues of A are 4 and 8, then

2 Marks GATE-CSE/IT-2010( )

[A] x = 4, y = 10 [B] x = 5, y = 8
[C] x = -3, y = 9 [D] x = -4, y = 10

109) The system of equations
x + y + z = 6
x + 4y + 6z = 20
$x + 4y + \lambda z = \mu$
has NO solution for values of λ and μ given by

2 Marks GATE-ECE/TCE-2011( )

[A] $\lambda = 6, \mu = 20$ [B] $\lambda = 6, \mu \neq 20$
[C] $\lambda \neq 6, \mu = 20$ [D] $\lambda \neq 6, \mu \neq 20$

110) The elgen values of the matrix $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ are

2 Marks GATE-ECE/TCE-1998( )

[A] 1 , 1 [B] -1 , -1
[C] j , -j [D] 1 , -1

111) The rank of the matrix $\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$ is

1 Marks GATE-CSE/IT-2002( )

[A] 4 [B] 2
[C] 1 [D] 0

112) Consider the following statements:
S1: The sum of two singular n × n matrices may be non-singular
S2: The sum of two n × n non-singular matrices may be singular.
Which of the following statements is correct?

1 Marks GATE-CSE/IT-2001( )

[A] S1 and S2 are both true [B] S1 is true, S2 is false
[C] S1 is false, S2 is true [D] S1 and S2 are both false

113) Suppose the adjacency relation of vertices in a graph is represented in a table Adj (X,Y). Which of the following queries cannot be expressed by a relational algebra expression of constant length?

1 Marks GATE-CSE/IT-2001( )

[A] List of all vertices adjacent to a given vertex [B] List all vertices which have self loops
[C] List all vertices which belong to cycles of less than three vertices [D] List all vertices reachable from a given vertex

114) Among the following, the pair of vectors orthogonal to each other is

2 Marks GATE-ME-1995( )

[A] [3,4,7], [3,4,7] [B] [1,0,0], [1,1,0]
[C] [1,0,2], [0,5,0] [D] [1,1,1], [-1,-1,-1]

115) In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to

1 Marks GATE-ME-1996( )

[A] diagonal matrix [B] lower triangular matrix
[C] upper triangular matrix [D] singular matrix

116) The eigen values of $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ are

2 Marks GATE-ME-1996( )

[A] 0,0,0 [B] 0,0,1
[C] 0,0,3 [D] 1,1,1

117) The eigenvalues of a symmetric matrix are all

1 Marks GATE-ME-2013( )

[A] complex with non-zero positive imaginary part. [B] complex with non-zero negative imaginary part.
[C] real. [D] pure imaginary.

118) Choose the CORRECT set of functions, which are linearly dependent.

1 Marks GATE-ME-2013( )

[A] sin x , $\sin^2 x$ and $\cos^2 x$ [B] cos x , sin x and tan x
[C] cos 2x , $\sin^2 x$ and $\cos^2 x$ [D] cos 2x , sin x and cos x

119) The eigen values of the matrix $\begin{bmatrix} 5 & 3 \\ 3 & -3 \end{bmatrix}$ are

2 Marks GATE-ME-1999( )

[A] 6 [B] 5
[C] -3 [D] -4

120) Consider the system of equations given below:

x+y=2
2x+2y =5

This system has

1 Marks GATE-ME-2001( )

[A] one solution [B] no solution
[C] infinite solutions [D] four solutions

121) The following set of equations has

3x+2y+z = 4
x-y+z=2
-2x+2z=5

2 Marks GATE-ME-2002( )

[A] no solution [B] a unique solution
[C] multiple solutions [D] an inconsistency.

122) The rank of a 3 x 3 matrix C (=AB), found by multiplying a non-zero column matrix A of size 3 x 1 and a non-zero row matrix B of size 1x3 is

2 Marks GATE-ME-2001( )

[A] 0 [B] 1
[C] 2 [D] 3

123) For the matrix $\begin{bmatrix} 4 & 1 \\ 1 & 4 \end{bmatrix}$ the eigen values are

1 Marks GATE-ME-2003( )

[A] 3 and -3 [B] -3 and -5
[C] 3 and 5 [D] 5 and 0

124) The vector field. $\vec{F} = x\vec{i} - y\vec{j}$ (where $\vec{i}$ and $\vec{j}$ are unit vectors) is

2 Marks GATE-ME-2003( )

[A] divergence free, but not irrotational [B] irrotational, but not divergence free
[C] divergence free and irrotational [D] neither divergence free nor irrotational.

125) One of the eigen vectors of the matrix A = $\begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}$ is

2 Marks GATE-ME-2010( )

[A] $\begin{Bmatrix} 2 \\ -1 \end{Bmatrix}$ [B] $\begin{Bmatrix} 2 \\ 1 \end{Bmatrix}$
[C] $\begin{Bmatrix} 4 \\ 1 \end{Bmatrix}$ [D] $\begin{Bmatrix} 1 \\ -1 \end{Bmatrix}$

Linear Algebra

126)Eigenvalues of a real symmetric matrix are always

1 Marks GATE-ME-2011( )

[A] positive
[B] negative
[C] real
[D] complex

127)For the matrix $A = \begin{bmatrix} 5 & 3 \\ 1 & 3 \end{bmatrix}$, ONE of the normalized eigen vectors is given as

2 Marks GATE-ME-2012( )

[A] $\begin{bmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{bmatrix}$
[B] $\begin{bmatrix} \frac{1}{2} \\ \frac{-1}{\sqrt{2}} \end{bmatrix}$
[C] $\begin{bmatrix} \frac{3}{\sqrt{10}} \\ \frac{-1}{\sqrt{10}} \end{bmatrix}$
[D] $\begin{bmatrix} \frac{1}{\sqrt{5}} \\ \frac{2}{\sqrt{5}} \end{bmatrix}$

128)x+2y +z =4
2x+y+2x = 5
x-y+z = 1
The system of algebraic equations given above has

2 Marks GATE-ME-2012( )

[A] a unique solution of x = 1, y = 1 and z = 1.
[B] only the two solutions of (x = 1, y = 1, z = 1) and (x = 2, y = 1, z = 0).
[C] infinite number of solutions.
[D] no feasible solution.

129) For a matrix $[M] = \begin{bmatrix} \frac{3}{5} & \frac{4}{5} \\ x & \frac{3}{5} \end{bmatrix}$, the transpose of the matrix is equal to the inverse of the matrix $[M]^T = [M]^{-1}$The value of x is given by

1 Marks GATE-ME-2009( )

[A] $-\frac{4}{5}$
[B] $-\frac{3}{5}$
[C] $\frac{3}{5}$
[D] $\frac{4}{5}$

130)The sum of the eigen values of the given matrix
$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$

1 Marks GATE-ME-2004( )

[A] 5
[B] 7
[C] 9
[D] 18

131)For which value of r will the matrix given below become singular ?
$\begin{bmatrix} 8 & x & 0 \\ 4 & 0 & 2 \\ 12 & 6 & 0 \end{bmatrix}$

2 Marks GATE-ME-2004( )

[A] 4
[B] 6
[C] 8
[D] 12

132)A is a 3 x 4 real matrix and Ax = b is an inconsistent system of equations. The highest possible rank of A is

1 Marks GATE-ME-2005( )

[A] 1
[B] 2
[C] 3
[D] 4

133) Which one of the following is an eigenvector of the matrix $\begin{bmatrix} 5 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 \\ 0 & 0 & 2 & 1 \\ 0 & 0 & 3 & 1 \end{bmatrix}$?

2 Marks GATE-ME-2005( )

[A] $\begin{bmatrix} 1 \\ -2 \\ 0 \\ 0 \end{bmatrix}$
[B] $\begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$
[C] $\begin{bmatrix} 1 \\ 0 \\ 0 \\ -2 \end{bmatrix}$
[D] $\begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$

Linear Algebra

134)Match the items in columns I and II.

Column I	Column II
P. Singular matrix	1. Determinant is not
Q. Non-square matrix	2. Determinant is always one
R. Real symmetric matrix	3, Determinant is zero
S. Orthogonal matrix	4. Eigen values are always real
	5, Eigen values are not defined

2 Marks GATE-ME-2006( )

[A] P-3, Q-1, R-4, S-2 [B] P-2, Q-3, R-4, S-1
[C] P-3, Q-2, R-5, S-4 [D] P-3, Q-4, R-2. S-1.

135)Multiplication of matrices E and F is G. Matrices.E and G are

$E = \begin{bmatrix} cos\theta & -sin\theta & 0 \\ sin\theta & cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $G = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ What is the matrix F?

2 Marks GATE-ME-2006( )

[A] $\begin{bmatrix} cos\theta & -sin\theta & 0 \\ sin\theta & cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ [B] $\begin{bmatrix} sin\theta & cos\theta & 0 \\ -cos\theta & sin\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$
[C] $\begin{bmatrix} cos\theta & sin\theta & 0 \\ -sin\theta & cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ [D] $\begin{bmatrix} sin\theta & -cos\theta & 0 \\ cos\theta & sin\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

136)
The matrix $\begin{bmatrix} 1 & 2 & 4 \\ 3 & 0 & 6 \\ 1 & 1 & p \end{bmatrix}$ has one eigenvalue equal to 3. The sum of the other two eigenvalues is

1 Marks GATE-ME-2008( )

[A] p [B] p - 1
[C] p - 2 [D] p - 3

137)If a square matrix A is real and symmetric, then the Eigen values

1 Marks GATE-ME-2007( )

[A] are always real [B] are always real and positive
[C] are always real and non-negative [D] occur in complex conjugate pairs.

138)For what value of a, if any, will the following system of equations in x, y and. z have a solution ?

2x+3y= 4
x+Y+z=4
x+2y-z=a

2 Marks GATE-ME-2008( )

[A] Any real number [B] 0
[C] 1 [D] There is no such value.

139)The eigenvectors of the matrix $\begin{bmatrix} 1 & 2 \\ 0 & 2 \end{bmatrix}$ are written in the form $\begin{bmatrix} 1 \\ a \end{bmatrix}$ and $\begin{bmatrix} 1 \\ b \end{bmatrix}$. What is a+b ?

2 Marks GATE-ME-2008( )

[A] 0 [B] 1/2
[C] 1 [D] 2

140)The area of a triangle formed by the tips of vectors $\bar{a}, \bar{b}$ and $\bar{c}$ is

2 Marks GATE-ME-2007( )

[A] $\frac{1}{2}\left|(\bar{a}-\bar{b}) \times (\bar{a}-\bar{c})\right|$ [B] $\frac{1}{2}\left|(\bar{a}-\bar{b}) \times (\bar{a}-\bar{c})\right|$
[C] $\frac{1}{2}\left|\bar{a} \times \bar{b} \times \bar{c}\right|$ [D] $\frac{1}{2}(\bar{a} \times \bar{b}).\bar{c}$

141)The number of linearly independent Eigen vectors of $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$ is

2 Marks GATE-ME-2007( )

[A] 0 [B] 1
[C] 2 [D] infinite

Statement for Linked answer Q142 and Q143 is given below

Linear Algebra

142) $P = \begin{bmatrix} -10 \\ 1 \\ 3 \end{bmatrix}^T, Q = \begin{bmatrix} -2 \\ -5 \\ 9 \end{bmatrix}, R = \begin{bmatrix} 2 \\ -7 \\ 12 \end{bmatrix}$ are three vectors

An orthogonal set of vectors having a span that contains P, Q, R is

2 Marks GATE-EEE-2006,GATE-EEE-2006(   )

[A] $\begin{bmatrix} -6 \\ -3 \\ -6 \end{bmatrix} \begin{bmatrix} 4 \\ -2 \\ 3 \end{bmatrix}$

[B] $\begin{bmatrix} -4 \\ 2 \\ 4 \end{bmatrix} \begin{bmatrix} 5 \\ 7 \\ -11 \end{bmatrix} \begin{bmatrix} 8 \\ 2 \\ -3 \end{bmatrix}$

[C] $\begin{bmatrix} 6 \\ 7 \\ -1 \end{bmatrix} \begin{bmatrix} -3 \\ 2 \\ -2 \end{bmatrix} \begin{bmatrix} 3 \\ 9 \\ -4 \end{bmatrix}$

[D] $\begin{bmatrix} 4 \\ 3 \\ 11 \end{bmatrix} \begin{bmatrix} 1 \\ 31 \\ 3 \end{bmatrix} \begin{bmatrix} 5 \\ 3 \\ 4 \end{bmatrix}$

143)The following vector is linearly dependent upon the solution to the previous problem

2 Marks GATE-EEE-2006(   )

[A] $\begin{bmatrix} 8 \\ 9 \\ 3 \end{bmatrix}$

[B] $\begin{bmatrix} -2 \\ -17 \\ 30 \end{bmatrix}$

[C] $\begin{bmatrix} 4 \\ 4 \\ 5 \end{bmatrix}$

[D] $\begin{bmatrix} 13 \\ 2 \\ -3 \end{bmatrix}$

Statement for Linked answer Q144 and Q145 is given below

144)Cayley- Hamilton Theorem states that a square matrix satisfies its own characteristic equation. Consider matrix

$$A = \begin{bmatrix} -3 & 2 \\ -1 & 0 \end{bmatrix}$$

A satisfies the relation

2 Marks GATE-EEE-2007,GATE-EEE-2007(   )

[A] $A + 3I + 2A^{-1} = 0$

[B] A2 + 2A + 2I = 0

[C] (A+I) (A+2I)

[D] exp (A) = 0

145) A^9 equals

2 Marks GATE-EEE-2007(   )

[A] 511 A + 510 I

[B] 309 A + 104 I

[C] 154 A + 155 I

[D] exp (9A)

Linear Algebra

Key Paper

1.	A	2.	B	3.	C	4.	C	5.	A
6.	A	7.	A	8.	D	9.	C	10.	C
11.	A	12.	B	13.	A	14.	D	15.	D
16.	B	17.	C	18.	C	19.	C	20.	B
21.	C	22.	A	23.	A	24.	B	25.	D
26.	C	27.	A	28.	B	29.	B	30.	D
31.	A	32.	A	33.	B	34.	D	35.	A
36.	B	37.	B	38.	C	39.	B	40.	A
41.	A	42.	D	43.	C	44.	B	45.	A
46.	D	47.	A	48.	A	49.	A	50.	A
51.	A	52.	C	53.	A	54.	C	55.	B
56.	B	57.	A	58.	D	59.	B	60.	A
61.	A	62.	B	63.	A	64.	A	65.	A
66.	B	67.	A	68.	A	69.	C	70.	A
71.	B	72.	B	73.	B	74.	A	75.	C
76.	A	77.	C	78.	C	79.	A	80.	C
81.	C	82.	C	83.	B	84.	D	85.	D
86.	A	87.	D	88.	B	89.	B	90.	C
91.	D	92.	D	93.	D	94.	A	95.	A
96.	B	97.	D	98.	D	99.	B	100.	A
101.	D	102.	B	103.	B	104.	C	105.	A
106.	B	107.	D	108.	D	109.	B	110.	D
111.	C	112.	C	113.	C	114.	C	115.	C
116.	C	117.	C	118.	C	119.	A	120.	B
121.	B	122.	A	123.	C	124.	C	125.	A
126.	C	127.	B	128.	C	129.	A	130.	B
131.	A	132.	C	133.	A	134.	A	135.	C
136.	C	137.	A	138.	D	139.	B	140.	B
141.	B	142.	D	143.	D	144.	A	145.	A

Calculus

1) The function f(t) has the Fourier Transform g(ω). The Fourier Transform $ff(t)g(t) = \left(\int_{-\infty}^{\infty} g(t)e^{-j\omega t}dt\right)$ is

2 Marks GATE-ECE/TCE-1997( )

[A] $\frac{1}{2\Pi}f(\omega)$

[B] $\frac{1}{2\Pi}f(-\omega)$

[C] $2\Pi f(-\omega)$

[D] None of the above

2) Which of the following improper integrals is (are) convergent?

2 Marks GATE-ECE/TCE-1993( )

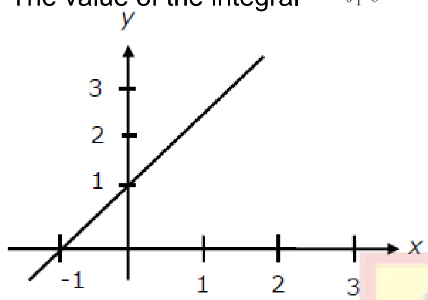
[A] $\int_0^1 \frac{sinx}{1-cosx}dx$

[B] $\int_0^{\infty} \frac{cosx}{1+x}dx$

[C] $\int_0^{\infty} \frac{x}{1+x^2}dx$

[D] $\int_0^1 \frac{1-cosx}{1+x^{\frac{5}{2}}}dx$

3) The following plot shows a function y which varies linearly with x .
The value of the integral $I = \int_1^2 y\, dx$ is



2 Marks GATE-ECE/TCE-2007( )

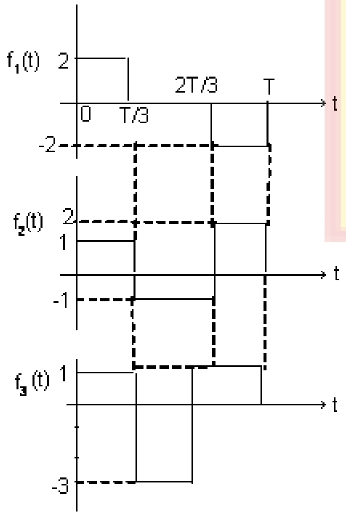
[A] 1.0

[B] 2.5

[C] 4.0

[D] 5.0

4) Three functions $f_1(t)$, $f_2(t)$ and $f_3(t)$ which are zero outside the interval [0, T] are shown in the figure. Which of the following statements is correct ?



2 Marks GATE-ECE/TCE-2007( )

[A] $f_1(t)$ and $f_2(t)$ are orthogonal

[B] $f_1(t)$ and $f_3(t)$ are orthogonal

[C] $f_2(t)$ and $f_3(t)$ are orthogonal

[D] $f_1(t)$ and $f_2(t)$ are orthogonal

5) If $X = \sqrt{-1}$, then the value of X^X is

1 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] $e^{-\frac{\pi}{2}}$

[B] $e^{\frac{\pi}{2}}$

[C] x

[D] 1

6) The value of the integral $I = \frac{1}{\sqrt{2\pi}}\int_0^{\infty} exp\left(-\frac{X^2}{8}\right)dX$

2 Marks GATE-ECE/TCE-2005( )

[A] 1

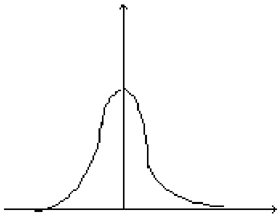
[B] π

[C] 2

[D] 2π

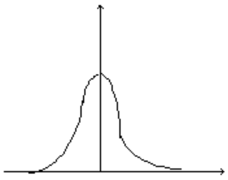
Calculus

7)The derivative of the symmetric function drawn in given figure will look like



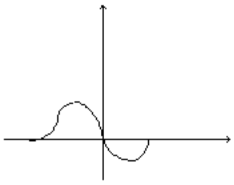
2 Marks GATE-ECE/TCE-2005( )

[A]

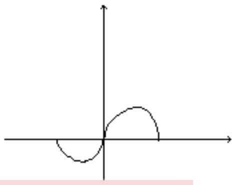


[B]

[C]



[D]



8)$\nabla \times \nabla \times P$, where P is a vector is equal to

2 Marks GATE-ECE/TCE-2006( )

[A] $P \times \nabla \times P - \nabla^2 P$
[B] $\nabla^2 P + \nabla(\nabla \times P)$
[C] $\nabla^2 P + (\nabla \times P)$
[D] $\nabla(\nabla . P) - \nabla^2 P$

9)$\int\int \nabla \times P \; ds$ where P is a vector, is equal to

2 Marks GATE-ECE/TCE-2006( )

[A] $\oint P.dl$
[B] $\oint \nabla \times \nabla \times P.dl$
[C] $\oint \nabla \times P.dl$
[D] $\int\int\int \nabla.P \; dv$

10)

As x increased from - ∞ to ∞, the function f (x) = $\dfrac{e^X}{1 + e^X}$

2 Marks GATE-ECE/TCE-2006( )

[A] Monotonically increases
[B] Monotonically decreases
[C] Increases to a maximum value and then decreases
[D] Decreases to a minimum value and then increases

11)For |x| <<1, coth (x) can be approximated as

1 Marks GATE-ECE/TCE-2007( )

[A] x
[B] x^2
[C] 1/x
[D] 1/x^2

12)Which one of the following is strictly bounded?

1 Marks GATE-ECE/TCE-2007( )

[A] $1/x^2$
[B] e^x
[C] x^2
[D] e^{-x2}

13)For the function e^{-x} the linear approximation around x = 2 is

1 Marks GATE-ECE/TCE-2007( )

[A] $(3 - x)e^{-2}$
[B] $1 - x$
[C] $[3 + 2\sqrt{2} - (1 + \sqrt{2})x]e^{-2}$
[D] e^{-2}

14)Consider the function $f(x) = x^2 - x - 2f$(. The maximum value of f(x) in the closed interval [-4, 4] is

2 Marks GATE-ECE/TCE-2007( )

[A] 18
[B] 10
[C] -2.25
[D] Indeterminate

15)For real values of x, the minimum value of the function f(x)= exp (x) + exp (-x) is

2 Marks GATE-ECE/TCE-2008( )

[A] 2 [B] 1
[C] 0.5 [D] 0

16)Which of the following functions would have only odd powers of x in its Taylor series expansion about the point x = 0?

2 Marks GATE-ECE/TCE-2008( )

[A] $sin(x^3)$ [B] $sin(x^2)$
[C] $cos(x^3)$ [D] $cos(x^2)$

17)In the Taylor series expansion of exp(x) + sin (x) about the point x = π, the coefficient of $(x-\Pi)^2$ is

2 Marks GATE-ECE/TCE-2008( )

[A] exp (π) [B] 0.5 exp (π)
[C] exp (π) + 1 [D] exp (π) -1

18)The value of the integral of the function $g(x,y) = 4x^3 + 10y^4$ along the straight line segment from the point (0,0) to the point (1,2) in the x-y plane is

2 Marks GATE-ECE/TCE-2008( )

[A] 33 [B] 35
[C] 40 [D] 56

19)

Consider points P and Q in the x-y plane, with P = (1, 0) and Q= (0,1). The line integral $2\int_P^Q (xdx + ydy)$ along the semicircle with the line segment PQ as its diameter

2 Marks GATE-ECE/TCE-2008( )

[A] is-1 [B] is 0
[C] is 1 [D] depends on the direction (clockwise or anticlockwise) of the semicircle

20)The Taylor series expansion of $\frac{sinX}{x-\pi}$ at $x = \Pi$given by

2 Marks GATE-ECE/TCE-2009( )

[A] $1 + \frac{(X-\pi)^2}{3!} + ...$ [B] $-1 - \frac{(X-\pi)^2}{3!} + ...$
[C] $1 - \frac{(X-\pi)^2}{3!} + ...$ [D] $-1 + \frac{(X-\pi)^2}{3!} + ...$

21)The maximum value of θ until which the approximation $\sin\theta \approx \theta$ holds to within 10% error is

1 Marks GATE-ECE/TCE-2013( )

[A] 10^0 [B] 18^0
[C] 50^0 [D] 90^0

22)The maximum value of $f(x) = x^3 - 9x^2 + 24x + 5$in the interval [1 6] is

2 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] 21 [B] 25
[C] 41 [D] 46

23)If $e^y = X^{\frac{1}{x}}$, then y has a

2 Marks GATE-ECE/TCE-2010( )

[A] Maximum at X = e [B] Minimum at X = e
[C] Maximum at $X = e^{-1}$ [D] Minimum at $X = e^{-1}$

Calculus

Key Paper

1.	C	2.	A	3.	B	4.	C	5.	A
6.	A	7.	C	8.	D	9.	A	10.	A
11.	C	12.	D	13.	A	14.	A	15.	A
16.	A	17.	B	18.	A	19.	B	20.	B
21.	B	22.	C	23.	A				

Differential Equations

1)The formula used to compute an approximation for the second derivative of a function f at a point x_0 is.

1 Marks GATE-CSE/IT-1996( )

[A] $\frac{f(x_0+h)+f(x_0-h)}{2}$ [B] $\frac{f(x_0+h)-f(x_0-h)}{2h}$
[C] $\frac{f(x_0+h)+2f(x_0)+f(x_0-h)}{h^2}$ [D] $\frac{f(x_0+h)-2f(x_0)+f(x_0-h)}{h^2}$

2)Thesolutionofdifferentialequation y_'' +3y_' +2y=0isoftheform

2 Marks GATE-CSE/IT-1995( )

[A] $C_1e^x + C_2e^{2x}$ [B] $C_1e^{-x} + C_2e^{3x}$
[C] $C_1e^{-x} + C_2e^{-2x}$ [D] $C_1e^{-2x} + C_2 2^{-x}$

3)Backward Euler method for solving the differential equation $\frac{dy}{dx} = f(x,y)$ is specified by, (choose one of the following).

1 Marks GATE-CSE/IT-1994( )

[A] $y_{n+1} = y_n + hf(x_n, y_n)$ [B] $y_{n+1} = y_n + hf(x_{n+1}, y_{n+1})$
[C] $y_{n+1} = y_{n-1} + 2hf(x_n, y_n)$ [D] $y_{n+1} = (1+h)f(x_{n+1}, y_{n+1})$

4)The differential equation
$\frac{d^2y}{dx^2} + \frac{dy}{dx} + siny = 0$ is

1 Marks GATE-CSE/IT-1993( )

[A] linear [B] non-linear
[C] homogeneous [D] of degree two

5)The differential equation, $\frac{d^2y}{dx^2} + siny = 0$

2 Marks GATE-ECE/TCE-1993( )

[A] linear [B] non-linear
[C] homogeneous [D] of degree two

6)With initial condition x(1)=0.5 the solution of the differential equation $t\frac{dX}{Dt} + X = t$ is

1 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] $X = t - \frac{1}{2}$ [B] $X = t^2 - \frac{1}{2}$
[C] $X = \frac{t^2}{2}$ [D] $X = \frac{t}{2}$

7)With K as a constant, the possible solution for the first order differential equation $\frac{dy}{dx} = e^{-3x}$

1 Marks GATE-EEE-2011( )

[A] $-\frac{1}{3}e^{-3x} + K$ [B] $-\frac{1}{3}e^{3x} + K$
[C] $-\frac{1}{3}e^{-3x} + K$ [D] $-3e^{-x} + K$

8)The order and degree of the differential equation
$\frac{d^3y}{dx^3} + 4\sqrt{\left(\frac{dy}{dx}\right)^3} + y^2 = 0$ are respectively

1 Marks GATE-CE-2010( )

[A] 3 and 2 [B] 2 and 3
[C] 3 and 3 [D] 3 and 1

9)The solution to the ordinary differential equation
$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$

2 Marks GATE-CE-2010( )

[A] $y = c_1e^{3x} + c_2e^{-2x}$ [B] $y = c_1e^{3x} + c_2e^{2x}$
[C] $y = c_1e^{-3x} + c_2e^{2x}$ [D] $y = c_1e^{-3x} + c_2e^{-2x}$

10)The partial differential equation that can be formed from
z=ax + by + ab has the from (with $p = \frac{\partial z}{\partial x}$ and $q = \frac{\partial z}{\partial y}$)

2 Marks GATE-CE-2010( )

[A] z = px + qy [B] z = px + pq
[C] z = px + qy + pq [D] z = qy + pq

11)Given a function
$f(x,y) = 4x^2 + 6y^2 + -8x - 4y + 8$
The optimal value of f(x, y)

2 Marks GATE-CE-2010( )

[A] Is a minimum equal to 10/3 [B] Is a maximum equal to 10/3
[C] Is a minimum equal to 8/3 [D] Is a maximum equal to 8/3

12) The solution of the ordinary differential equation $\frac{dy}{dx}+2y=0$ for the boundary condition, y = 5 at x=1

2 Marks GATE-CE-2012( )

[A] $y=e^{-2x}$ [B] $y=2e^{-2x}$
[C] $y=10.95e^{-2x}$ [D] $y=36.95e^{-2x}$

13) For an analytic function, f(x+iy)=u(x,y)+iv(x,y), u is given by u=3x^2 -3y^2. The expression for v, considering K to be a constant is

2 Marks GATE-CE-2011( )

[A] 3y^2- 3x^2+ K [B] 6x- 6y + K
[C] 6y - 6x + K [D] 6xy + K

14) The solution of the differential equation $\frac{dy}{dx}+\frac{y}{x}=x$, with the condition that y = 1 at x = 1, is

2 Marks GATE-CE-2011( )

[A] $y=\frac{2}{3x^2}+\frac{x}{3}$ [B] $y=\frac{x}{2}+\frac{1}{2x}$
[C] $y=\frac{2}{3}+\frac{x}{3}$ [D] $y=\frac{2}{3x}+\frac{x^2}{3}$

15) The differential equation $\frac{dy}{dx}=0.25y^2$ is to be solved using the backward (implicit) Euler's method with boundary condition y=1 at x=0 and with a step size of 1. What would be the value of y at x=1

1 Marks GATE-CE-2006( )

[A] 1.33 [B] 1.67
[C] 2.00 [D] 2.33

16) The general solution $\frac{d^2y}{dx^2}-y=0$ is

1 Marks GATE-CE-2008( )

[A] $y=p\ cos\ x+\ Q\ sin\ x$ [B] $y=p\ cos\ x$
[C] $y=\ P\ sin\ x$ [D] $y=\ P\ sin^2\ x$

17) Solution of the differential equation $3y\frac{dy}{dx}+2x=0$ represents a family of

2 Marks GATE-CE-2009( )

[A] ellipses [B] circles
[C] parabolas [D] hyperbolas

18) The solution of the differential equation, $x^2\frac{dy}{dx}+2xy-x+1$, given that at x = 1 , y = 0 is

2 Marks GATE-CE-2006( )

[A] $\frac{1}{2}-\frac{1}{x}+\frac{1}{2x^2}$ [B] $\frac{1}{2}-\frac{1}{x}-\frac{1}{2x^2}$
[C] $\frac{1}{2}+\frac{1}{x}+\frac{1}{2x^2}$ [D] $-\frac{1}{2}+\frac{1}{x}+\frac{1}{2x^2}$

19) The equation $k_x\frac{\partial^2h}{\partial x^2}+k_z\frac{\partial^2h}{\partial z^2}=0$ can be transformed to $\frac{\partial^2h}{\partial x_1^2}+\frac{\partial^2h}{\partial z^2}=0$ by substiting

2 Marks GATE-CE-2008( )

[A] $x_1=x\frac{k_z}{k_x}$ [B] $x_1=x\frac{k_x}{k_z}$
[C] $x_1=x\sqrt{\frac{k_x}{k_z}}$ [D] $x_1=x\sqrt{\frac{k_z}{k_x}}$

20) Solution of $\frac{dy}{dx}=-\frac{x}{y}$ at x=1 and $x=\sqrt{3}$ is

2 Marks GATE-CE-2008( )

[A] $x.y^2=2$ [B] $x+y^2=4$
[C] $x^2.y^2=-2$ [D] $x^2+y^2=4$

21) The solution of $\frac{d^2y}{dx^2}+2\frac{dy}{dx}+17y=0,\ y(0)=1,\ \frac{dy}{dx}\left(\frac{p}{4}\right)=0$ in the range $0<x<\frac{\pi}{4}$ is given by

2 Marks GATE-CE-2005( )

[A] $e^{-x}\left(cos4x+\frac{1}{4}sin4x\right)$ [B] $e^{x}\left(cos4x-\frac{1}{4}sin4x\right)$
[C] $e^{-4x}\left(cosx-\frac{1}{4}sinx\right)$ [D] $e^{-4x}\left(cos4x-\frac{1}{4}sin4x\right)$

22) The degree of the differential equation $\frac{d^2x}{dt^2}+2x^3=0$ is

1 Marks GATE-CE-2007( )

[A] 0 [B] 1
[C] 2 [D] 3

Differential Equations

23)The solution for the differential equation $\frac{dy}{dx}=x^2y$ with condition that y = 1 at x=0 is

1 Marks GATE-CE-2007( )

[A] $y=e^{\frac{1}{2x}}$
[B] $ln(y)=\frac{x^3}{3}+4$
[C] $ln(y)=\frac{x^2}{2}$
[D] $y=e^{\frac{x^3}{3}}$

24)A body originally at 60^0C cools down to 40^0C in 15minutes when kept in air at a temperature of 25^0C. What will be the temperature of the body at the end of 30minutes?

2 Marks GATE-CE-2007( )

[A] $35.2^0\,C$
[B] $31.5^0\,C$
[C] $28.7^0\,C$
[D] $15^0\,C$

25)For the differentia l equation,f(x,y) $\frac{dy}{dx}$ + g(x,y) = 0 to be exact,

2 Marks GATE-CE-1997( )

[A] $\frac{\partial f}{\partial y}=\frac{\partial g}{\partial x}$
[B] $\frac{\partial f}{\partial x}=\frac{\partial g}{\partial y}$
[C] f = g
[D] $\frac{\partial^2 f}{\partial x^2}=\frac{\partial^2 g}{\partial y^2}$

26)The differential equa tion $\frac{dy}{dx}$+ Py = Q, is a linear equation of first order only if

2 Marks GATE-CE-1997( )

[A] P is a constant but Q is a function of y
[B] P and Q are functions of y or constants
[C] P is a function of y but Q is a constant
[D] P and Q are functions of x or constants

27)Biotransformation of an organic compound having concentration (x) can be modeled using an ordinary differential equation $\frac{dx}{dt}+kx^2=0$, where k is the reaction rate constant. If x = a at t = 0, the solution of the equation is

2 Marks GATE-CE-2004( )

[A] $x=ae^{-kt}$
[B] $\frac{1}{x}=\frac{1}{a}+kt$
[C] $x=a(1-e^{-kt})$
[D] $x=a+kt$

28)
The number of boundary conditions required to solve the differential equations $\frac{\partial^2\phi}{\partial x^2}+\frac{\partial^2\phi}{\partial y^2}=0$ is

1 Marks GATE-CE-2001( )

[A] 2
[B] 0
[C] 4
[D] 1

29)The solution for the following differential equation with boundary conditions y(0) = 2 and y'(1) = -3 is
$\frac{d^2y}{dx^2}=3x-2$

2 Marks GATE-CE-2001( )

[A] $y=\frac{x^3}{3}-\frac{x^2}{2}+3x-6$
[B] $y=3x^3-\frac{x^2}{2}-5x+2$
[C] $y=\frac{x^3}{2}-x^2-\frac{5x}{2}+2$
[D] $y=x^3-\frac{x^2}{2}+5x+\frac{3}{2}$

30)Number of terms in the expansion of general determinant of order n is

2 Marks GATE-CE-1999( )

[A] n^2
[B] $n!$
[C] n
[D] $(n+1)^2$

31)If c is a constant , solution of the equation $\frac{dy}{dx}=1+y^2$ is

2 Marks GATE-CE-1999( )

[A] y=sin(x+c)
[B] y=cos(x+c)
[C] y=tan(x+c)
[D] $y=e^x+c$

32)
The equation $\begin{bmatrix}2 & 1 & 1\\ 1 & 1 & -1\\ y & x^2 & x\end{bmatrix}$=0 represents a parabola passing through the points

2 Marks GATE-CE-1999( )

[A] (0, 1), (0, 2), (0, -1)
[B] (0, 0), (-1, 1),(1, 2)
[C] (1, 1), (0, 0), (2, 2)
[D] (1, 2), (2i 1), (0, 0)

33)Consider the differential equation $\ddot{y}+2\dot{y}+y=0$with boundary conditions y(0) =1 , y(1) = 0. The value of y(2) is

2 Marks GATE-EIN/IN-2011( )

[A] -1 [B] $-e^{-1}$
[C] $-e^{-2}$ [D] $-e^{2}$

34) Consider the difference equation $y[n]-\frac{1}{3}y[n-1]=x[n]$ and suppose that $x[n]=\left(\frac{1}{2}\right)^n u[n]$. Assuming the condition of initial of rest , the solution for y[n] , $n\geq 0$ is

2 Marks GATE-EIN/IN-2011( )

[A] $3\left(\frac{1}{3}\right)^n-2\left(\frac{1}{2}\right)^n$ [B] $-2\left(\frac{1}{3}\right)^n+3\left(\frac{1}{2}\right)^n$
[C] $\frac{2}{3}\left(\frac{1}{3}\right)^n+\frac{1}{3}\left(\frac{1}{2}\right)^n$ [D] $\frac{1}{3}\left(\frac{1}{3}\right)^n+\frac{2}{3}\left(\frac{1}{2}\right)^n$

35) The type of the partial differential equation $\frac{\partial f}{\partial t}=\frac{\partial^2 f}{\partial x^2}$ is

1 Marks GATE-EIN/IN-2013( )

[A] parabolic [B] Elliptic
[C] Hyperbolic [D] Nonlinear

36) While numerically solving the differential equation $\frac{dy}{dx}+2xy^2=0$, y(0) = 1, using Euler's predictorcorrector (improved Euler-Cauchy) method with a step size of 0.2, the value of y after the first step is

2 Marks GATE-EIN/IN-2013( )

[A] 1.00 [B] 1.03
[C] 0.97 [D] 0.96

37) The maximum value of $f(x)=x^3-9x^2+24x+5$ in the interval [1,6] is:

2 Marks GATE-EIN/IN-2012( )

[A] 21 [B] 25
[C] 41 [D] 46

38) Consider the Differential equation

$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=\delta(t)$ with $y(t)|_{t=0}=-2$ and $\frac{dy}{dt}|_{t=0^-}=0$

The numerical value of $\frac{dy}{dt}|_{t=0^+}=0$ is :

2 Marks GATE-EIN/IN-2012( )

[A] -2 [B] -1
[C] 0 [D] 1

39) Given $y=x^2+2x+10$, the value of $\frac{dy}{dx}|_{x=1}$ is equal to

1 Marks GATE-EIN/IN-2008( )

[A] 0 [B] 4
[C] 12 [D] 13

40) Consider the differential equation $\frac{dy}{dx}=1+y^2$ Which one of the following can be a particular solution of this differential equation?

2 Marks GATE-EIN/IN-2008( )

[A] y = tan(x+3) [B] y = tanx + 3
[C] x=tan(y+3) [D] x = tany+3

41) Consider the function y = x^2- 6x +9 The maximum value of y obtained when x varies over the interval 2 to 5 is

2 Marks GATE-EIN/IN-2008( )

[A] 1 [B] 3
[C] 4 [D] 9

42) Consider differential equation $\frac{dy}{dx}+y=e^x$ with y (0) = 1 . The value of y(1) is

2 Marks GATE-EIN/IN-2010( )

[A] $e+e^{-1}$ [B] $\frac{1}{2}\left(e-e^{-1}\right)$
[C] $\frac{1}{2}\left(e+e^{-1}\right)$ [D] $2\left(e-e^{-1}\right)$

43) The differential equation $\frac{dx}{dt}=\frac{4-x}{\tau}$ with x(0)=0, and the constant τ>0 , is to be numerically integrated using the forward Euler method with a constant integration time step T. The maximum value of T such that the numerical solution of x converges is

2 Marks GATE-EIN/IN-2009( )

[A] $\pi/4$ [B] $\pi/2$
[C] π [D] 2π

44) The general solution of the differential equation $(D^2-4D+4)y=0$, is of the form (given D=d/dx) and C_1 and C_2 are constants

2 Marks GATE-EIN/IN-2005( )

[A] C_1e^{2x} [B] $C_1e^{2x}+C_2e^{-2x}$
[C] $C_1e^{2x}+C_2xe^{-2x}$ [D] $C_1e^{2x}+C_2xe^{2x}$

45) The following differential equation has $3\left(\frac{d^2y}{dt^2}\right)+4\left(\frac{dy}{dt}\right)^3+y^2+2=x$

2 Marks GATE-ECE/TCE-2005( )

[A] degree = 2, order = 1 [B] degree= 1, order = 2
[C] degree= 4, order = 3 [D] degree= 2, order = 3

46) A solution of the following differential equation is given by $\frac{d^2y}{dx^2}-5\frac{dy}{dx}+6y=0$

2 Marks GATE-ECE/TCE-2005( )

[A] $y=e^{2x}+e^{-3x}$ [B] $y=e^{2x}+e^{3x}$
[C] $y=e^{-2x}+e^{3x}$ [D] $y=e^{-2x}+e^{-3x}$

47) A solution for the differential equation $\dot{x}(t)+2x(t)=\delta(t)$ with initial condition x(0-)= 0 is

2 Marks GATE-ECE/TCE-2006( )

[A] $e^{-2t}u(t)$ [B] $e^{2t}u(t)$
[C] $e^{-t}u(t)$ [D] $e^{t}u(t)$

48) For the differential equation $\frac{d^2y}{dX^2}+k^2y=0$ the boundary conditions are
(i) y = 0 for x = 0 and (ii) y = 0 for x = a
The form of non-zero solutions of y (where m varies over all integers) are

2 Marks GATE-ECE/TCE-2006( )

[A] $y=\sum_m A_m sin\frac{m\pi X}{a}$ [B] $y=\sum_m A_m cos\frac{m\pi X}{a}$
[C] $y=\sum_m A_m X^{\frac{m\pi}{a}}$ [D] $y=\sum_m A_m e^{\frac{m\pi}{a}}$

49) The solution of the differential equation $k^2\frac{d^2y}{dX^2}=y-y_2$ under the boundary conditions
(i) y = y_1 at x= 0 and
(ii) y = y_2 at x = ∞, where k, y_1 and y_2 are constant is

2 Marks GATE-ECE/TCE-2007( )

[A] $y=(y_1-y_2)exp(-x/k^2)+y_2$ [B] $y=(y_2-y_1)exp(-x/k)+y_1$
[C] $y=(y_1-y_2)sin\,h(x/k)+y_1$ [D] $y=(y_1-y_2)exp(-x/k)+y_2$

50) Which of the following is a solution to the differential equation $\frac{dx(t)}{dt}+3x(t)=0$?

2 Marks GATE-ECE/TCE-2008( )

[A] $x(t)=3e^{-t}$ [B] $x(t)=2e^{-3t}$
[C] $x(t)=(-3/2)t^2$ [D] $x(t)=3t^2$

51) The order of the differential equation $\frac{d^2y}{dt^2}+\left(\frac{dy}{dt}\right)^3+y^4=e^{-t}$ is

1 Marks GATE-ECE/TCE-2009( )

[A] 1 [B] 2
[C] 3 [D] 4

Differential Equations

52) Match each differential equation in Group I to its family of solution curves from Group II

Group I	Group II
A . $\frac{dy}{dx} = \frac{y}{x}$	1 . Circles
B . $\frac{dy}{dx} = \frac{y}{x}$	2 . Straight lines
C . $\frac{dy}{dx} = \frac{x}{y}$	3 . Hyperbolas
D . $\frac{dy}{dx} = \frac{x}{y}$	

2 Marks GATE-ECE/TCE-2009( )

[A] A B C D
2 3 3 1

[B] A B C D
1 3 2 1

[C] A B C D
2 1 3 3

[D] A B C D
3 2 1 2

53) The solution of the first order differential equation $x'(t) = -3x(t)$, x (0) = x_0 is

2 Marks GATE-EEE-2005( )

[A] $x(t) = x_0 e^{-3t}$

[B] $x(t) = x_0 e^{-3}$

[C] $x(t) = x_0 e^{-1/3}$

[D] $x(t) = x_0 e^{-1}$

54) Equation $e^x - 1 = 0$ is required to be solved using Newton's method with a initial guess $x_0 = -1$. Then, after one step of Newton's method, estimate x_1 of the solution will be given by

2 Marks GATE-EEE-2008( )

[A] 0.71828

[B] 0.36784

[C] 0.20587

[D] 0.00000

55) A system is described by the differential equation $\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y(t) = x(t)$.Let x(t) be a rectangular pulse given by

$$x(t) = \begin{cases} 1 & 0 < t < 2 \\ 0 & otherwise \end{cases}$$

Assuming that y(0) =0 and $\frac{dy}{dt} = 0$ at t =0 , the Laplace transform of y(t) is

2 Marks GATE-ECE/TCE-2013( )

[A] $\frac{e^{-2s}}{s(s+2)(s+3)}$

[B] $\frac{1-e^{-2s}}{s(s+2)(s+3)}$

[C] $\frac{e^{-2s}}{(s+2)(s+3)}$

[D] $\frac{1-e^{-2s}}{(s+2)(s+3)}$

56) A system described by a linear, constant coefficient, ordinary, first order differential equation has an exact solution given by y(t) for t>0, when the forcing function is x(t) and the initial condition is y(0). If one wishes to modify the system so that the solution becomes -2y(t) for t>0, we need to

2 Marks GATE-ECE/TCE-2013( )

[A] change the initial condition to –y(0) and the forcing function to 2x(t)

[B] change the initial condition to 2y (0) and the forcing function to -x (t)

[C] Change the initial condition to $j\sqrt{2y(0)}$ and the forcing function to $j\sqrt{2x(t)}$

[D] change the initial condition to 2y (0) and the forcing function to -2x (t)

57) Consider the differential equation

$\frac{d^2y(t)}{dt^2} + 2\frac{dy(t)}{dt} + y(t) = \delta(t)$, with $y(t)|_{t=0} = -2$ and $\frac{dy}{dt}|_{t=0} = 0$

The numerical value of $\frac{dy}{dt}|_{t=0}$ is

2 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] -2

[B] -1

[C] 0

[D] 1

58) A function n(x) satisfied the differential equation $\frac{d^2n(x)}{dx^2} - \frac{n(x)}{L^2} = 0$ where L is a constant . The boundary conditions are : n(0) = K and $n(\infty) = 0$. The solution to this equation is

Differential Equations

1 Marks GATE-ECE/TCE-2010( )

[A] n (x) = K exp(x/L) [B] $n(x) = K\ exp(-x/\sqrt{L})$
[C] $n(x) = K^2\ exp(-x/L)$ [D] n(x) = K exp(-x/L)

59) Consider differential equation $\frac{dy(x)}{dx} - y(x) = x$ with the initial condition y(0)=0 . Using Euler's first order method with a step of 0.1 , the value of y(0.3) is

2 Marks GATE-ECE/TCE-2010( )

[A] 0.01 [B] 0.031
[C] 0.0631 [D] 0.1

60) For the differential equation $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 8x = 0$ with initial conditions X(0)=1 and $\frac{dx}{dt}|_{t=0}$, the solution is

2 Marks GATE-EEE-2010( )

[A] $x(t) = 2e^{-6t} - e^{-2t}$ [B] $x(t) = 2e^{-2t} - e^{-4t}$
[C] $x(t) = -e^{-6t} + 2e^{-4t}$ [D] $x(t) = -e^{-2t} + 2e^{-4t}$

61) The solution of the differential equation $\frac{dy}{dx} = ky,\ y(0) = c$ is

1 Marks GATE-ECE/TCE-2011( )

[A] $x = ce^{-ky}$ [B] $x = ke^{cy}$
[C] $y = ce^{kx}$ [D] $y = ce^{-kx}$

62) The value of ξ in the mean value theorem of $f(b) - f(a) = (b-a)f'(\xi)$ for $f(x) = Ax^2 + Bx + c$ in (a,b) is

2 Marks GATE-ME-1994( )

[A] b+a [B] b-a
[C] $\frac{b+a}{2}$ [D] $\frac{b-a}{2}$

63) For the differential equation $\frac{dy}{dt} + 5y = 0$ with y(o)=1, the general solution is

2 Marks GATE-ME-1994( )

[A] e^{5t} [B] e^{-5t}
[C] $5e^{-5t}$ [D] $e^{\sqrt{-5t}}$

64) The solution to the differential equation f''(x)+4f'(x)+4f(x) = 0 is

2 Marks GATE-ME-1995( )

[A] $f_1(x) = e^{-2x}$ [B] $f_1(x) = e^{2x}, f_2(x) = e^{-2x}$
[C] $f_1(x) = e^{-2x}, f_2(x) = e^{-2x}$ [D] $f_1(x) = e^{-2x}, f_2(x) = e^{-x}$

65) For the following set of simultaneous equations :
1.5x-0.5y=2
4x+2y+3z=9
7x+y+5z=10

1 Marks GATE-ME-1997( )

[A] the solution is unique [B] infinitely many solutions exist
[C] the equations are incompatible [D] finite number of multiple solutions exist.

66) The particular solution for the differential equation $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 5\ \cos\ x$ is

2 Marks GATE-ME-1996( )

[A] 0.5 cos x+1.5 sin x [B] 1.5 cos x+0.5 sin x
[C] 1.5 sin x [D] 0.5 cos x

67) If $\phi(x) = \int_0^{x^2} \sqrt{t}\,dt$, then $\frac{d\phi}{dx}$ is

1 Marks GATE-ME-1998( )

[A] $2x^2$ [B] $\sqrt{x}$
[C] 0 [D] 1

68) The general solution of the differential equation $X^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$ is

2 Marks GATE-ME-1998( )

[A] $Ax + Bx^2 \quad (A, B\ \text{are constants})$ [B] $Ax + B\ log(x) \quad (A, B\ \text{are constants})$
[C] $Ax + Bx^2\ log(x) \quad (A, B\ \text{are constants})$ [D] $Ax + Bx\ log(x) \quad (A, B\ \text{are constants})$

69) $\frac{\partial^2 u}{\partial t^2} = C^2\frac{\partial^2 u}{\partial x^2}$ represents the equation for

1 Marks GATE-ME-1999( )

[A] Vibration of a stretched string
[B] motion of a projectile in agravitational field
[C] Heat flow in thin rod
[D] Oscillation of a simple pendulum

70) The partial differential equation $\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} = \frac{\partial^2 u}{\partial x^2}$ is a

1 Marks GATE-ME-2013( )

[A] linear equation of order 2
[B] non-linear equation of order 1
[C] linear equation of order 1
[D] non-linear equation of order 2

71) The function f (t) satisfies the differential equation $\frac{d^2 f}{dt^2} + f = 0$ and the auxiliary conditions, f(o) = 0, $\frac{df}{dt}(0) = 4$. The Laplace transform of f (t) is given by

2 Marks GATE-ME-2013( )

[A] $\frac{2}{s+1}$
[B] $\frac{4}{s+1}$
[C] $\frac{4}{s^2+1}$
[D] $\frac{2}{s^4+1}$

72) The solution to the differential equation $\frac{d^2 u}{dx^2} - k\frac{du}{dx} = 0$ where k is a constant, subjected to the boundary conditions u(0) = 0 and u(L) = U, is

2 Marks GATE-ME-2013( )

[A] $u = U\frac{x}{L}$
[B] $u = U\left(\frac{1-e^{kx}}{1-e^{kL}}\right)$
[C] $u = U\left(\frac{1-e^{-kx}}{1-e^{-kL}}\right)$
[D] $u = U\left(\frac{1+e^{kx}}{1+e^{kL}}\right)$

73) If z = f (x,y),then dz is equal to

1 Marks GATE-ME-2000( )

[A] $\frac{\partial f}{\partial x}dx + \frac{\partial f}{\partial y}dy$
[B] $\frac{\partial f}{\partial y}dx + \frac{\partial f}{\partial x}dy$
[C] $\frac{\partial f}{\partial y}dx - \frac{\partial f}{\partial x}dy$
[D] $\frac{\partial f}{\partial y}dx - \frac{\partial f}{\partial x}dy$

74) The solution of the differential equation
$\frac{d^2 y}{dx^2} + \frac{dy}{dx} + y = 0$

1 Marks GATE-ME-2000( )

[A] $Ae^x + Be^{-x}$
[B] $e^x(Ax+B)$
[C] $e^x[Acos(\sqrt{3}/2)x + Bcos(\sqrt{3}/2)x]$
[D] $e^{x/2}[Acos(\sqrt{3}/2)x + Bcos(\sqrt{3}/2)x]$

75) $\frac{d^2 y}{dx^2} + (x^2+4x)\frac{dy}{dx} + y = x^8 - 8$
The above equation is a

2 Marks GATE-ME-1999( )

[A] partial differential equation
[B] non-linear differential equation
[C] non-homogeneous differential equation
[D] ordinary differential equation.

76) The maximum value of the directional derivative of the function $\phi = 2x^2 + 3y^2 + 5z^2$ at a point (1,1,-1) is

2 Marks GATE-ME-2000( )

[A] 10
[B] -4
[C] $\sqrt{152}$
[D] 152

77) Consider the system of simultaneous equations
x+2y+z=6
2x +y +2z =6
x+y+z=5
This system has

2 Marks GATE-ME-2003( )

[A] unique solution
[B] infinite number of solutions
[C] no solution
[D] exactly two solutions.

78) The solution of the differential equation $\frac{dy}{dx} + y^2 = 0$

2 Marks GATE-ME-2003( )

[A] $y = \frac{1}{x+c}$
[B] $y = \frac{-x^3}{3} + c$
[C] ce^x
[D] unsolvable as equation is non-linear.

Differential Equations

79)The Blasius equation $\frac{d^3f}{d\eta^3} + \frac{f}{2}\frac{d^2f}{d\eta^2} = 0$ is a

1 Marks GATE-ME-2010( )

[A] second order nonlinear ordinary differential equation
[B] third order nonlinear ordinary different equation
[C] third order linear ordinary differential equation
[D] mixed order nonlinear ordinary differential equation

80) Consider the differential equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} - 4y = 0$ with the boundary conditions of y (0)=0 and y (1) =1. The complete solution of the differential equation is

2 Marks GATE-ME-2012( )

[A] x^2
[B] $\sin\left(\frac{\pi x}{2}\right)$
[C] $e^x \sin\left(\frac{\pi x}{2}\right)$
[D] $e^{-x} \sin\left(\frac{\pi x}{2}\right)$

81)Consider the differential equation $\frac{dy}{dx} = (1+y^2)x$. The general solution with constant c is

2 Marks GATE-ME-2011( )

[A] $y = \tan\frac{x^2}{2} + \tan c$
[B] $y = \tan^2(\frac{x}{2} + c)$
[C] $y = \tan^2(\frac{x}{2}) + c$
[D] $y = \tan(\frac{x^2}{2} + c)$

82) The solution of $x\frac{dy}{dx} + y = x^4$ with the condition $y(1) = \frac{6}{5}$ is

2 Marks GATE-ME-2009( )

[A] $y = \frac{x^4}{5} + \frac{1}{x}$
[B] $y = \frac{4x^4}{5} + \frac{1}{5x}$
[C] $y = \frac{x^4}{5} + 1$
[D] $y = \frac{x^5}{5} + 1$

83)If $x = a(\theta + \sin\theta)$ and $y = a(1-\cos\theta)$, then $\frac{dy}{dx}$ will be equal to

1 Marks GATE-ME-2004( )

[A] $\sin\left(\frac{\theta}{2}\right)$
[B] $\cos\left(\frac{\theta}{2}\right)$
[C] $\tan\left(\frac{\theta}{2}\right)$
[D] $\cot\left(\frac{\theta}{2}\right)$

84) The solution of the differential equation $\frac{dy}{dx} + 2xy = e^{-x^2}$ with y(0) = 1 is

1 Marks GATE-ME-2006( )

[A] (1+x)e^{+x^2}
[B] (1+x)e^{-x^2}
[C] (1-x)e^{+x^2}
[D] (1-x)e^{-x^2}

85)By a change of variables x(u,v) = u,v,y(u,v) = vlu. in a double integral, the integrand f(x, y) changes to f(u v, u/v) $\phi(u,v)$. Then $\phi(u,v)$ is

2 Marks GATE-ME-2005( )

[A] 2v/u
[B] 2uv
[C] V^2
[D] 1

86)If $x^2\frac{dy}{dx} + 2xy = \frac{2\ln x}{x}$, and y(1)=0 ,then what is y(e) ?

2 Marks GATE-ME-2005( )

[A] e
[B] 1
[C] 1/e
[D] $1/e^2$

87) For $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = 3e^{2x}$, the particular integral is

2 Marks GATE-ME-2006( )

[A] $\frac{1}{15}e^{2x}$
[B] $\frac{1}{5}e^{2x}$
[C] $3e^{2x}$
[D] $C_1e^{-x} + C_2e^{-3x}$

88)Given that $\ddot{x}$ + 3x= 0, and x(0) = 1, $\dot{x}$(0) = 0, what is x (1) ?

1 Marks GATE-ME-2008( )

[A] -0.99
[B] -0.16
[C] 0.16
[D] 0.99

89)The minimum value of function $y = x^2$ in the interval [1, 5] is

1 Marks GATE-ME-2007( )

[A] 0
[B] 1
[C] 25
[D] undefind

Differential Equations

90)The partial differential equation, $\frac{\partial^2\varphi}{\partial x^2}+\frac{\partial^2\varphi}{\partial y^2}+\frac{\partial\varphi}{\partial x}+\frac{\partial\varphi}{\partial y}=0$ has

1 Marks GATE-ME-2007( )

[A] degree 1 order 2
[B] degree 1 order 1
[C] degree 2 order 1
[D] degree 2 order 2

91) Let f=y^x, What is $\frac{\partial^2 f}{\partial x\partial y}$ at x=2, y=1 ?

2 Marks GATE-ME-2008( )

[A] 0
[B] ln 2
[C] 1
[D] $\frac{1}{ln\ 2}$

92)It is given that y''+ 2y' + y = 0, y(0) = 0 y(1) = 0. What is y(0.5) ?

2 Marks GATE-ME-2008( )

[A] 0
[B] 0.37
[C] 0.62
[D] 1.13

93)If $y=x+\sqrt{x+\sqrt{x+\sqrt{x+\ldots\infty}}}$, then y(2)=

2 Marks GATE-ME-2007( )

[A] 4 or 1
[B] 4 only
[C] 1 only
[D] undefined

94)The solution of $\frac{dy}{dx}=y^2$ with initial value y(0) =1 is bounded in the interval

2 Marks GATE-ME-2007( )

[A] $-\infty\le x\le\infty$
[B] $-\infty\le x\le 1$
[C] x <1 , x >1
[D] $-2\le x\le 2$

Statement for Linked answer Q95 and Q96 is given below

95)The complete solution of the ordinary differential equation $\frac{d^2y}{dx^2}+p\frac{dy}{dx}+qy=0$ is $y=c_1e^{-x}+c_2e^{-3x}$.

Q. Then p and q are

2 Marks GATE-ME-2005,GATE-ME-2005( )

[A] p=3,q=3
[B] p=3,q=4
[C] p=4 , q=3
[D] p=4 ,q=4

96)Which of the following is a solution of the differential equation $\frac{d^2y}{dx^2}+p\frac{dy}{dx}+(q+1)y=0$?

2 Marks GATE-ME-2005,GATE-ME-2005( )

[A] e^{-3x}
[B] xe^{-x}
[C] xe^{-2x}
[D] $x2e^{-2x}$

Differential Equations

Key Paper

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

Complex Analysis

1) $\oint \frac{z^2-4}{z^2+4}dz$ evaluated anticlockwise around the circle $|z-i|=2$, where $i=\sqrt{-1}$, is

2 Marks GATE-EEE-2013( )

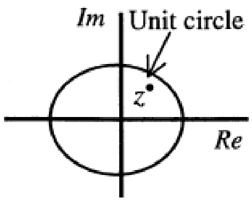
[A] -4Π
[B] 0
[C] $2+\pi$
[D] 2+2i

2) Given $f(z)=\frac{1}{z+1}-\frac{2}{z+3}$ If C is a counterclockwise path in the z-plane such that $|z+1|=1$, the value of $\frac{1}{2\Pi i}P_c f(z)dz$ is

1 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

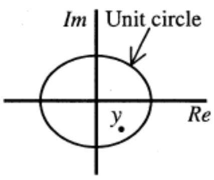
[A] -2
[B] -1
[C] 1
[D] 2

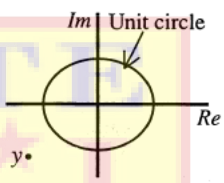
3) A point Z has been plotted in the complex plane, as shown in figure below.

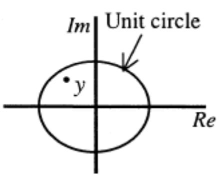


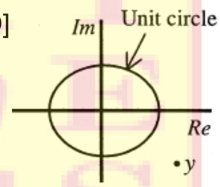
The plot of the complex number $y=\frac{1}{z}$ is

1 Marks GATE-EEE-2011( )

[A]


[B]


[C]


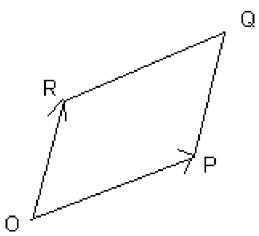
[D]


4) The infinite series $1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\frac{x^4}{4!}+\ldots\ldots$ corresponds to

1 Marks GATE-CE-2012( )

[A] $see\ x$
[B] e^x
[C] $cos\ x$
[D] $1+sin^2x$

5) For the parallelogram OPQR shown in the sketch, $\overline{op}=a\hat{i}+b\hat{j}$ and $\overline{OR}=c\hat{i}+d\hat{j}$. The area of the parallelogram is



2 Marks GATE-CE-2012( )

[A] ad-bc
[B] ac+bd
[C] ad+bc
[D] ab-cd

6) The analytic function $f(z)=\frac{z-1}{z^2+1}$ has singularities at

1 Marks GATE-CE-2009( )

[A] 1 and -1
[B] 1 and i
[C] 1 and -i
[D] i and -i

Complex Analysis

7) The value of the integral $\int_c \frac{cos(2\pi z)}{(2z-1)(z-3)}dz$ (where C is a closed curve given by $|z|=1$) is

2 Marks GATE-CE-2009( )

[A] $-\pi i$
[B] $\frac{\pi i}{5}$
[C] $\frac{2\pi i}{5}$
[D] πi

8) What is the area common to the circles r = a and r = 2a cosϕ ?

2 Marks GATE-CE-2006( )

[A] 0.524 a^2
[B] 0.614 a^2
[C] 1.047 a^2
[D] 1.228 a^2

9) The velocity field for flow is given by $\vec{V} = (5x+6y+7z)\hat{i} + (6x+5y+9z)\hat{j} + (3x+2y+\lambda z)\hat{k}$ and the density varies as $\rho = \rho_0$ exp (-21). In order that the mass is conserved, the value of λ should be

2 Marks GATE-CE-2006( )

[A] -12
[B] -10
[C] -8
[D] 10

10) Which one of the following is NOT true for complex number Z_1 and Z_2?

1 Marks GATE-CE-2005( )

[A] $\frac{Z_1}{Z_2} = \frac{Z_1\overline{Z_2}}{|Z_2|^2}$
[B] $|Z_1+Z_2| \le |Z_1| + |Z_2|$
[C] $|Z_1 - Z_2| \le |Z_1| - |Z_2|$
[D] $|Z_1+Z_2|^2 + |Z_1-Z_2|^2 = 2|Z_1|^2 + 2|Z_2|^2$

11) For real values of x, can be written in one of the forms of a convergent series given below :

2 Marks GATE-CE-1997( )

[A] cos (x) = 1 + $\frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!}$....$\infty$
[B] cos (x) = 1 - $\frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^5}{5!}$....$\infty$
[C] cos (x) = x - $\frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!}$....$\infty$
[D] cos (x) = x - $\frac{x^2}{1!} + \frac{x^2}{2!} - \frac{x^3}{3!}$....$\infty$

12) The summation of series
$S = 2 + \frac{5}{2} + \frac{8}{2^2} + \frac{11}{2^3} + ...\infty$

1 Marks GATE-CE-2004( )

[A] 4.50
[B] 6.0
[C] 6.75
[D] 10.0

13) The value of the function $f(x) = \lim_{x\to 0} \frac{x^3+x^2}{2x^3-7x^2}$ is

1 Marks GATE-CE-2004( )

[A] 0
[B] -1/7
[C] 1/7
[D] ∞

14) The function $f(x) = 2x^3 - 3x^2 - 36x + 2$ has its maxima at

2 Marks GATE-CE-2004( )

[A] x = -2 only
[B] x = 0 only
[C] x = 3 only
[D] both x = - 2 and x = 3

15) The following function has a local minim a at which value of x $f(x) = x\sqrt{5-x^2}$

2 Marks GATE-CE-2002( )

[A] $-\frac{\sqrt{5}}{2}$
[B] $\sqrt{5}$
[C] $\sqrt{\frac{5}{2}}$
[D] $-\sqrt{\frac{5}{2}}$

16) The directional derivative of the following function at (1, 2) in the direction of (4i + 3j) is $f(x,y) = x^2 + y^2$

2 Marks GATE-CE-2002( )

[A] 4/5
[B] 4
[C] 2/5
[D] 1

17) The function $f(x) = e^x$ is

2 Marks GATE-CE-1999( )

[A] Even
[B] Odd
[C] Neither even nor odd
[D] None of the above

18) If $f(x,y,z) = (x^2+y^2+z^2)^{-\frac{1}{2}}$, $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$ is equal to

2 Marks GATE-CE-2000( )

[A] Zero
[B] 1
[C] 2
[D] $-3(x^2+y^2+z^2)$

19)The Taylor expansion of sin x about $x=\pi/6$ is given by

2 Marks GATE-CE-2000( )

[A] $\frac{1}{2}+\frac{\sqrt{3}}{2}\left(x-\frac{\pi}{6}\right)-\frac{1}{4}\left(x-\frac{\pi}{6}\right)^2-\frac{\sqrt{3}}{12}\left(x-\frac{\pi}{6}\right)^3.....$
[B] $x-\frac{x^3}{3!}+\frac{x^5}{5!}-\frac{x^7}{7!}+...$
[C] $\left(x-\frac{\pi}{6}\right)-\frac{\left(x-\frac{\pi}{6}\right)^3}{3!}+\frac{\left(x-\frac{\pi}{6}\right)^5}{5!}-\frac{\left(x-\frac{\pi}{6}\right)7}{7!}+.......$
[D] $\frac{1}{2}$

20)The limit of the function $f(x)=[1-a^4/x^4]$ as $x\to\infty$ is given by

2 Marks GATE-CE-2000( )

[A] 1
[B] $exp(-a^4)$
[C] ∞
[D] Zero

21)The maxima and minima of the function $f(x)=2x^3-15x^2+36x+10$ occur, respectively at

2 Marks GATE-CE-2000( )

[A] X= 3 and x = 2
[B] x = 1and x = 3
[C] x = 2 and x = 3
[D] x = 3 and x = 4

22)The curve given by the equation x^2+y^2= 3 axy, is

1 Marks GATE-CE-1997( )

[A] symmetrical about x - axis
[B] symmetrical about y - axis
[C] symmetrical about line y = x
[D] tangential to x = y = a / 3

23)e^x is periodic, with a period of

1 Marks GATE-CE-1997( )

[A] 2π
[B] $2i\pi$
[C] π
[D] $i\pi$

24)A discontinuous real function can be expressed as

1 Marks GATE-CE-1998( )

[A] Tay lor's series and Fourier's series
[B] Taylor's series and not by Fourier's series
[C] neither Taylor's series nor Fourier's series
[D] not by Taylor's series,bu t by Fourier's series

25)The Taylor's series expansion of $sin\ x$ is

1 Marks GATE-CE-1998( )

[A] $1-\frac{x^2}{2!}+\frac{x^4}{4!}$
[B] $1+\frac{x^2}{2!}+\frac{x^4}{4!}$
[C] $x+\frac{x^3}{3!}+\frac{x^5}{5!}$
[D] $x-\frac{x^3}{3!}+\frac{x^5}{5!}$

26)The infinite series $1+\frac{1}{2}+\frac{1}{3}$.........

2 Marks GATE-CE-1998( )

[A] converges
[B] diverges
[C] oscillates
[D] unstable

27)If $x=\sqrt{-1}$, then the value of x^x is :

1 Marks GATE-EIN/IN-2012( )

[A] $e^{-\pi/2}$
[B] $e^{\pi/2}$
[C] X
[D] 1

28) The infinite series $f(x)=x-\frac{x^3}{3!}+\frac{x^5}{5!}-\frac{x^7}{7!}........\infty$ converges to

1 Marks GATE-EIN/IN-2010( )

[A] cos(X)
[B] Sin(x)
[C] Sinh(x)
[D] e^x

29)Consider the function $f(x)=|x|^3$ where x is real. Then the function f(x) at x = 0 is

2 Marks GATE-EIN/IN-2007( )

[A] continuous but not differentiable
[B] once differentiable but not twic
[C] twice differentiable bnut not thrice
[D] thrice differentiable

30)For the function of a complex variable W = In z (where, W = u + jv and Z = x + jy,the u = constant lines get mapped in Z-plane as

2 Marks GATE-ECE/TCE-2006( )

[A] set of radial straight lines
[B] set of concentric circles
[C] set of confocal hyperbolas
[D] set of confocal ellipses

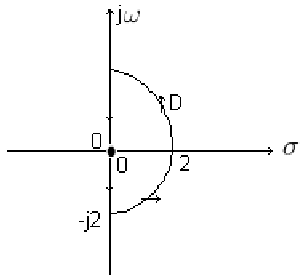
31) The value of the contour integral $\oint_{|z-j|=2} \frac{1}{z^2+4}$ dz in positive sense is

2 Marks GATE-ECE/TCE-2006( )

[A] $j\Pi/2$ [B] $-\Pi/2$

[C] $-j\Pi/2$ [D] $\Pi/2$

32) If the semi-circular contour D of radius 2 is as shown in the figure. Then the value of the integral $\oint_D \frac{1}{(s^2-1)}ds$ is



2 Marks GATE-ECE/TCE-2007( )

[A] j Π [B] -j Π

[C] - Π [D] Π

33) The equation sin (z) = 10 has

2 Marks GATE-ECE/TCE-2008( )

[A] No real or complex solution [B] Exactly two distinct complex solutions

[C] A unique solution [D] An infinite number of complex solutions

34) If $f(z) = c_0 + c_1 z^{-1}$, then $\oint_{Unitcircle} \frac{1+f(z)}{z} dz$ is given by

1 Marks GATE-ECE/TCE-2009( )

[A] $2\Pi c_1$ [B] $2\Pi(1+C_0)$

[C] $2\Pi j C_1$ [D] $2\Pi j(1+C_0)$

35) The value of $\oint_c \frac{dz}{(1+z^2)}$ where C is the contour |z-i/2| =1 is

2 Marks GATE-EEE-2007( )

[A] 2 π i [B] π

[C] $\tan^{-1} z$ [D] $\Pi i \tan^{-1} z$

36) The function $f(x) = 2x - x^2 - x^3 + 3$ has

2 Marks GATE-EEE-2011( )

[A] a maxima at x = 1 and minimum at x = 5 [B] a maxima at x = 1 and minimum at x = -5

[C] only maxima at x = 1 and [D] only a minimum at x = 5

37) The residues of a complex function $X(z) = \frac{1-12z}{z(z-1)(z-2)}$ at its poles are

2 Marks GATE-ECE/TCE-2010( )

[A] $\frac{1}{2}, -\frac{1}{2}$ and 1 [B] $\frac{1}{2}, -\frac{1}{2}$ and -1

[C] $\frac{1}{2}, 1$ and $-\frac{3}{2}$ [D] $\frac{1}{2}, -1$ and $\frac{3}{2}$

38) The value of the integral $\oint_c \frac{-3z+4}{(z^2+4z+5)}dz$ where c is the circle |z| = 1 is given by

2 Marks GATE-ECE/TCE-2011( )

[A] 0 [B] 1/10

[C] 4/5 [D] 1

39) Let f: A → B be a function, and let E and F be subsets of A. Consider the following statements about images

S1: f(E∪F) = f(E) ∪f(F)

S2: f(E∩F) = f(E) ∩f(F)

Which of the following is true about S1 and S2?

2 Marks GATE-CSE/IT-2001( )

[A] Only S1 is correct
[B] Only S2 is correct
[C] Both S1 and S2 are correct
[D] None of S1 and S2 is correct

40) The residence of the function $f(z) = \frac{1}{(z+2)^2(z-2)^2}$ at z=2 is

1 Marks GATE-ECE/TCE-2008( )

[A] -1/32
[B] -1/16
[C] 1/16
[D] 1/32

41) The function f(x) = $|x+1|$ on the interval [-2, 0] is

1 Marks GATE-ME-1995( )

[A] continuous and differentiable
[B] continuous on the integral but not differentiable at all points
[C] neither continuous nor differentiable
[D] differentiable but not continuous

42) i^i, where $i = \sqrt{-1}$, is given by

1 Marks GATE-ME-1996( )

[A] 0
[B] $e^{\frac{-\pi}{2}}$
[C] $\frac{\pi}{2}$
[D] 1

43) The magnitude of the gradient of function $f = xyz^3$ at (1,0,2) is

1 Marks GATE-ME-1998( )

[A] 0
[B] 3
[C] 8
[D] ∞

44) What is the derivative of f(x) = x at x = O ?

1 Marks GATE-ME-2001( )

[A] 1
[B] -1
[C] 0
[D] Does not exit

45) Which of the following functions is not differentiable in the domain [- 1, 1] ?

1 Marks GATE-ME-2002( )

[A] f(x) = x^2
[B] f(x) = x-1
[C] f(x) = 2
[D] f(x) = maximum (x, -x)

46) A regression model is used to express a variable Y as a function of another variable X.

1 Marks GATE-ME-2002( )

[A] there is a causal relationship between Y and X
[B] a value of X may be used to estimate a value of Y
[C] values of X exactly determine values of Y
[D] there is no causal relationship between Y and X.

47) The minimum point of the function $f(x) = \frac{(x^3)}{3} - x$ is at

2 Marks GATE-ME-2001( )

[A] x=1
[B] x= -1
[C] x = 0
[D] $x = \frac{1}{\sqrt{3}}$

48) The function f(x, y) = $2x^2 + 2xy - y^3$ has

2 Marks GATE-ME-2002( )

[A] only one stationary point at (0, 0)
[B] two stationary points at (0, 0) and and (1/6, -1/3)
[C] two stationary points at (0, 0) and (1, - 1)
[D] no stationary point.

49) The modulus of the complex number $\left(\frac{3+4i}{1-2i}\right)$ is

1 Marks GATE-ME-2010( )

[A] 5
[B] $\sqrt{5}$
[C] $1/\sqrt{5}$
[D] 1/5

50) The function y = $|2-3x|$

1 Marks GATE-ME-2010( )

[A] is continuous $\forall x \in R$ and differentiable $\forall x \in R$
[B] is continuous $\forall x \in R$ and differentiable $\forall x \in R$ except at x = 3/2
[C] is continuous $\forall x \in R$ and differentiable $\forall x \in R$ except at x = 2/3
[D] is continuous $\forall x \in R$ except at x = 3 and differentiable $\forall x \in R$

51) A box contains 2 washers, 3 nuts and 4 bolts. Items are drawn from the box at random one at a time without replacement. The probability of drawing 2 washers first followed by 3 nuts and subsequently the 4 bolts is

2 Marks GATE-ME-2010( )

[A] 2/315 [B] 1/630
[C] 1/1260 [D] 1/2520

52)Consider the function f (x) = $|x|$ in the interval -1≤ x ≤1. At the point x = 0, f(x) is

1 Marks GATE-ME-2012( )

[A] continuous and differentiable. [B] non-continuous and differentiable.
[C] continuous and non-differentiable. [D] neither continuous nor differentiable.

53)A t x = 0, the function f (x) = x^3+1 has

1 Marks GATE-ME-2012( )

[A] a maximum value [B] a minimum value
[C] a singularity [D] a point of inflection

54)A series expansion for the function $\sin\theta$ is

1 Marks GATE-ME-2011( )

[A] $1-\frac{\theta^2}{2!}+\frac{\theta^4}{4!}-\ldots\ldots$ [B] $\theta-\frac{\theta^3}{3!}+\frac{\theta^5}{5!}-\ldots\ldots\ldots$
[C] $1+\theta+\frac{\theta^2}{2!}+\frac{\theta^3}{3!}-\ldots\ldots$ [D] $\theta+\frac{\theta^3}{3!}+\frac{\theta^5}{5!}+\ldots\ldots\ldots$

55)The product of two complex numbers 1+ i and 2- 5i is

1 Marks GATE-ME-2011( )

[A] 7-3i [B] 3-4i
[C] -3-4i [D] 7+3i

56)An analytic function of a complex variable z = x + iy is expressed as f (z) = u(x,y) + iv (x, y) where i = $\sqrt{-1}$.
If u = xy, the expression for v should be

2 Marks GATE-ME-2009( )

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

57)The distance between the origin and the point nearest to it on the surface z^2 = 1 + xy is

2 Marks GATE-ME-2009( )

[A] 1 [B] $\frac{\sqrt{3}}{2}$
[C] $\sqrt{3}$ [D] 2

58)The volume of an object expressed in spherical co-ordinates is given by

$$V=\int_0^{2\pi}\int_0^{\pi/3}\int_0^1 r^2\sin\phi\, dr d\phi\, d\theta$$

The value of the integral is

2 Marks GATE-ME-2004( )

[A] $\frac{\pi}{3}$ [B] $\frac{\pi}{6}$
[C] $\frac{2\pi}{3}$ [D] $\frac{\pi}{4}$

59)The divergence of the vector field (x-y) $\hat{i}$ + (y-x) $\hat{j}$+ (x+y+z) $\hat{k}$,is

1 Marks GATE-ME-2008( )

[A] 0 [B] 1
[C] 2 [D] 3

60)The integral $\oint f(z)\, dz$ evaluated around the unit circle on the complex plane for $f(z)=\frac{\cos z}{z}$ is

2 Marks GATE-ME-2008( )

[A] 2πi [B] 4πi
[C] -2πi [D] 0

61)The length of the curve $y=\frac{2}{3}x^{3/2}$ between x=0 and x=1 is

2 Marks GATE-ME-2008( )

[A] 0.27 [B] 0.67
[C] 1 [D] 1.22

Complex Analysis

Key Paper

1.	A	2.	C	3.	D	4.	B	5.	A
6.	D	7.	C	8.	D	9.	B	10.	C
11.	D	12.	D	13.	B	14.	A	15.	D
16.	B	17.	B	18.	A	19.	A	20.	A
21.	C	22.	D	23.	A	24.	D	25.	D
26.	D	27.	A	28.	B	29.	A	30.	B
31.	D	32.	A	33.	A	34.	D	35.	B
36.	C	37.	C	38.	A	39.	A	40.	A
41.	B	42.	B	43.	C	44.	C	45.	A
46.	B	47.	A	48.	B	49.	B	50.	C
51.	C	52.	C	53.	D	54.	B	55.	A
56.	C	57.	A	58.	A	59.	D	60.	A
61.	A								

Numerical Methods

1) The Newton-Raphson method is to be used to find the root of the equation f(x)=0 where x_0 is the initial approximation and f ′ is the derivative of f. The method converges

1 Marks GATE-CSE/IT-1999( )

[A] always
[B] only if f is a polynomial
[C] only if f(x_0)<0
[D] None of the above

2) The Newton-Raphson method is used to find the root of the equation x^2 -2=0 If the iterations are started form –1, the iterations will

1 Marks GATE-CSE/IT-1997( )

[A] converge to -1
[B] converge to $\sqrt{2}$
[C] converge to - $\sqrt{2}$
[D] not converge

3) Using a forward Euler method to solve y" (t) =f(t), y(0), y" (0)=0 with a step size of h, we obtain the following values of y in the first four iterations:

2 Marks GATE-CSE/IT-1997( )

[A] 0, hf (0), h(f(0) + f(h)) and h(f(0) + f(h) = f(2h))
[B] 0, 0 h2 f(0) and 2h2f(0)+f(h)
[C] 0, 0, h2f(0) 3h2f(0)
[D] 0, 0, hf(0) + h2f(0) and hf (0) + h2f(0)+hf(h)

4) The trapezoidal method to numerically obtain $\int \int_a^b f(x)$dx has an error E bounded by $\frac{b-a}{12}h^2$ max f"(x) x ∈ [a,b]

where h is the width of the trapezoids. The minimum number of trapezoids guaranteed to ensure E ≤10^{-4} is computing in 7 using f = 1/x is

2 Marks GATE-CSE/IT-1997( )

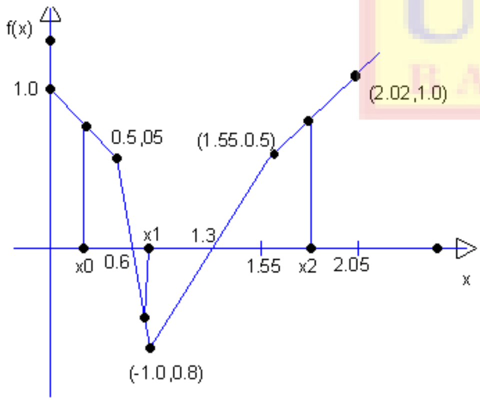
[A] 60
[B] 100
[C] 600
[D] 10000

5) TheiterationformulatofindthesquarerootofapositiverealnumberbusingtheNewtonRaphsonmethodis

2 Marks GATE-CSE/IT-1995( )

[A] $X_{k+1} = \frac{X_k^2 + b}{2X_k}$
[B] $x_{k+1} = 3(x_k + b)$
[C] $x_{k+1} = x_k - 2x_k/x_k^2 + b$
[D] None of the above

6) A piecewise linear function f(x) is plotted using thick solid lines in the figure below (the plot is drawn to scale).



If we use the Newton-Raphson method to find the roots of f(x)=0 using x0 ,x1 , and x2 respectively as initial guesses ,the obtained would be

2 Marks GATE-CSE/IT-2003( )

[A] 1.3 , 0.6 and 0.6 respectively
[B] 0.6 , 0.6 and 1.3 respectively
[C] 1.3 , 1.3 and 0.6 respectively
[D] 1.3 , 0.6 and 1.3 respectively

7) Simpson’s rule for integration gives exact result when f(x) is a polynomial of degree

2 Marks GATE-ECE/TCE-1993( )

[A] 1
[B] 2
[C] 3
[D] 4

8) When the Newton-Raphson method is applied to solve the equation $f(x) = x^3 + 2x - 1 = 0$, the solution at the end of the first iteration with the initial guess value as $x_0 = 1.2$ is

2 Marks GATE-EEE-2013( )

[A] -0.82 [B] 0.49
[C] 0.705 [D] 1.69

9) Solution of the variables x1 and x2 for the following equations is to be obtained by employing the Newton-Raphson iterative method.
equation(i) $10x_2 sinx_1 - 8 = 0$
equation(ii) $10x_2^2 - 10x_2 cosx_1 - 0.6 = 0$
Assuming the initial valued $x_1 = 0.0$ and $x_2 = 1.0$, the jacobian matrix is

2 Marks GATE-EEE-2011( )

[A] $\begin{bmatrix} 10 & -0.8 \\ 0 & -0.6 \end{bmatrix}$ [B] $\begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$
[C] $\begin{bmatrix} 0 & -0.8 \\ 10 & -0.6 \end{bmatrix}$ [D] $\begin{bmatrix} 10 & 0 \\ 10 & -10 \end{bmatrix}$

10) The value of $\int_1^2 \left(\frac{1}{x}\right) dx$ computed using Simpson's rule with a steps size of h=0.25 is:

2 Marks GATE-EEE-1998( )

[A] 0.69430 [B] 0.69385
[C] 0.69325 [D] 0.69415

11) The estimate of $\int_{0.5}^{1.5} \frac{dx}{x}$ obtained using Simpson's rule with three-point function evaluation exceeds the exact values by

1 Marks GATE-CE-2012( )

[A] 0.235 [B] 0.068
[C] 0.024 [D] 0.012

12) The table below gives values of a function F(x) obtained for values of x at intervals of 0.25.

x	0	0.25	0.5	0.75	1.0
F(x)	1	0.9412	0.8	0.64	0.50

The value of the integral of the function between the limits 0 to 1 using Simpson's rule is

2 Marks GATE-CE-2010( )

[A] 0.7854 [B] 2.3562
[C] 3.1416 [D] 7.5000

13) The square root of a number N is to be obtained by applying the Newton Raphson iterations to the equation x^2- N = 0. If i denotes the iteration index, the correct iterative scheme will be

1 Marks GATE-CE-2011( )

[A] $x_{i+1} = \frac{1}{2}\left(x_i + \frac{N}{x_i}\right)$ [B] $x_{i+1} = \frac{1}{2}\left(x_i^2 + \frac{N}{x_i^2}\right)$
[C] $x_{i+1} = \frac{1}{2}\left(x_i + \frac{N^2}{x_i}\right)$ [D] $x_{i+1} = \frac{1}{2}\left(x_i - \frac{N}{x_i}\right)$

14) In the solution of the following set of linear equations by Gauss elimination using partial pivoting
5x+y+2z=34; 4y-3z=12; and 10x-2y+z=-4;
the pivots for elimination of x and y are

2 Marks GATE-CE-2009( )

[A] 10 and 4 [B] 10 and 2
[C] 5 and 4 [D] 5 and -4

15) A 2^{nd} degree polynomial, f(x), has values of 1, 4, and 15 at x = O, 1, and 2, respectively. The integral $\int_0^2 f(x)dx$ is to be estimated by applying the trapezoidal rule to this data. What is the error (defined as "true value - approximate value") in the estimate?

2 Marks GATE-CE-2006( )

[A] -4/3 [B] -2/3
[C] 0 [D] 2/3

16) The following equation needs to be numerically solved using the Newton- Raphson method
$x^3 + 4x - 9 = 0$ The iterative equation for this purpose is (k indicates the iteration level)

2 Marks GATE-CE-2007( )

[A] $x_{k+1} = \frac{2x_k^3+9}{3x_k^2+4}$ [B] $x_{k+1} = \frac{3x_k^3+4}{2x_k^2+9}$
[C] $x_{k+1} = x_k - 3x_k^2 + 4$ [D] $x_{k+1} = \frac{4x_k^2+3}{9x_k^2+2}$

17)Area bounded by the curve y = $x^2$and lines x = 4 and y = 0 is given by

1 Marks GATE-CE-1997( )

[A] 64 [B] 64/3
[C] 128/3 [D] 128/4

18)The extremum (minimum or maximum) point of a function f(x) is to be determined by solving $\frac{df(x)}{dx} = 0$using the Newton - Raphson method . Let $f(x) = x^3 - 6x$ and $x_0 = 1$be the initial guess of x . The value of x after two iterations $(x_2)$is

2 Marks GATE-EIN/IN-2011( )

[A] 0.0141 [B] 1.4142
[C] 1.4167 [D] 1.5000

19)For k = 0, 1, 2, ...,the steps of Newton-Raphson method for solving a non-linear equation is given as $x_{k+1} = \frac{2}{3}x_k + \frac{5}{3}x_k^{-2}$
Starting from a suitable initial choice as k tends to ∞, the iterate x_k tends.to

2 Marks GATE-EIN/IN-2006( )

[A] 1.7099 [B] 2.2361
[C] 3.1251 [D] 5.0000

20)Identify the Newton - Raphson iteration scheme for finding the square root of 2.

2 Marks GATE-EIN/IN-2007( )

[A] $x_{n+1} = \frac{1}{2}\left(x_n + \frac{2}{x_n}\right)$ [B] $x_{n+1} = \frac{1}{2}\left(x_n - \frac{2}{x_n}\right)$
[C] $x_{n+1} = \frac{2}{x_n}$ [D] $x_{n+1} = \sqrt{2 + x_n}$

21)Using secant method , the first approximation to the root of the equation $x^2 - 4x - 10 = 0$ with the initial estimates x_1 = 9 and x_2= 4 is ....

2 Marks ( )

[A] 5.9563 [B] 5.1111
[C] 5.5014 [D] 5.6182

22)Using Newton- Raphson method the first approximation to a real root of the equation $x^5 = 3$ is .... (take initial approximation $x_0 = 1$)

1 Marks ( )

[A] 1.1 [B] 1.2
[C] 1.3 [D] 1.4

23)Starting from x_0 = 1 one step of Newton- Raphson method , in solving the equation $x^3 + 3x - 7 = 0$ gives the next value $x_1$as

1 Marks ( )

[A] 0.5 [B] 1.5
[C] 0.75 [D] 1.25

24)Given that $\frac{dy}{dx} = x^2 + y^2$; y(0) = 1 , Find y(0.02) using modified method of Euler . (Take step size h = 0.02)

2 Marks ( )

[A] 1.0424 [B] 1.0204
[C] 1.0324 [D] 1.0414

25)Given that $\frac{dy}{dx} = (1 + xy);\ y(0) = 1$. Using Taylor's Series method find y(0,1) by considering the Taylor's Series expansion upto h^2 term (take h = 0.5)

2 Marks ( )

[A] 1.011 [B] 1.115
[C] 1.015 [D] 1.105

26)Given that $\frac{dy}{dx} = (1 + xy);\ y(0) = 1$. Using Taylor's Series method find y(0,1) by considering the Taylor's Series expansion upto h^2 term (take h = 0.5)

2 Marks ( )

[A] 1.011 [B] 1.115
[C] 1.015 [D] 1.105

27)The first approximation of $xe^{x^{-2}} = 0$, which lies in [0, 1] by using Regula - falsi method is

1 Marks ( )

[A] 0.7676 [B] 0.7353
[C] 0.7962 [D] 0.4632

28) The initial approximation of 3x = cos x + 1 is 1 , then the first approximation by using Newton- Raphson method is

2 Marks ( )

[A] 0.6338 [B] 0.6200
[C] 0.6093 [D] 0.6123

29) If 'n'is the number of sub-intervals then which of the following is not a value for 'n' to use Simpson's 3/8 rule

1 Marks ( )

[A] 6 [B] 9
[C] 12 [D] 16

30) Using the bisection method find the negative root of $x^3 - 4x + 9 = 0$ correct to the three decimal places

2 Marks ( )

[A] - 2.506 [B] - 2.706
[C] - 2.406 [D] None

31) Use Secant method to determine the root of the equation $cos\ x = xe^x$ with initial approximation $x_0 = 0$ and $x_1 = 1$. What is x_2?

2 Marks ( )

[A] 1 [B] - 2.178
[C] 0.3147 [D] 0.4467

32) Match the following and choose the correct combination

Group-I	Group-II
E. Newton-Raphson method	1. Solving nonlinear equations
F. Rung-kutta method	2. Solving linear simultaneous equations
G. Simpson's Rule	3. Solving ordinary differential equations
H. Gauss elimination	4. Numerical integration
	5. Interpolation
	6. Calculation of Eigen values

2 Marks GATE-ECE/TCE-2005( )

[A] E-6, F-1, G-5, H-3 [B] E-1, F-6, G-4, H-3
[C] E-1, F-3, G-4, H-2 [D] E-5, F-3, G-4, H-1

33) The equation $x^3 - x^2 + 4x - 4 = 0$ is to be solved using the Newton- Raphson method. If x = 2 is taken as the initial approximation of the solution, then the next approximation using this method will be

2 Marks GATE-ECE/TCE-2007( )

[A] 2/3 [B] 4/3
[C] 1 [D] 3/2

34) The recursion relation to solve x = e^{-x} using Newton Raphson method is

2 Marks GATE-ECE/TCE-2008( )

[A] $x_{n+1} = e^{-x_n}$ [B] $x_{n+1} = x_n - e^{-x_n}$
[C] $x_{n+1} = (1 + x_n)\dfrac{e^{-x_n}}{1 + e^{-x_n}}$ [D] $X_{n+1} = \dfrac{X_n^2 - e^{Xn}(1 + X_n) - 1}{X_n - e^{-Xn}}$

35)Function f is known at the following points:

x	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
f(x)	0	0.09	0.36	0.81	1.44	2.25	3.24	4.41	5.76	7.29	9.00

The value of $\int_0^3$ f(x)dx computed using the trapezoidal rule is

1 Marks GATE-CSE/IT-2013( )

[A] 8.983
[B] 9.003
[C] 9.017
[D] 9.045

36)Newton-Raphson method is used to compute a root of the equation x^2 - 13 = 0 with 3.5 as the initial value. The approximation after one iteration is

1 Marks GATE-CSE/IT-2010( )

[A] 3.575
[B] 3.676
[C] 3.667
[D] 3.607

37)A numerical solution of the equation $f(x) = x + \sqrt{x} - 3 = 0$ can be obtained using Newton - Raphson method. If the starting values is x = 2 for the iteration, the value of x that is to be used in the next step is

2 Marks GATE-ECE/TCE-2011( )

[A] 0.306
[B] 0.739
[C] 1.694
[D] 2.306

38)Let $x^2 - 117 = 0$. The iterative steps for the solution using Newton-Raphson's method is given by

2 Marks GATE-EEE-2009( )

[A] $x_{k+1} = \frac{1}{2}\left(x_k + \frac{117}{x_k}\right)$
[B] $x_{k+1} = x_k - \frac{117}{x_k}$
[C] $x_{k+1} = x_k - \frac{x_k}{117}$
[D] $x_{k+1} = x_k - \frac{1}{2}\left(x_k + \frac{117}{x_k}\right)$

39)The trapezoidal rule for integration gives exact result when the integrand is a polynomial of degree

1 Marks GATE-CSE/IT-2002( )

[A] 0 but not 1
[B] 1 but not 0
[C] 0 or 1
[D] 2

40) The Newton-Raphson iteration $X_{n+1} = \left(\frac{X_n}{2} + \frac{3}{(2X_n)}\right)$ can be used to solve the equation

2 Marks GATE-CSE/IT-2002( )

[A] x^2= 3
[B] x^3= 3
[C] x^2= 2
[D] x^3= 2

41)Which of the following is useful for solving algebraic equations

1 Marks ( )

[A] Euler's method
[B] Coulombs method
[C] Simpson's Rule
[D] Newton Raphson method

42)The N-R method for finding roots of f(x)=0 converging to the root

1 Marks ( )

[A] If f(x) is polynomial
[B] If $f'(x_0)$>0
[C] Converges always
[D] none of these

43)The N-R iteration formula for Square root of 'C' where c >0

1 Marks ( )

[A] $x_{n+1} = \frac{x_n^2 + c}{x_n}$
[B] $x_{n+1} = \frac{x_n^2 + c}{2x_n}$
[C] $x_{n+1} = \frac{x_n^2 - c}{2x_n}$
[D] $x_{n+1} = \frac{x_n^2 - c}{x_n}$

44) N-R formula $x_{n+1} = \frac{1}{2}\left(x_n + \frac{R}{x_n}\right)$ evaluates

1 Marks ( )

[A] Square of R
[B] Logarithm of R
[C] Reciprocal of R
[D] Square root of R

45) $f(x) = x^5 + x + 2 = 0$ has

1 Marks ( )

[A] All complex roots
[B] All real roots
[C] 1 real &4 complex roots
[D] 2 real roots &3 complex roots

46)

x	0	0.25	0.5	0.75	1.00
f(x)	1	0.9412	0.8	0.64	0.50

The value of the integral of the function between the limit 0 to 1 using simpson's rule is

2 Marks ( )

[A] 0.7854
[B] 2.3562
[C] 3.1416
[D] 7.5000

47) Newton-Raphson iteration formula for finding $\sqrt[3]{C}$, where c >0 is

1 Marks ( )

[A] $x_{n+1} = \frac{2x_n^3 + \sqrt[3]{c}}{3x_n^2}$
[B] $x_{n+1} = \frac{2x_n^3 - \sqrt[3]{c}}{3x_n^2}$
[C] $x_{n+1} = \frac{2x_n^3 + C}{3x_n^2}$
[D] $x_{n+1} = \frac{2x_n^2 - c}{3x_n^2}$

48) For $\frac{dy}{dx} = xy$ given that y = 1 at x = 0. Using Euler method taking the step size 0.1, the y at x = 0.4 is

2 Marks ( )

[A] 1.0611
[B] 2.4680
[C] 1.6321
[D] 2.4189

49) The root of the equation $x^3 - 4x - 9 = 0$ using the bisection method in 4 stages

2 Marks ( )

[A] 2.4065
[B] 2.6875
[C] 2.750
[D] None of the above

50) The Newton-Raphson iteration $x_{n+1} = \frac{x_n}{2} + \frac{3}{2x_n}$ can be used to solve the equation

1 Marks ( )

[A] $x^2 = 3$
[B] $x^3 = 3$
[C] $x^2 = 2$
[D] $x^3 = 2$

51) The 2's complement representation of (− 539)10 is hexadecimal is

1 Marks ( )

[A] ABE
[B] DBC
[C] DE5
[D] 9E7

52) The decimal value of 0.2

1 Marks ( )

[A] is equivalent to the binary value 0.1

[B] is equivalent to the binary value 0.01

[C] is equivalent to the binary value 0.00111.....
[D] cannot be represented precisely in binary

53) Minimum number of equivalent sub intervals needed to approximate $\int_1^2 x\, e^x\, dx$ to an accuracy at least $\frac{1}{3} \times 10^{-6}$ using Trapezoidal rule

2 Marks ( )

[A] 1000 e
[B] 100
[C] 100 e
[D] 1000

54) The order of error is the Simpson's rule for numerical integration with a step size h is

1 Marks GATE-ME-1997( )

[A] h
[B] h^2
[C] h^3
[D] h^4

Numerical Methods

55)Following are the values of a function y(x) : y(-1)=5 , y(o) , $y(1) = 8\frac{dy}{dx}$at x=0 as per Newton's central difference is

1 Marks GATE-ME-1999( )

[A] 0 [B] 1.5
[C] 2.0 [D] 3.0

56)Match the CORRECT pairs.

Numerical Integration Scheme	Order of Fitting Polynomial
P. Simpson's 3/8 Rule	1. First
Q. Trapezoidal Rule	2. Second
R. Simpson's 1/3 Rule	3. Third

1 Marks GATE-ME-2013( )

[A] P-2, Q-1, R-3 [B] P-3, Q-2, R-1
[C] P-1, Q-2, R-3 [D] P-3, Q-1, R-2

57)We wish to solve $x^2 - 2 = 0$ by Newton Raphson technique. Let the initial guess b $x_0 = 1.0$. Subsequent estimate of x (i.e. x_1) will be

2 Marks GATE-ME-1999( )

[A] 1.414 [B] 1.5
[C] 2.0 [D] none of these

58)The accuracy of Simpson's rule quadrature for a step size h is

1 Marks GATE-ME-2003( )

[A] $O(h^2)$ [B] $O(h^3)$
[C] $O(h^4)$ [D] $O(h^5)$

59)The values of a function f(x) are tabulated below

x	0	1	2	3
f(x)	1	2	1	10

Using Newton's forward difference formula, the cubic polynomial that can be fitted to the above data, is

2 Marks GATE-ME-2004( )

[A] $2x^3+7x^2-6x+2$ [B] $2x^3-7x^2-6x-2$
[C] x^3-7x^2-6x+1 [D] $2x^3-7x^2+6x+1$

60)Starting from $x_0 = 1$ one step of Newton- Raphson method in solving the equation $x^3 + 3x - 7$ gives the next value (x_1) as

2 Marks GATE-ME-2005( )

[A] x_1=0.5 [B] x_1=1.406
[C] x_1=1.5 [D] x_1=2

Statement for Linked answer Q61 and Q62 is given below

61)Given a >0, we wish to calculate its reciprocal value $\frac{1}{a}$by using Newton Raphson method for f(x) = 0

2 Marks GATE-CE-2005,GATE-CE-2005( )

[A] $X_{K+1} = \frac{1}{2}\left(X_K + \frac{a}{X_K}\right)$ [B] $X_{K+1} = \left(X_K + \frac{a}{2}X_K^2\right)$
[C] $X_{K+1} = 2X_K - aX_K^2$ [D] $X_{K+1} = X_K - \frac{a}{2}X_K^2$

62)For a = 7 and starting with xo= 0.2, the first two iterations will

2 Marks GATE-CE-2005( )

[A] 0.11, 0.1299 [B] 0.12, 0.1392
[C] 0.12, 0.1416 [D] 0.13, 0.1428

Numerical Methods

Key Paper

1.	D	2.	C	3.	D	4.	C	5.	A
6.	B	7.	C	8.	C	9.	B	10.	C
11.	D	12.	A	13.	A	14.	A	15.	A
16.	A	17.	B	18.	B	19.	A	20.	A
21.	B	22.	D	23.	B	24.	B	25.	D
26.	D	27.	B	28.	B	29.	D	30.	B
31.	B	32.	C	33.	B	34.	C	35.	D
36.	D	37.	C	38.	A	39.	C	40.	A
41.	D	42.	D	43.	B	44.	D	45.	C
46.	A	47.	C	48.	A	49.	B	50.	A
51.	C	52.	D	53.	A	54.	B	55.	B
56.	D	57.	D	58.	D	59.	D	60.	C
61.	C	62.	B						

Probability & Statistics

1) Let P(E) denote the probability of the event E.Given P(A) = 1 , P(B) = 1/2 , the values of P(A|B) and P(B|A) respectively are

1 Marks GATE-CSE/IT-2003( )

[A] 1/4, 1/2 [B] 1/2 , 1/4
[C] 1/2 , 1 [D] 1 , 1/2

2) A polynomial p(r) is such that p(0) = 5, p(1) = 4, p(2) = 9 and P(3) =20 The minimum degree it can have is

2 Marks ( )

[A] 1 [B] 2
[C] 3 [D] 4

3) Two events A and B with probability 0.5 and 0.7 respectively, have joint probability of 0.4 . The probability that neither A or B happens is

2 Marks DRDO-ECE/TCE-2008( )

[A] 0.2 [B] 0.4
[C] 0.6 [D] 0.8

4) There are two fair coins $\left((PHead) = P(Tail) = \frac{1}{2}\right)$ and a third biased coin where $P(Head) = \frac{1}{4}$ and $P(Tail) = \frac{3}{4}$. One coin is picked at random and tossed once a Head is obtained . The probability that the coin tossed is one of the fair coins is

2 Marks DRDO-ECE/TCE-2009( )

[A] $R_x(\tau) = \begin{cases} 1, & |\tau| \le 1 \\ 0, & otherwise \end{cases}$ [B] $R_x(\tau) = \frac{sin\tau}{2\tau}$
[C] $R_x(\tau) = 1 - sin^2 \tau$ [D] $R_x(\tau) = \begin{cases} 1-|\tau| & |\tau| \le 1 \\ 0, & otherwise \end{cases}$

5) A probability density function is given by
$p(x) = Ke^{-x^2/2} - \infty < x < \infty$
The value of K should be

2 Marks GATE-ECE/TCE-1997( )

[A] $\frac{1}{\sqrt{2\Pi}}$ [B] $\sqrt{\frac{2}{\Pi}}$
[C] $\frac{1}{2\sqrt{\Pi}}$ [D] $\frac{1}{\pi\sqrt{2}}$

6) The function $f(X,Y) = X^2Y - 3XY + 2Y + X$, has

2 Marks GATE-ECE/TCE-1993( )

[A] no local extremum [B] one local minimum but no local maximum
[C] one local maximum but no local minimum [D] one local minimum but no local minimum

7) An event has two possible outcomes with probability $P_1 = \frac{1}{2}$ and $P_2 = \frac{1}{64}$ The rate of information with 16 outcomes per second is:

1 Marks IES-ECE/TCE-2013( )

[A] $\frac{38}{4}$ bits/sec [B] $\frac{38}{64}$ bits/sec
[C] $\frac{38}{2}$ bits/sec [D] $\frac{38}{32}$ bits/sec

8) Two independent random variables X and y are uniformly distributed in the interval [-1 1]. The probability that max[X y] is less than 1/2 is

1 Marks GATE-EEE-2012,GATE-ECE/TCE-2012( )

[A] 3/4 [B] 9/16
[C] 1/4 [D] 2/3

9) Two coins are simultaneously tossed.The probability of two heads simultaneously appearing is

1 Marks GATE-CE-2010( )

[A] 1/8 [B] 1/6
[C] 1/4 [D] 1/2

10) In an experiment, positive and negative values are equally likely to occur. The probability of obtaining at most one negative value in five trials is

2 Marks GATE-CE-2012( )

[A] $\frac{1}{32}$ [B] $\frac{2}{32}$
[C] $\frac{3}{32}$ [D] $\frac{6}{32}$

11)There are two containers, with one containing 4 Red and 3 Green balls and the other containing 3 Blue and 4 Green balls. One ball is drawn at random from each container. The probability that one of the balls is Red and the other is Blue will be

1 Marks GATE-CE-2011( )

[A] 1/7 [B] 9/49
[C] 12/49 [D] 3/7

12)A classof first year B.Tech. students is composed of four batches A, B, C and D, each consisting of 30 students. It is found that the sessional marks of students in Engineering Drawing in batch C have a mean of 6.6 and standard deviation of 2.3. The mean and standard deviation of the marks for the entire class are 5.5 and 4.2, respectively. It is decided by the course instructor to normalize the marks of the students of all batches to have the same mean and standard deviation as that of the entire class. Due to this, the marks of a stu-dent in batch C are changed from 8.5 to

2 Marks GATE-CE-2006( )

[A] 6.0 [B] 7.0
[C] 8.0 [D] 9.0

13)The standard normal probability function can be approximated as

$$F(x_N) = \frac{1}{1 + exp(-1.7255 x_N |x_N|^{0.12})}$$

where x_N = standard normal deviate. If mean and standard deviation of annual precipitation are 102 em and 27 em respectively, the probability that the annual precipitation will be between 90 em and 102 em is

2 Marks GATE-CE-2009( )

[A] 66.7% [B] 50.0%
[C] 33.3% [D] 16.7%

14)If probability density function of a random variable X is
$f(x) = x^2 \text{ for } -1 \leq x \leq 1$, and
= 0 for any other value of x
Then, the percentage probability $p\left(-\frac{1}{3} \leq x \leq \frac{1}{3}\right)$ is

2 Marks GATE-CE-2008( )

[A] 0.247 [B] 2.47
[C] 24.7 [D] 247

15)A person on a trip has a choice between private car and public transport. The probability of using a private car is 0.45. While u s.ing the public transport, further choices available are bus and metro, out of which the probability of commuting by a bus is 0.55. In such a situation, the probability (rounded up to two decimals) of using a car, bu s and metro, respectively would be

2 Marks GATE-CE-2008( )

[A] 0.45, 0.30 and 0.25 [B] 0.45, 0.25 and 0.30
[C] 0.45, 0.55 and 0.00 [D] 0.45, 0.35 and 0.20

16)A hydraulic structure has four gates which operate independently. The probability of failure of each gate is 0.2. Given that gate 1 has failed, the probability that both gates 2 and 3 will fail is

2 Marks GATE-CE-2004( )

[A] 0.240 [B] 0.200
[C] 0.040 [D] 0.008

17)A box contains 10 screws, 3 of which are defective. Two screws are drawn at random with replacement. The probability that none of the two screws is defective will be

1 Marks GATE-CE-2003( )

[A] 100% [B] 50%
[C] 49% [D] None of these

18)The probability that the load on a scaffolding will exceed the design load of 3 tonnes is 0.15. At the same time, the probability that the strength of the scaffolding will be more than 3tonnes is 0.85. The probability that the scaffolding will fail is

2 Marks IES-CE-2002( )

[A] 0.2775 [B] 0.1275
[C] 0.0225 [D] 0.0020

19)The probability that the load on a scaffolding will exceed 2t is 0.15. The probability that the strength of the scaffolding will be more than 2t is 0.8. The probability of failure of the scaffolding will be

2 Marks IES-CE-2000( )

[A]0.68 [B]0.17
[C]0.12 [D]0.03

20)From the probability equation it is found that the most probable values of a series of errors arising out of observations of equal weightage are those for which the sum of their squares is

2 Marks IES-CE-2003( )

[A]Zero [B]infinity
[C]minimum [D]maximum

21)The box 1 contains chips numbered 3 , 6 , 9 , 12 and 15 . The box 2 contains chips numbered 6 , 11 , 16 , 21 and 26 . Two chips , one from each box , are drawn at random.The numbers . The numbers written on these chips are multiplied . The probability for the to be even number is

2 Marks GATE-EIN/IN-2011( )

[A]6/25 [B]2/5
[C]3/5 [D]19/25

22)A continuous random variable X has a probability density function f (x) = e^{-x} , 0 <x <∞. Then P{X >1} is

1 Marks GATE-EIN/IN-2013( )

[A]0.368 [B]0.5
[C]0.632 [D]1.0

23)A fair coin is tossed till a head appears for the first time . The probability that the number of required tosses is odd , is :

1 Marks GATE-EIN/IN-2012( )

[A]1/3 [B]1/2
[C]2/3 [D]3/4

24)Two dices are rolled simultaneously. The probability that the sum of digits on the top surface of the two dices is even is

2 Marks GATE-EIN/IN-2006( )

[A]0.5 [B]0.25
[C]0.167 [D]0.125

25)A random variable X has $\bar{X} = 0$ & $\sigma_x^2 = 1$. Form a new random variable Y = 2x + 1 . The values of $\bar{Y}$ & σ_Y^2 are :

2 Marks ISRO-ECE/TCE-2012( )

[A]0 &1 [B]1 &2
[C]1 &4 [D]None of these

26)Person X can solve 80 % of the ISRO and person Y can solve 60 % . The probability that at least one of them will solve a problem from the question paper , selected at random is :

2 Marks ISRO-ECE/TCE-2012( )

[A]0.48 [B]0.70
[C]0.88 [D]0.92

27)A man with n keys wants to open a clock . He tries his keys at random . The expected number of attempts for this success is (keys are replaced after every attempt)

2 Marks ISRO-ECE/TCE-2009( )

[A]n/2 [B]n
[C]$\sqrt{n}$ [D]None of the above

28)A husband and wife appear in an interview for two vacancies for same post . The probability of husband getting selected is 1/5 while the probability of wife getting selected is 1/7 . Then the probability that anyone of them getting selected is

2 Marks ISRO-ECE/TCE-2008( )

[A]11/35 [B]12/35
[C]1/35 [D]34/35

29)A bag contains eight white and six red marbles . The probability of drawing two marbles of same colour is

2 Marks ISRO-ECE/TCE-2007( )

[A]$\frac{8c_2.6c_2}{14c_2}$ [B]$\frac{8c_2}{14c_2}+\frac{6c_2}{14c_2}$
[C]$\frac{8c_2.6c_2}{14c_2.14c_2}$ [D]$\frac{8c_2}{14c_2}+\frac{6c_2}{12c_2}$

Probability & Statistics

30)A box contains 5 black and 5 red balls . Two balls are randomly picked one after another from the box, without replacement . The probability for both balls being red is

2 Marks ISRO-ECE/TCE-2006( )

[A] 1/90 [B] 1/5
[C] 19/90 [D] 2/9

31)If A and B are two events and P(A / B) = 1 then $P(B^c/A^c)$ is

1 Marks ( )

[A] $P(B^c)$ [B] $P(A^c)$
[C] 0 [D] 1

32)The regression equations are x + 2y = 3 ; 2x + 3y = 4 then E(X) , E(Y) are

1 Marks ( )

[A] - 1 , -2 [B] 1, -2
[C] 2, 1 [D] -1, 2

33)From 6 positive and 8 negative numbers , 4 numbers are chosen at random (without replacement) and multiplied , the probability that the product is a positive number is

2 Marks ( )

[A] $\frac{505}{1001}$ [B] $\frac{50}{1001}$
[C] $\frac{5}{101}$ [D] 55 / 1001

34)The probability of error on a single transmission in a digital communication system is 10^{-4}. Then the probability of more than three errors in 1000 transmissions is

2 Marks ( )

[A] 2×10^{-6} [B] 3×10^{-6}
[C] 4×10^{-6} [D] 5×10^{-6}

35)The regression equations are 2x + 3y = 6 ; 4x + 3y = 6 then the correlation coefficient is ....

2 Marks ( )

[A] 1 / 2 [B] 2
[C] - 1/2 [D] $1/\sqrt{2}$

36) A problem is given to three students A, B and C ; whose chances of solving it are $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ respectively . The probability that the problem will be solved by at least one of them is

1 Marks ( )

[A] $\frac{1}{4}$ [B] $\frac{2}{3}$
[C] $\frac{3}{4}$ [D] $\frac{4}{5}$

37)A and B are two independent events with $P(A\cup B)$ = 0.8 and P(A) = 0.5 then P(B) =

1 Marks ( )

[A] 0.3 [B] 0.4
[C] 0.1 [D] 0.6

38)A party of 'n' persons take their seats at random at a round table , then the probability that two specified persons do not sit together is

2 Marks ( )

[A] $\frac{2}{(n-1)}$ [B] $\frac{(n-3)}{(n-1)}$
[C] $\frac{(n-2)}{(n-1)}$ [D] $\frac{1}{(n-1)}$

39)A manufacturer knows that the condensers he makes contain on an average 1% defectives . He packs them in boxes of 100 . What is the probability that a box picked up at random will contain 3 or more faulty condensers ?

2 Marks ( )

[A] $1-\frac{3}{2}e^{-1}$ [B] $1-\frac{5}{2}e^{-1}$
[C] $1-\frac{2}{e}$ [D] $1-\frac{5}{e}$

40)In a series of independent trials with the result of each trial being classified either a success or failure , the probability of a success in a trail is 1/3 . The probability that the fifth trail results in the third success is

2 Marks ( )

[A] 8/81 [B] 40/243

[C] 1/27 [D] 4/243

41) A gambler has in his pocket a fair coin and a two headed coin . He selects one of the coins at random and flips it and it shows head. The probability that it is the fair coin is

2 Marks ( )

[A] 1/4 [B] 3/4
[C] 1/3 [D] 2/3

42) A man takes a step forward with probability 0.4 and backward with probability 0.6. The probability that at the end of 11 steps he is one step away from the starting point is

2 Marks ( )

[A] $\left(\frac{6}{25}\right)^5$ [B] $462\left(\frac{6}{25}\right)^5$
[C] $538\left(\frac{1}{25}\right)^5$ [D] $\left(\frac{1}{25}\right)^5$

43) Out of 10,000 families with 4 children each the probable number of families , all of whose children are daughters is

2 Marks ( )

[A] 1250 [B] 625
[C] 2500 [D] 9375

44) If A and B are mutually exclusive events, then

1 Marks ( )

[A] $P(A\cup B)=P(A).P(B)$ [B] $P(A\cap B)=P(A).P(B)$
[C] $P(A\cup B)=0$ [D] $P(A\cap B)=0$

45) The variance of the two-point distribution

X	A	b
F(x)	P	q

where p + q = 1 is

1 Marks ( )

[A] ap + bq [B] $\sqrt{ap+bq}$
[C] $pq(a-b)^2$ [D] 2pq

46) A fair dice is rolled twice. The probability that an odd number will follow an even number is

2 Marks GATE-ECE/TCE-2005( )

[A] 1/2 [B] 1/4
[C] 1/6 [D] 1/3

47) A probability density function is of the form

$$p(x)=Ke^{-\alpha x}, x\epsilon(-\infty,\infty)$$

The value of K is

2 Marks GATE-ECE/TCE-2006( )

[A] 0.5 [B] 1
[C] 0.5 α [D] α

48) An examination consists of two papers. Paper 1 and Paper 2. The probability of failing in Paper 1 is 0.3 and that in Paper 2 is 0.2. Given that a student has failed in Paper 2, the probability of failing in Paper 1 is 0.6. The probability of a student failing in both the papers is

2 Marks GATE-ECE/TCE-2007( )

[A] 0.5 [B] 0.18
[C] 0.12 [D] 0.06

49) A fair coin is tossed 10 times. What is the probability that Only the first two tosses will yield heads?

1 Marks GATE-ECE/TCE-2009( )

[A] $\left(\frac{1}{2}\right)^2$ [B] ${}^{10}C_2\left(\frac{1}{2}\right)^2$
[C] $\left(\frac{1}{2}\right)^{10}$ [D] ${}^{10}C_2\left(\frac{1}{2}\right)^{10}$

50)If P and Q are two random events, then the following is TRUE

2 Marks GATE-EEE-2005( )

[A] Independence of P and Q implies that probability (P ∩ Q) = 0
[B] Probability (P U Q) ≥ Probability (P) + Probability (Q)
[C] If P and Q are mutually exclusive, then they must be independent
[D] Probability (P ∩ Q) ≤ Probability (P)

51)A fair coin is tossed three times in succession. If the first toss produces a head, then the probability of getting exactly two heads in three tosses is

2 Marks GATE-EEE-2005( )

[A] 1/8
[B] 1/2
[C] 3/8
[D] 3/4

52)Two fair dice are rolled and the sum r of the numbers turned up is considered

2 Marks GATE-EEE-2006( )

[A] Pr (r >6)= $\frac{1}{6}$
[B] Pr (r/3 is an integer) = $\frac{5}{6}$
[C] Pr (r= 8| r/4 is an integer) = $\frac{5}{9}$
[D] Pr (r= 6| r/5 is an integer) = $\frac{1}{18}$

53)X is a uniformly distributed random variable that takes values between 0 and 1. The value of $E\{X^3\}$ will be

2 Marks GATE-EEE-2008( )

[A] 0
[B] 1/8
[C] 1/4
[D] 1/2

54)Consider an undirected random graph of eight vertices. The probability that there is an edge between a pair of vertices is 1/2. What is the expected number of unordered cycles of length three?

1 Marks GATE-CSE/IT-2013( )

[A] 1/8
[B] 1
[C] 7
[D] 8

55)A continuous random variable X has a probability density function $f(x) = e^{-x}, 0 < x < \infty$. Then P{X>1} is

1 Marks GATE-EEE-2013( )

[A] 0.368
[B] 0.5
[C] 0.632
[D] 1.0

56)The minimum Eigen value of the following matrix is

$$\begin{bmatrix} 3 & 5 & 2 \\ 5 & 12 & 7 \\ 2 & 7 & 5 \end{bmatrix}$$

1 Marks GATE-ECE/TCE-2013( )

[A] 0
[B] 1
[C] 2
[D] 3

57)Suppose p is number of cars per minute passing through a certain road junction between 5 PM and 6PM, and p has a Poisson distribution with mean 3. What is the probability of observing fewer than 3 cars during any given minute in this interval?

1 Marks GATE-CSE/IT-2013( )

[A] 8/(2e^3)
[B] 9/(2e^3)
[C] 17/(2e^3)
[D] 26/(2e^3)

58)Consider a random variable X that takes values + 1 and -1 with probability 0.5 each. The values of the cumulative distribution function F(x) at x = -1 and +1 are

1 Marks GATE-CSE/IT-2012( )

[A] 0 and 0.5
[B] 0 and 1
[C] 0.5 and 1
[D] 0.25 and 0.75

59)If the difference between the expectation of the square of random variable $(E[X^2])$ and the square of the expectation of the random variable $(E[X^2])$ is denoted by R then

1 Marks GATE-CSE/IT-2011( )

[A] R = 0
[B] R<0
[C] $R \geq 0$
[D] R>0

60)If two fair coins are flipped and at least one of the outcomes is known to be a head, what is the probability that both outcomes are heads?

1 Marks GATE-CSE/IT-2011( )

[A] 1/3 [B] 1/4
[C] 1/2 [D] 2/3

61)A fair coin is tossed independently four times. The probability of the event " the number of time heads shown up is more than the number of times tails shown up" is

2 Marks GATE-ECE/TCE-2010( )

[A] $\frac{1}{16}$ [B] $\frac{1}{8}$
[C] $\frac{1}{4}$ [D] $\frac{5}{16}$

62)Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared boolean variables S1 and S2 are randomly assigned.

Method used by PI	Method used by P2
while (S1 = = S2) ; Critica1 Section S1 = S2;	while (S1 != S2) ; Critica1 Section S2 = not (S1);

Which one of the following statements describes the properties achieved?

1 Marks GATE-CSE/IT-2010( )

[A] Mutual exclusion but not progress [B] Progress but not mutual exclusion
[C] Neither mutual exclusion nor progress [D] Both mutual exclusion and progress

63)Consider a company that assembles computers. The probability of a faulty assembly of any computer is p. The company therefore subjects each computer to a testing process. This testing process gives the correct result for any computer with a probability of q. What is the probability of a computer being declared faulty?

2 Marks GATE-CSE/IT-2010( )

[A] pq + (1 - p) (1 - q) [B] (1-q)p
[C] (1-p)q [D] pq

64)What is the probability that divisor of 10^{99} is a multiple of 10^{96}?

2 Marks GATE-CSE/IT-2010( )

[A] 1/625 [B] 4/625
[C] 12/625 [D] 16/625

65)A fair dice is tossed two times . The probability that the second toss results in a value that is higher than the first toss is

2 Marks GATE-ECE/TCE-2011( )

[A] 2/36 [B] 2/6
[C] 5/12 [D] 1/2

66)Two dice are rolled once. The probability that the sum on the dice is neither 9 nor 11 is

2 Marks ( )

[A] 5/6 [B] 1/3
[C] 2/3 [D] 1/2

67)Let P(E) denotes the probability of the event E. Given P(A) = 1, P(B)=1/2. The values of P(A/B) and P(B/A) respectively are

1 Marks ( )

[A] 1/4 , 1/2 [B] 1/2 , 1/4
[C] 1/2 , 1 [D] 1, 1/2

68)A speaks truth in 75% and in 80% of cases. In what percentage of cases are they likely to contradict each other narrating the same incident

2 Marks ( )

[A] 5% [B] 45%
[C] 35% [D] 15%

69)If 3 is the mean &3/2 is the standard deviation of a binomial distribution, then the distribution is

2 Marks ( )

[A] $\left(\frac{3}{4}+\frac{1}{4}\right)^{12}$ [B] $\left(\frac{1}{2}+\frac{3}{2}\right)^{12}$
[C] $\left(\frac{4}{5}+\frac{1}{5}\right)^{60}$ [D] $\left(\frac{1}{5}+\frac{4}{5}\right)^{5}$

70)If a fair coin is tossed four times. What is the probability that two heads and two tails will result ?

1 Marks ( )

[A] 3/8 [B] 1/2
[C] 5/8 [D] 3/4

71)→The probability that a man who is 'x' years old will die in a year is P. Then amongst 'n' persons $A_1, A_2, \ldots A_n$ each 'x' years old now, the probability that A_1 will die in one year is

2 Marks ( )

[A] $1/n^2$ [B] $1-(1-P)^n$
[C] $1/n^2[1-(1-P)^n]$ [D] $1/n[1-(1-P)^n]$

72)A can solve 90% of the problems given in a book and B can solve 70%. What is the probability that at least one of them will solve a problem, selected at random from the book?

1 Marks ( )

[A] 0.16 [B] 0.63
[C] 0.97 [D] 0.20

73)If the probabilities that A and B will die within a year are p and q respectively, then the probability that only one of them will be alive at the end of the year is

1 Marks ( )

[A] pq [B] p(1 −q)
[C] q(1 −p) [D] p+q−2pq

74)How many positive integers less than 100 are divisible by either 7 or 11

1 Marks ( )

[A] 2 [B] 22
[C] 20 [D] 23

75)Let a set A has a 4 elements then P(A) denotes the powerset of the set A. Now cardinality of P(A) is

1 Marks ( )

[A] 16 [B] 81
[C] 256 [D] 1

76)Which of the following statements is true in a year ?

1 Marks ( )

[A] Among any group of 366 people there must be at least one with the same birthday
[B] Among any group of 366 people there must be at least two with the same birthday
[C] Among any group of 366 people there must be at most one with the same birthday
[D] Among any group of 366 people there must be at most none with the same birthday

77)What is the probability that a card selected from a deck is a king ?

1 Marks ( )

[A] 1/4 [B] 1/52
[C] 4/52 [D] 2/52

78)What is the probability that a positive integer less than 100 selected at random is divisible by 25 ?

2 Marks ( )

[A] 3 / 100 [B] 4 / 100
[C] 2 / 100 [D] 5 / 100

79)What is the probability that a positive integer selected at random from the set of positive integers not exceeding 21 is divisible by 5 or 3 ?

1 Marks ( )

[A] 11/ 20 [B] 10 / 20
[C] 11 / 21 [D] 10 / 21

80)X is uniformly distributed random variable that takes values between 0 and 1. The value of $E(x^3)$ will be

1 Marks (   )

[A] 1/4 [B] 0
[C] 1/8 [D] 1/2

81)In answering a question on multiple choice test , the students either knows the answer or guesses the answer . Let ' P' be the probability that student knows the answer and i- p that of guessing the answer . Assume that the student guess the answer to a question will be correct with a probability 1/5 . What is the additional probability that the students knows the answer to a question given that he answered correctly .

1 Marks (   )

[A] $\frac{4P}{5P+1}$ [B] $\frac{5P}{4P+1}$
[C] $\frac{5P+1}{4}$ [D] $\frac{4P+1}{5}$

82)An unbalanced dice (with 6 faces, numbered from 1 to 6) is thrown. The probability that the face value is odd is 90% of the probability that the face value is even. The probability of getting any even numbered face is the same. If the probability that the face is even given that it is greater than 3 is 0.75, which one of the following options is closest to the probability that the face value exceeds 3 ?

2 Marks (   )

[A] 0.453 [B] 0.468
[C] 0.485 [D] 0.492

83)If 20 percent managers are technocrats, the probability that a random committee of 5 managers consists of exactly 2 technocrats is:

2 Marks GATE-ME-1993(   )

[A] 0.2048 [B] 0.4000
[C] 0.4096 [D] 0.9421

84)The manufactunng area of a plat is divided into four quadrants. Four machines have to be located, one in each quandrant. The total number of possible layouts is

1 Marks GATE-ME-1995(   )

[A] 4 [B] 8
[C] 16 [D] 24

85)A box contains 5 black balls and B red balls. A total of three balls are picked from the box one after another, without replacing them back. The probability of getting two black balls and one red ball is

2 Marks GATE-ME-1997(   )

[A] 3/8 [B] 2/15
[C] 15/28 [D] 1/2

86)The probability of a defective piece being produced in a manufacturing process is 0.01. The probability that out of 5 successive pieces, only one is defective is

2 Marks GATE-ME-1996(   )

[A] $(0.99)^4(0.01)$ [B] $(0.99)(0.01)^4$
[C] $5\times(0.99)(0.01)^4$ [D] $5\times(0.99)^4(0.01)$

87)The probability that two friends share the same birth-month is

1 Marks GATE-ME-1998(   )

[A] 1/6 [B] 1/12
[C] 1/144 [D] 1/24

88)The probability that a student knows the correct answer to a multiple choice question is $\frac{2}{3}$. If the student does not know the answer, then the student guesses the answer. The probability of the guessed answer being correct is $\frac{1}{4}$. Given that the student has answered the question correctly, the conditional probability that the student knows the correct answer is

2 Marks GATE-ME-2013(   )

[A] $\frac{2}{3}$ [B] $\frac{3}{4}$
[C] $\frac{5}{6}$ [D] $\frac{8}{9}$

89)In a manufacturing plant, the probability of making a defective bolt is 0.1. The mean and standard deviation of defective bolts in a total of 900 bolts are respectively

2 Marks GATE-ME-2000(   )

[A] 90 and 9 [B] 9 and 90
[C] 81 and 9 [D] 9 and 81

90)Suppose X is a normal random variable with mean 0 and variance 4. Then the mean of the absolute value of X is

2 Marks GATE-ME-1999,GATE-ME-1999( )

[A] $\frac{1}{\sqrt{2\pi}}$ [B] $\frac{2\sqrt{2}}{\sqrt{\pi}}$

[C] $\frac{2\sqrt{2}}{\sqrt{\pi}}$ [D] $\frac{2}{\sqrt{\pi}}$

91)Two dice are thrown. What is the probability that the sum of the numbers on the two dice is eight ?

1 Marks GATE-ME-2002( )

[A] 5/36 [B] 5/18

[C] 1/4 [D] 1/3

92)Manish has to travel from A to D changing buses at stops B and C enroute. The maximum waiting time at either stop can be 8 minutes each, but any time of waiting up to 8 minutes is equally likely at both places. He can afford up to 13 minutes of total waiting time, if he is to arrive at D on time. What is the probability that Manish will arrive late at D ?

2 Marks GATE-ME-2002( )

[A] 8/13 [B] 13/64

[C] 119/128 [D] 9/128

93)Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between successive arrivals. The length of a phone call is distributed exponentially with mean 3 minutes. The probability that an arrival does not have to wait before service is

2 Marks GATE-ME-2002( )

[A] 0.3 [B] 0.5

[C] 0.7 [D] 0.9

94)An unbiased coin is tossed three times. The probability that the head turns up in exactly two cases is

2 Marks GATE-ME-2001( )

[A] 1/9 [B] 1/8

[C] 2/3 [D] 3/8

95)The area enclosed between the parabola y = x^2 and the straight line y = x is

2 Marks GATE-ME-2003( )

[A] 1/8 [B] 1/6

[C] 1/3 [D] 1/2

96)A box contains 5 black and 5 red balls. Two balls are.randomly picked one after another from the box, without replacement. The probability for both balls being red is

2 Marks GATE-ME-2003( )

[A] 1/90 [B] 1/5

[C] 19/90 [D] 2/9

97)A flexible rotor-shaft system comprises of a 10 kg rotor disc placed in the middle of a mass-less shaft of diameter 30 mm and length 500 mm between bearings (shaft is being taken mass-less as the equivalent mass of the shaft is included in the rotor mass) mounted at the ends. The bearings are assumed to simulate simply supported boundary conditions. the shaft is made of steel fo; which the value of E is 2.1 x 10^{11} Pa. What is the critical speed of rotation of the shaft ?

2 Marks GATE-ME-2003( )

[A] 60 Hz [B] 90 Hz

[C] 135 Hz [D] 180 Hz

98)The parabolic are y = $\sqrt{x}$, 1 $\le$x $\le$2 is revolved around the x-axis. The volume of the solid of revolution is

1 Marks GATE-ME-2010( )

[A] π/4 [B] π/2

[C] 3π/4 [D] 3π/2

99)25 persons are in a room.15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is :

1 Marks GATE-ME-2010( )

[A] 2 [B] 17

[C] 13 [D] 3

100)Given digits 2, 2, 3, 3, 3, 4, 4, 4, 4 how many distinct 4 digit numbers greater than 3000 can be formed ?

2 Marks GATE-ME-2010( )

[A] 50 [B] 51
[C] 52 [D] 54

101)The area enclosed between the straight line y = x and the parabola y = x^2 in the x-y plane is

1 Marks GATE-ME-2012( )

[A] 1/6 [B] 1/4
[C] 1/3 [D] 1/2

102)A box contains 4 red balls and 6 black balls. Three balls are selected randomly from the box one after another, without replacement. The probability that the selected set contains one red ball and two black balls is

2 Marks GATE-ME-2012( )

[A] 1/20 [B] 1/12
[C] 3/10 [D] 1/2

103)If three coins are tossed simultaneously, the probability of getting at least one head

1 Marks GATE-ME-2009( )

[A] 1/8 [B] 3/8
[C] 1/2 [D] 7/8

104)An unbiased coin is tossed five times. The outcome of each toss is either a head or a tail. The probability of getting at least one head is

2 Marks GATE-ME-2011( )

[A] 1/32 [B] 13/32
[C] 16/32 [D] 31/32

105)From a pack of regular playing cards, two cards are drawn at random. What is the probability that both cards will be Kings, if the first card is NOT replaced ?

2 Marks GATE-ME-2004( )

[A] 1/26 [B] 1/52
[C] 1/169 [D] 1/221

106)A lot has 10% defective items. Ten items are chosen randomly from this lot. The probability that exactly 2 of the chosen items are defective is

1 Marks GATE-ME-2005( )

[A] 0.0036 [B] 0.1937
[C] 0.2234 [D] 0.3874

107)A box contains 20 defective items and 80 non-defective items. If two items are selected at random without replacement, what will be the probability that both items are defective ?

1 Marks GATE-ME-2006( )

[A] 1/5 [B] 1/25
[C] 20/99 [D] 19/495

108)A single die is thrown twice. What is the probability that the sum is neither 8 nor 9?

2 Marks GATE-ME-2005( )

[A] 1/9 [B] 5/36
[C] 1/4 [D] 3/4

109)Consider a continuous random variable with probability density function
f(t)=1+t for $-1 \leq t \leq 0$
The standard deviation of the random variable is

2 Marks GATE-ME-2006( )

[A] $\frac{1}{\sqrt{3}}$ [B] $\frac{1}{\sqrt{6}}$
[C] $\frac{1}{3}$ [D] $\frac{1}{6}$

110)A coin is tossed 4 times. What is the probability of getting heads exactly 3 times?

1 Marks GATE-ME-2008( )

[A] $\frac{1}{4}$ [B] $\frac{3}{8}$
[C] $\frac{1}{2}$ [D] $\frac{3}{4}$

111)Let X and Y be two independent random variables. Which one of the relations between expectation (E), variance (Var) and covariance (Cov) given below is FALSE ?

2 Marks GATE-ME-2007( )

[A] E(XY)= E(X)E(Y) [B] Cov (X,Y) = 0
[C] Var (X+Y) = Var (X)+Var(Y) [D] $E(X^2Y^2) = (E(X))^2(E(Y))^2$

112) Arrivals at a telephone booth are considered be Poisson with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with a mean of 3 minutes. The probability that a person arriving at the booth will have to wait, is

2 Marks IES-ME-2000( )

[A] 0.043 [B] 0.300
[C] 0.429 [D] 0.700

Statement for Linked answer Q113 and Q114 is given below

113) If A is a 3 x 3 matrix with entries from the set { - 1 , 0 , 1}
Then the total number of different matrices of order '3' , which are neither symmetric nor skew-symmetric is

2 Marks ( )

[A] $(3^3+1)(3^6+1)$ [B] $(3^3-1)(3^6-1)$
[C] $3^9-3^6-3^3-1$ [D] $3^9-3^6+3^3-1$

114) The probability that 'A' is neither symmetric nor skew symmetric is

2 Marks ( )

[A] $(1-3^{-6})(1-3^{-3})$ [B] $(1+3^{-6})(1-3^{-3})$
[C] $(1-3^{-6})(1+3^{-3})$ [D] $(1+3^{-6})(1+3^{-3})$

Statement for Linked answer Q115 and Q116 is given below

115) Consider the experiment of tossing a pair of unbiased dice
The probability that the sum of the two numbers is a prime number is

2 Marks ( )

[A] 7/9 [B] 5/12
[C] 4/9 [D] 7/12

116) If the experiment is repeated 180 times then how many times we can expect the sum to be a prime number

2 Marks ( )

[A] 140 [B] 105
[C] 80 [D] 75

Statement for Linked answer Q117 and Q118 is given below

117) The probability of a man hitting a target is 1/4 .
If he fires 4 times , then the probability of his hitting the target at least twice is

2 Marks ( )

[A] 189/256 [B] 196/256
[C] 67/256 [D] 64/256

118) The least number of times he must fire so that the probability of his hitting the target at least once is greater than 2/3 is

2 Marks ( )

[A] 3 [B] 4
[C] 5 [D] 6

Probability & Statistics

Key Paper

1.	D	2.	B	3.	A	4.	D	5.	A
6.	A	7.	A	8.	B	9.	C	10.	D
11.	C	12.	D	13.	B	14.	B	15.	C
16.	C	17.	D	18.	C	19.	D	20.	C
21.	D	22.	A	23.	C	24.	A	25.	C
26.	D	27.	B	28.	A	29.	B	30.	D
31.	D	32.	D	33.	A	34.	C	35.	D
36.	C	37.	D	38.	B	39.	B	40.	B
41.	C	42.	B	43.	C	44.	D	45.	C
46.	B	47.	C	48.	C	49.	C	50.	D
51.	B	52.	C	53.	C	54.	C	55.	A
56.	A	57.	C	58.	C	59.	C	60.	A
61.	D	62.	A	63.	A	64.	D	65.	C
66.	A	67.	D	68.	C	69.	A	70.	A
71.	D	72.	C	73.	D	74.	A	75.	A
76.	B	77.	C	78.	A	79.	D	80.	A
81.	B	82.	B	83.	A	84.	D	85.	C
86.	D	87.	B	88.	D	89.	A	90.	C
91.	A	92.	A	93.	A	94.	D	95.	C
96.	D	97.	B	98.	D	99.	D	100.	B
101.	A	102.	D	103.	D	104.	D	105.	D
106.	B	107.	D	108.	D	109.	B	110.	A
111.	D	112.	B	113.	B	114.	A	115.	B
116.	D	117.	C	118.	B				

Transforms

1) If X(Z) is the z-transform of $x[n]=\left(\frac{1}{2}\right)^{|n|}$ the ROC of X(z) is

2 Marks DRDO-ECE/TCE-2008( )

[A] |z|>2
[B] |z|<2
[C] $\frac{1}{2}<|z|<2$
[D] the entire z-plane

2) The two sided Laplace transform of $x(t)=e^{-3t}u(t)+e^{2t}u(-t)$

2 Marks DRDO-ECE/TCE-2009( )

[A] $X(s)=\frac{-5}{s^2+s-6}, -3<\sigma<2$
[B] $X(s)=\frac{-5}{s^2+s-6}, -2<\sigma<3$
[C] $X(s)=\frac{-5}{s^2+s-6}, -3<\sigma<-2$
[D] $X(s)=\frac{-5}{s^2+s-6}, -2<\sigma<3$

3) The z-transform X(z) of a sequence x[n] is given by

$$X(z)=\frac{z^{30}}{\left(z-\frac{1}{2}\right)(z-2)(z+3)}$$

If X(z) converges for |z|=1 then x[-18] is

2 Marks ( )

[A] $-\frac{1}{9}$
[B] $-\frac{2}{21}$
[C] $-\frac{1}{10}$
[D] $-\frac{2}{27}$

4) The z-transform X(z) of a real and right sided sequences x[n] has exactly two poles and one of them is at $z=e^{i\pi/2}$ and there are two zeroes at the origin . If X(1) =1 , which one of the following is TRUE?

2 Marks DRDO-ECE/TCE-2009( )

[A] $X(z)=\frac{2z^2}{(z-1)^2+2},\ ROC\ is \frac{1}{2}<|z|<1$
[B] $X(z)=\frac{2z^2}{(z)^2+1},\ ROC\ is\ |z|>\frac{1}{2}$
[C] $X(z)=\frac{2z^2}{(z-1)^2+2},\ ROC\ is\ |z|>1$
[D] $X(z)=\frac{2z^2}{(z)^2+1},\ ROC\ is\ |z|>1$

5) The Fourier Transform of $e^{\alpha t}$ cos (αt) is equal to

2 Marks GATE-ECE/TCE-1997( )

[A] $\frac{(s-\alpha)}{(s-\alpha)^2+\alpha^2}$
[B] $\frac{(s+\alpha)}{(s-\alpha)^2+\alpha^2}$
[C] $\frac{1}{(s-\alpha)^2}$
[D] None of the above

6) The inverse Laplace transform of the $\frac{s+5}{(s+1)(s+3)}$ is

2 Marks GATE-ECE/TCE-1996( )

[A] $2e^{-t}-e^{-3t}$
[B] $2e^{-t}+e^{-3t}$
[C] $e^{-t}-2e^{-3t}$
[D] $e^{-t}+e^{-3t}$

7) Which of the following Derichlets conditions are correct for convergence of Fourier transform of the function x(t)?
1. x(t) is square integrable
2. x(t) must be periodic
3. x(t) should have finite number of maxima and minima within any finite interval
4. x(t) should have finite number of discontinuities within any finite interval

1 Marks IES-ECE/TCE-2013( )

[A] 1, 2, 3 and 4 only
[B] 1, 2 and 4 only
[C] 1, 3 and 4 only
[D] 2, 3 and 4 only

8) If f(t) is a real and odd function, then its Fourier transform F(ω) will be

1 Marks IES-ECE/TCE-2013( )

[A] real and even function of ω
[B] real and odd function of ω
[C] imaginary and odd function of ω
[D] imaginary function of ω

9) For certain sequences which are neither absolutely summable nor square summable, it is possible to have a Fourier Transform (FT) representation if we

1 Marks IES-ECE/TCE-2013( )

[A] take short time FT
[B] evaluate FT only the real part of the sequence
[C] allow DTFT to contain impulses
[D] evaluate FT over a limited time span

Transforms

10)A unit impulse function $\delta(t)$ is defined by
1. $\delta(t)$ = 0 for all t except t = 0
2. $\int_{-\infty}^{\infty}\delta(t)$ =1
The Fourier transform F(ω) of $\delta(t)$ is

1 Marks IES-ECE/TCE-2013( )

[A] 1 [B] 1 / ω
[C] 0 [D] 1 / jω

11) if the z - transform of x(n) is x(z) = $\frac{z(8z-7)}{4z^2-7z+3}$, then the $\lim_{n\to\infty} x(n)$ is

1 Marks IES-ECE/TCE-2013( )

[A] 1 [B] 2
[C] ∞ [D] 0

12)For the discrete signal x[n] = a^nu[n] the z - transform is

1 Marks IES-ECE/TCE-2013( )

[A] z / z+a [B] z-a / z
[C] z / a [D] z / z-a

13)
If the power spectral density is $\frac{\eta}{2}\frac{W}{Hz}$ and the auto correlation function is defined by $R(\tau) = \frac{\eta}{2}\int_{-\infty}^{\infty} e^{j\omega\tau}$ df
The integral on the right represents the Fourier transform of

1 Marks IES-ECE/TCE-2013( )

[A] Delta function [B] Step function
[C] Ramp function [D] Sinusoidal function

14)Laplace transform for the function f(x) = cosh(ax) is

2 Marks GATE-CE-2009( )

[A] $\frac{a}{s^2 - a^2}$ [B] $\frac{s}{s^2 - a^2}$
[C] $\frac{a}{s^2 + a^2}$ [D] $\frac{s}{s^2 + a^2}$

15)
Transformation to linear form by substituting $v = y^{1-n}$ of the equation $\frac{dy}{dt} + p(t)y = q(t)y^n; n > 0$ will be

2 Marks GATE-CE-2005( )

[A] $\frac{dv}{dt} + (1-n)pv = (1-n)q$ [B] $\frac{dv}{dt} + (1-n)pv = (1+n)q$
[C] $\frac{dv}{dt} + (1+n)pv = (1-n)q$ [D] $\frac{dv}{dt} + (1+n)pv = (1+n)q$

16)If L defines the Laplace Transform of a function, L [sin (at)] will be equal to

2 Marks GATE-CE-2003( )

[A] $a/(s^2 - a^2)$ [B] $a/(s^2 + a^2)$
[C] $s/(s^2 + a^2)$ [D] $s/(s^2 - a^2)$

17)The Fourier series expansion of a symmetric and even function, f(x) where
$f(x) = 1 + (2X/\pi),\ -\pi < x < 0$
$= 1 - (2X/\pi),\ 0 < x < \pi$
will be

2 Marks GATE-CE-2003( )

[A] $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1 + cos n\pi)$ [B] $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1 - cos n\pi)$
[C] $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1 - sin n\pi)$ [D] $\sum_{n=1}^{\infty}(4/\pi^2n^2)(1 + sin n\pi)$

18)List of the following series as x approaches $\frac{\pi}{2}$ is
$f(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!}$

1 Marks GATE-CE-2001( )

[A] $\frac{2\pi}{3}$ [B] $\frac{\pi}{2}$
[C] $\frac{\pi}{3}$ [D] 1

19)The Laplace Transform of the following function is
$f(t) = \begin{cases} sint\ for\ 0 \le t \le \pi \\ 0\ for\ t > \pi \end{cases}$

Transforms

2 Marks GATE-CE-2002( )

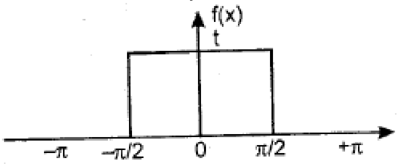
[A] $\frac{1}{1+s^2}$ for all $s>0$
[B] $\frac{1}{1+s^2}$ for all $s<\pi$
[C] $\frac{1+e^{-\pi s}}{1+s^2}$ for all $s>0$
[D] $\frac{e^{-\pi s}}{1+s^2}$ for all $s>0$

20) The inverse Laplace Transform of $\frac{1}{(s^2+2s)}$ is

2 Marks GATE-CE-2001( )

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

21) A function with a period 2π is shown below.



The Fourier series for this function is given by

1 Marks GATE-CE-2000( )

[A] $f(x)=\frac{1}{2}+\sum_{n=l}^{\infty}\frac{2}{n\pi}sin\frac{n\pi}{2}$
[B] $f(x)=\sum_{n=l}^{\infty}\frac{2}{n\pi}sin\frac{n\pi}{2}cos\ nx$
[C] $f(x)=\sum_{n=l}^{\infty}\frac{2}{n\pi}sin\frac{n\pi}{2}$
[D] $f(x)=\sum_{n=l}^{\infty}\frac{2}{n\pi}sin\frac{n\pi}{2}sin\ nx$

22) The Laplace transform of the function
f(t) = k, 0 <t <c
= 0,c <t <∞ is

2 Marks GATE-CE-1999( )

[A] $\frac{k}{s}e^{-\infty}$
[B] $\frac{k}{s}e^{\infty}$
[C] ke^{∞}
[D] $\left(\frac{k}{s}\right)(1-e^{\infty})$

23) Let $£F(s)=£[If(t)]$ denote the Laplac transform of the function f(t). Which of the following statements is correct ?

2 Marks GATE-CE-2000( )

[A] $£\left[\frac{df}{dt}\right]=\frac{1}{s}F(s)$; $£\int_0^t f(\tau)d\tau=sF(s)-f(o)$
[B] $£\left[\frac{df}{dt}\right]=sF(s)-F(0)$; $£\left[\int_0^t f(\tau)d\tau\right]=-\frac{dF}{ds}$
[C] $£\left[\frac{df}{dt}\right]=sF(s)-F(0)$; $£\left[\int_0^t f(\tau)d\tau\right]=F(s-a)$
[D] $£\left[\frac{df}{dt}\right]=sF(s)-F(0)$; $£\left[\int_0^t f(\tau)d\tau\right]=\frac{1}{s}F(s)$

24) The Laplace Transform of a unit step function $u_o(t)$, defined as
$u_o(t)=\{0\ for\ 1<a$
$=\{1\ for\ t>a$

1 Marks GATE-CE-1998( )

[A] $e^{-\alpha s}/s$
[B] $se^{-\alpha s}$
[C] $s-u(0)$
[D] $se^{-\alpha s}-1$

25) If the unilateral Laplace transform X(s) of a signal x(t) is $\frac{7s+10}{s(s+2)}$, then the initial and final values of the signal would be respectively.

1 Marks IES-EEE-2000( )

[A] 3.5 and 5
[B] zero and 7
[C] 5 and zero
[D] 7 and 5

26) The Fourier transform of a signal $x(t)=e^{-4|t|}$ is

2 Marks ISRO-ECE/TCE-2010( )

[A] $8/(16+\omega^2)$
[B] $-8/(16-\omega^2)$
[C] $4/(16+\omega^2)$
[D] $-4/(16+\omega^2)$

27) The region of the z plane for which $\left|\frac{z-a}{z+a}\right|=1(Re\ a\neq 0)$ is

2 Marks ISRO-ECE/TCE-2007( )

[A] x-axis
[B] y-axis
[C] The straight line z = | a|
[D] None of the above

Transforms

28)Laplace transform of t^2+2t+3 is

2 Marks ISRO-ECE/TCE-2007( )

[A] $\frac{-2}{s^3}-\frac{2}{s^2}-\frac{3}{s}$
[B] $\frac{2}{s^3}+\frac{2}{s^2}-\frac{3}{s}$
[C] $\frac{2}{s^3}+\frac{2}{s^2}+\frac{3}{s}$
[D] $\frac{-2}{s^3}+\frac{2}{s^2}-\frac{3}{s}$

29)The constant term in the Fourier expansion of f(x) if f(x) = 2 + x , -2 <x <0
= 2 - x , 0 <x <2

1 Marks ( )

[A] 2
[B] - 2
[C] 1
[D] 1/2

30)If Fourier Transform of F(x) is f(s) then the Fourier Transform of F(x - a) is

1 Marks ( )

[A] $e^{ias}f(s)$
[B] $e^{-ias}f(s)$
[C] 1/a f(s/a)
[D] 1/a f(a/s)

31)The Fourier Series of f(x) if f(x) = 1 0 <x <π
= 0 π<x <2π is

2 Marks ( )

[A] $\frac{1}{2}-\frac{2}{\pi}\sum_{n=1}^{\infty}\frac{sin\ nx}{n}$
[B] $\frac{1}{2}-\frac{4}{\pi}\sum_{n=1}^{\infty}\frac{sin\ nx}{n}$
[C] $\frac{1}{2}-\frac{2}{\pi}\sum_{n=1}^{\infty}\frac{cos\ nx}{n}$
[D] $\frac{1}{2}-\frac{4}{\pi}\sum_{n=1}^{\infty}\frac{cos\ nx}{n}$

32)The Laplace Transform of $\frac{sin\ ht}{t}$ is

2 Marks ( )

[A] $\frac{1}{2}\ log\left(\frac{S+1}{S-1}\right)$
[B] $\frac{1}{2}\ log\left(\frac{S-1}{S+1}\right)$
[C] $\frac{1}{4}\ log\left(\frac{S^2+1}{S^2-1}\right)$
[D] $\frac{1}{4}\ log\left(\frac{S^2-1}{S^2+1}\right)$

33)The Z-transform of $2^n.Sin(n\pi/2)$ is

2 Marks ( )

[A] $\frac{2z}{(4Z^2+1)}$
[B] $\frac{2z}{(Z^2+4)}$
[C] $\frac{2z}{(4Z^2-1)}$
[D] $\frac{2z}{(Z^2-4)}$

34)The Laplace Transform of t sint is

1 Marks ( )

[A] $\frac{-2s}{(s^2+1)^2}$
[B] $\frac{2s}{(s^2+1)^2}$
[C] $\frac{2s^2}{(s^2+1)^2}$
[D] $\frac{-2s^2}{(s^2+1)^2}$

35)Z-Transform of $n.z^n$ is ....

1 Marks ( )

[A] $\frac{2z}{(z-2)^2}$
[B] $\frac{2z}{(2z-1)^2}$
[C] $\frac{4z}{(z-2)^2}$
[D] $\frac{z}{(2z-1)^2}$

36)The half range cosine series of f(x) = x in the interval (0,2) is given by $f(x)=\frac{a_0}{2}+\sum a_n\ cos\left(\frac{n\pi x}{2}\right)$ then a_1=

2 Marks ( )

[A] 0
[B] $\frac{-2}{\pi^2}$
[C] $\frac{4}{\pi^2}$
[D] $\frac{-8}{\pi^2}$

37)The Inverse Laplace Transform of $\frac{1}{(s+2)^2}$ is ....

2 Marks ( )

[A] t^2e^{-2t}
[B] te^{-2t}
[C] te^{2t}
[D] (e^{-2t}/t)

Transforms

38) $Z^{-1}\left\{\frac{z}{(z+1)^2}\right\} = \ldots\ldots\ldots$

2 Marks ( )

[A] $(-1)^n n^2$ [B] $(-1)^n\ n$
[C] $(-1)^{n-1}\ n$ [D] $(-1)^{n-1}\ n^2$

39) If F{ f(x) } = g(s) then F { f(x-1) } = ...

2 Marks ( )

[A] $e^{-is}g(s)$ [B] $e^{is}g(s)$
[C] $-e^{is}g(s)$ [D] $-e^{-is}g(s)$

40) $L^{-1}\left\{\frac{e^{-as}}{s^2}\right\} = \ldots\ldots\ldots$

2 Marks ( )

[A] (t - a) H(t - a) [B] $(t-a)\ \delta(t-a)$
[C] $(t-a)^2\ H(t-a)$ [D] $(t-a)^2\ \delta(t-a)$

41) The Fourier series of the periodic function $f(x) = x + x^2, -\pi < x \leq \pi$ at x = π converges to

1 Marks ( )

[A] π [B] 2π
[C] π^2 [D] π+ π^2

42) $L^{-1}\left\{\frac{1}{s}\left(\frac{s-1}{s+1}\right)\right\} =$

1 Marks ( )

[A] $2e^t - 1$ [B] $2e^{-t} - 1$
[C] $1 + 2e^{-t}$ [D] $1 - 2e^{-t}$

43) If the Fourier transform of f(x) = F(s) then the Fourier transform of f(x) cos ax is

1 Marks ( )

[A] $\frac{1}{2}[F(s+a)+F(s-a)]$ [B] $\frac{1}{2}[f(s+a)-F(s-a)]$
[C] $\frac{1}{4}[f(s-a)-F(s+a)]$ [D] $\frac{1}{4}[F(s+a)-F(s-a)]$

44) If $F(t) = \begin{cases} t, & 0 < t < 1 \\ 1, & 1 < t \end{cases}$ Then L { F(t) } =

2 Marks ( )

[A] $\frac{1+e^{-s}}{s^2}$ [B] $\frac{1-e^{-s}}{s^2}$
[C] $\frac{1+e^{s}}{s^2}$ [D] $\frac{1-e^{s}}{s^2}$

45) If $f(x) = \left(1 - \left(\frac{x}{\pi}\right)\right)^2$ then the Fourier cosine transform of f(x) in (0, π) is

2 Marks ( )

[A] $\frac{2}{\pi n^2}$ [B] $\frac{2n^2}{\pi}$
[C] $\frac{\pi}{2n^2}$ [D] $\frac{\pi n^2}{2}$

46) The Z-transform of $\frac{1}{(n+1)(n+2)}$ is

2 Marks ( )

[A] $(z^2-z)\ log\left(1-\frac{1}{z}\right)+z$ [B] $(z^2-z)\ log\left(z-\frac{1}{z}\right)-z$
[C] $(z^2-z)\ log\left(1+\frac{1}{z}\right)+z$ [D] $(z^2-z)\ log\left(1+\frac{1}{z}\right)-z$

47) In what range should Re(s) remain so that the Laplace transform of the function $e^{(a+2)t+5}$ exits.

2 Marks GATE-ECE/TCE-2005( )

[A] Re (s) >a+2 [B] Re (s) >a+7
[C] Re (s) <2 [D] Re (s) >a + 5

48) For the equation $x''(t) + 3x'(t) + 2x(t) = 5$, the solution x (t) approaches which of the following values at t $\rightarrow \infty$?

2 Marks GATE-EEE-2005( )

[A] 0 [B] 5/2
[C] 5 [D] 10

Transforms

49)The differential equation dx/dt = (1-x)/τ is discretised using Euler's numerical integration method with a time step Δ T >0. What is the maximum permissible value of Δ T to ensure stability of the solution of the corresponding discrete time equation?

2 Marks GATE-EEE-2007( )

[A] 1
[B] τ/2
[C] τ
[D] 2 τ

50)The bisection method is applied to compute a zero of the function f(x) = $x^4 - x^3 - x^2 - 4$ in the interval [1,9]. The method converges to a solution after_______ iterations.

2 Marks GATE-CSE/IT-2012( )

[A] 1
[B] 3
[C] 5
[D] 7

51)If $f(t) = \frac{\omega}{S^2 + \omega^2}$, then the value of $\lim_{t \to \infty} f(t)$

2 Marks GATE-ECE/TCE-1998( )

[A] Cannot be dertermined
[B] is zero
[C] is unity
[D] is infinite

52)The trigonometric Fourier series of a periodic time function can have only

2 Marks GATE-ECE/TCE-1998( )

[A] cosine terms
[B] sine terms
[C] cosine and sine terms
[D] d.c. and cosine terms

53)The following $e^{-3t}(2\ cos\ 5t - 3\ sin\ 5t)$ of Laplace transform is

1 Marks ( )

[A] $\frac{2s - 9}{s^2 + 6s + 34}$
[B] $\frac{s}{s^2 + 6s + 34}$
[C] $\frac{1}{s^3 + 6s + 34}$
[D] $\frac{s^2}{s^3 + 6s + 34}$

54)F.S.T of $\frac{1}{x}$

1 Marks ( )

[A] $\sqrt{\frac{2}{\pi}}$
[B] $\sqrt{\frac{\pi}{2}}$
[C] $\frac{\pi}{2}$
[D] $\frac{2}{\pi}$

55)If $Z\{u_n\} = \frac{z^2 - 3z + 4}{(z-3)^3}$ for $|z| < 3$, then $u_3$is

2 Marks ( )

[A] 1
[B] 0
[C] 3
[D] 2

56)If $u_n = 2^n$; n <0
$= 3^n$; $n \geq 0$, then ROC is

1 Marks ( )

[A] $2 < |z| < 3$
[B] $|z| > 0$
[C] $|z| \geq 3$
[D] Does not exist

57)Apply the transform to $L\{t\ J_1(t)\}$is

1 Marks ( )

[A] $\frac{5}{(s^2+1)^{3/2}}$
[B] $\frac{1}{(s^2+1)^{3/2}}$
[C] $\frac{s}{(s^2+1)^{3/2}}$
[D] $\frac{1}{(s^2+2)^{3/2}}$

58)if $\int_0^{\infty} f(x) sin\ tx\ dx = \begin{cases} 1 & ;0 \leq t \leq 1 \\ 2 & ;1 \leq t \leq 2 \\ 0 & ;t \geq 2 \end{cases}$ then find f(x) ?

2 Marks ( )

[A] $\frac{2}{\pi}\left[\frac{-cosx}{x} + \frac{1}{x} - \frac{2cos2x}{x} - \frac{2cosx}{x}\right]$
[B] $\frac{2}{\pi}\left[\frac{-cosx}{x} + \frac{1}{x} - \frac{2cos2x}{x} + \frac{2cosx}{x}\right]$
[C] $\frac{2}{\pi}\left[\frac{1}{x} - \frac{2cos2x}{x} - \frac{3cosx}{x}\right]$
[D] $\frac{2}{\pi}\left[\frac{-cosx}{x} + \frac{1}{x} + \frac{2cos2x}{x} + \frac{2cosx}{x}\right]$

Transforms

59)What is answer of this equation $\int_0^\infty t\ e^{-3t}\ sint\ dt$ is

1 Marks ( )

[A] $\frac{1}{50}$
[B] $\frac{3}{60}$
[C] $\frac{3}{50}$
[D] $\frac{2}{25}$

60) $z^{-1}\left[\frac{z}{(z-1)^2}\right]$ is____

2 Marks ( )

[A] u(n)
[B] $n^2 u(n)$
[C] nu(n)
[D] $n^{-2} u(n)$

61)Solve the following function $L\frac{1}{t}\delta(t-a)$

2 Marks ( )

[A] $\frac{1}{a}e^{-as}$
[B] $\frac{1}{as}e^{-as}$
[C] $\frac{s}{a}e^{-as}$
[D] $\frac{2s}{a}e^{-as}$

62) $a^n * a^n$= _____

1 Marks ( )

[A] (n+1)u(n)
[B] $a^n(n+1)u(n)$
[C] $a^n u(n)$
[D] u(n)

63) $\int_0^\infty \frac{x^2}{(x^2+a^2)^2}dx = ?$

2 Marks ( )

[A] $\frac{\pi}{2}$
[B] $\frac{\pi}{a}$
[C] $\frac{\pi}{2a}$
[D] $\frac{\pi}{4a}$

64)What is inverse Fourier transform of $\frac{s+2}{s^2-4s+13}$is

2 Marks ( )

[A] $e^{2t}\ cos\ 3t + \frac{4}{3}\ e^{2t}\ sin\ 3t$
[B] $e^{2t}\ sin\ 3t + \frac{4}{3}\ e^{2t}\ cos\ 3t$
[C] $e^{2t}\ sin\ 2t + \frac{4}{3}\ e^{2t}\ cos\ 3t$
[D] $e^{2t}\ cos\ 2t + \frac{4}{3}\ e^{2t}\ sin\ 2t$

65)The voltage across an impedance in a network is V (s) = z (s) I (s) , where V(s) , Z(s) are the Laplace transforms of the corresponding time function v (t) , z (t) and i (t). The voltage v (t) is:

2 Marks GATE-ME-1991( )

[A] $V(t) = Z(t).V(t)$
[B] $V(t) = \int_0^1 i(t).z(t-\tau)d\tau$
[C] $V(t) = \int_0^1 i(t).z(t+\tau)d\tau$
[D] $V(t) = z(t) + i(t)$

66) $(s+1)^{-2}$is the Laplace transform of

1 Marks GATE-ME-1998( )

[A] t^2
[B] t^3
[C] e^{-2t}
[D] te^{-t}

67)Laplace transform of $(a+bt)^2$ where 'a' and 'b' are constants is given by

1 Marks GATE-ME-1999( )

[A] $(a+bs)^2$
[B] $\frac{1}{(a+bs)^2}$
[C] $\frac{a^2}{s} + \frac{2ab}{s^2} + \frac{2b^2}{s^3}$
[D] $\frac{a^2}{s} + \frac{2ab}{s^2} + \frac{b^2}{s^3}$

68)The Laplace transform of the function $sin^2 2t$, is

2 Marks GATE-ME-2000( )

[A] $\left[\frac{1}{2s} - \frac{s}{2(s^2+16)}\right]$
[B] $\frac{s}{s^2+16}$
[C] $\frac{1}{s} - \frac{s}{(s^2+4)}$
[D] $\frac{s}{s^2+4}$

69)Laplace transform of the function sin ωt is

2 Marks GATE-ME-2003( )

[A] $\frac{s}{s^2+\omega^2}$
[B] $\frac{\omega}{s^2+\omega^2}$
[C] $\frac{s}{s^2-\omega^2}$
[D] $\frac{\omega}{s^2-\omega^2}$

70)The Laplace transform of a function f(t) is $\frac{1}{s^2(s+1)}$. The function f(t) is

Transforms

2 Marks GATE-ME-2010( )

[A] t - 1 + e^{-t} [B] t + 1 + e^{-t}
[C] -1 + e^{-t} [D] 2t + e^{t}

71) The inverse Laplace transform of the function $F(s) = \frac{1}{s(s+1)}$ is given by

2 Marks GATE-ME-2012( )

[A] f(t) = sin t [B] f(t) = e^{-t}sin t
[C] f(t) = e^{-t} [D] f(t) 1-e^{-t}

72) The inverse Laplace transform of $\frac{1}{(s^2+s)}$ is

1 Marks GATE-ME-2009( )

[A] 1 + e^{t} [B] 1 - e^{t}
[C] 1 - e^{-t} [D] 1 + e^{-t}

73) A delayed unit step function is defined as

$$u(t-a) = \begin{cases} 0 \text{ for } t < a \\ 1 \text{ for } t \geq a \end{cases}.$$

Its Laplace transform is

2 Marks GATE-ME-2004( )

[A] $a.e^{-as}$ [B] $\frac{e^{-as}}{s}$
[C] $\frac{e^{as}}{s}$ [D] $\frac{e^{as}}{a}$

74) Eigenvalues of a matrix $S = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$ are 5 and 1. What are the eigenvalues of the matrix S^2=SS?

2 Marks GATE-ME-2006( )

[A] 1 and 25 [B] 6 and 4
[C] 5 and 1 [D] 2 and 10

75) If F(s) is the Laplace transform of function f (t), then Laplace transform of $\int_0^t f(\tau)d\tau$ is

2 Marks GATE-ME-2007( )

[A] 1/s F(s) [B] 1/s F(s) - f(0)
[C] sF(s) -f(0) [D] $\int F(s)ds$

76) Given $f(t) = L^{-1}\left[\frac{3s+1}{s^3+4s^2+(k-3)s}\right]$ If $\lim_{t\to\infty} f(t) = 1$ then value of "K" is

2 Marks ( )

[A] 4 [B] 2
[C] 3 [D] 1

77) If $x[n] = (1/3)^{|n|} - (1/2)^n u[n]$, then the region of convergence (ROC) of its Z-transform in the Z-plane will be

1 Marks GATE-ECE/TCE-2012,GATE-EEE-2012( )

[A] $\frac{1}{3} < |z| < 3$ [B] $\frac{1}{3} < |z| < \frac{1}{2}$
[C] $\frac{1}{2} < |z| < 3$ [D] $\frac{1}{3} < |z|$

Transforms

Key Paper

1.	C	2.	A	3.	B	4.	D	5.	A
6.	A	7.	C	8.	C	9.	C	10.	A
11.	A	12.	D	13.	A	14.	B	15.	A
16.	B	17.	B	18.	D	19.	C	20.	D
21.	A	22.	D	23.	D	24.	A	25.	D
26.	A	27.	B	28.	C	29.	C	30.	B
31.	A	32.	A	33.	B	34.	B	35.	A
36.	D	37.	B	38.	C	39.	A	40.	A
41.	D	42.	B	43.	A	44.	B	45.	A
46.	A	47.	A	48.	B	49.	D	50.	B
51.	A	52.	D	53.	A	54.	B	55.	B
56.	D	57.	B	58.	B	59.	C	60.	C
61.	A	62.	B	63.	D	64.	A	65.	A
66.	D	67.	C	68.	A	69.	B	70.	A
71.	D	72.	C	73.	B	74.	A	75.	A
76.	A	77.	C						

Old GATE Questions along with Key from 1991-2014
In CS & IT Department
(Questions of other Departments are also added for Combined Syllabus)

Index- Programming and Data Structures

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Data types and Size

1) The smallest integer than can be represented by an 8-bit number in 2’s complement form is

1 Marks GATE-CSE/IT-2013( )

[A] -256 [B] -128
[C] -127 [D] 0

2) Consider the following declaration of a two-dimensional array in C:
char a[100][100];
Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a [40][50] is

2 Marks GATE-CSE/IT-2002( )

[A] 4040 [B] 4050
[C] 5040 [D] 5050

3) Randomized quicksort is an extension of quicksort where the pivot is chosen randomly. What is the worst case complexity of sorting n numbers using randomized quicksort?

1 Marks GATE-CSE/IT-2001( )

[A] O(n) [B] O(n log n)
[C] O(n^2) [D] O(n!)

4) Consider any array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array (i≤n), the index of the parent is

1 Marks GATE-CSE/IT-2001( )

[A] i-1 [B] [i / 2]
[C] [i / 2] [D] (i+1) /2

5) Let A be a two-dimensional array declared as follows:
A: array [1 …. 10] [1 …… 15] of integer;
Assuming that each integer takes one memory locations the array is stored in row-major order and the first element of the array is stored at location 100, what is the address of the element A[i][j]?

2 Marks GATE-CSE/IT-1998( )

[A] 15i + j + 84 [B] 15j + i + 84
[C] 10i + j + 89 [D] 10j + i + 89

Data types and Size

Key Paper

1.	B	2.	B	3.	B	4.	B	5.	B

Functions & Parameters

Common Data for Q1 and Q2 is given below

Consider the following recursive C function that takes two arguments

```
unsigned  int foo (unsigned int n, unsigned int r )
{
if (n >0) return (n%r ) + foo (n / r, r ));
else return 0;
}
```

1) What is the return value of the function foo when it is called as foo (513, 2)?

2 Marks GATE-CSE/IT-2011(   )

[A] 9 [B] 8
[C] 5 [D] 2

2) What is the return value of the function foo when it is called as foo (345, 10) ?

2 Marks GATE-CSE/IT-2011(   )

[A] 345 [B] 12
[C] 5 [D] 3

Common Data for Q3 and Q4 is given below

Consider the following C code segment:

```
 int a,  b,  c = 0;
void prtFun(void);
main( )
{
static int a = 1;         /* Line 1 */
 prtFun( );
a + = 1;
 prtFun( )
 printf("\n od od ", a, b);
 }
 Void  prtFun(void)
 {
static int a=2;        /* Line 2 */
int b=1;
a+=++b;
 printf("\n od od ", a, b);
 }
```

3) What output will be generated by the given code segment if:
 Line 1 is replaced by auto int a = 1;
 Line 2 is replaced by register int a = 2;

2 Marks GATE-CSE/IT-2012,GATE-CSE/IT-2012(   )

[A] 3 1
4 1
4 2

[B] 4 2
6 1
6 1

[C] 4 2
6 2
2 0

[D] 4 2
4 2
2 0

4) What output will be generated by the given code segment?

2 Marks GATE-CSE/IT-2012(   )

[A] 3 1
4 1
4 2

[B] 4 2
6 1
6 1

[C] 4 2
6 2
2 0

[D] 3 1
5 2
5 2

Common Data for Q6 and Q5 is given below

Functions & Parameters

The following program fragment is written in a programming language that allows variables and dows not allow nested declarations of functions.

```
Global int I = 100, j=5;
Void P(x) {
        int I = 10;
        print(x + 10);
        i= 200;
        j=20;
        print (x);
}
Main ( ) { P(i+j);}
```

5) If the programming language uses static scoping and call by need parameter passing mechanism, the values printed by the above program are

2 Marks GATE-CSE/IT-2003( )

[A] 115, 220 [B] 25, 220
[C] 25,15 [D] 115,105

6) If the programming language uses dynamic scoping and call by name parameter passing mechanism, the values printed by the above program are

2 Marks GATE-CSE/IT-2003( )

[A] 115, 220 [B] 25,200
[C] 25,15 [D] 115, 105

7) Consider the following class definitions in a hypothetical object oriented language that supports inheritance and uses dynamic binding. The language should not be assumed to be either Java or C ++, thogh the syntax is similar

```
Class P {                       Class Q subclass of P {
        Void f(int i) {              void f(int i) {
                Print(i) ;                   print (2*i);
        }                            }
}                               }
```

Now consider the following program fragment :

```
P x = new Q ( ) ;
Q y = new Q ( ) ;
P z = new Q ( );
x.f(1); ((P)y).f(1);z.f*(1);
```

Here ((P)y) denotes a typecast of y to P. The output produced by executing the above program fragment will be

2 Marks GATE-CSE/IT-2003( )

[A] 1 2 1 [B] 2 1 1
[C] 2 1 2 [D] 2 2 2

8) Which of the following are true ?

(i) A programming language which does not permit global variables of any kind and has no nesting of procedures / functions, but permits recursion can be implemented with static storage allocation

(ii) Multi-level access link (or display arrangement is needed to arrange activation records only if the programming language being implemented has nesting of procedures/function

(iii) Recursion in programming languages cannot be implemented with dynamic storage allocation

(iv) Nesting of procedures/functions and recursion require a dynamic heap allocation scheme for activation records

(v) Programming languages which permit a function to return a function as its result cannot be implemented with a stack-based storage allocation scheme for activation records

2 Marks GATE-CSE/IT-2008( )

[A] (ii) and (v) only
[B] (i), (iii) and (iv) only
[C] (i), (ii) and (v)
[D] (ii), (iii) and (v) only

9) What value would the following function return for the input x = 95?

```
Function fun (x:integer):integer;
Begin
 If x >100 then fun : x – 10
Else fun : fun(fun (x + 11))
End;
```

2 Marks GATE-CSE/IT-1998( )

[A] 89
[B] 90
[C] 91
[D] 92

10) What is the value printed by the following C program?

```
#include <stdio.h >
int f(int * a, int n)
{
if (n <= 0)return 0;
else if(*a % 2 = = 0) return * a + f(a + 1, n - 1);
else return * a - f(a + 1, n - 1);
}
int main ( )
{
int a[ ] = {12, 7, 13, 4, 11, 6};
pr int f (" %d", f(a, 6));
return 0;
}
```

2 Marks GATE-CSE/IT-2010( )

[A] -9
[B] 5
[C] 15
[D] 19

11) Which is the most appropriate match for the items in the first column with the items in the second column

X. Indirect Addressing	I. Array implementation
Y. Indexed Addressing	II. Writing re-locatable code
Z. Base Register Addressing	III. Passing array as parameter

2 Marks GATE-CSE/IT-2001( )

[A] (X, III) (Y, I) (Z, II)
[B] (X, II) (Y, III) (Z, I)
[C] (X, III) (Y, II) (Z, I)
[D] (X, I) (Y, III) (Z, II)

12) A data structure is required for storing a set of integers such that each of the following operations can be done in (log n)time, where n is the number of elements in the set.
1. Delection of the smallest element
2. Insertion of an element if it is not already present in the set.
Which of the following data structures can be used for this purpose ?

2 Marks GATE-CSE/IT-2003( )

[A] A heap can be used but not a balanced binary search tree
[B] A balanced binary search tree can be used but not a heap
[C] Both balanced binary search tree and heap can be used
[D] neither balanced binary search tree nor heap can be used.

Functions & Parameters

13)Consider the following C-program

```
void foo (int n, int sum 0 ) {
    int k = 0, j=0;
if (n = = 0) return ;
k = n% 10; j=n/10;
   sum = sum + k;
   foo (j, sum);
printf("%d",k);
      }
  int main () {
int a= 2048, sum = 0;
      foo (a, sum);
pritf("%d/n", sum);
         }
```

What does the above program print ?

1 Marks GATE-CSE/IT-2005( )

[A] 8,4,0,2,14
[B] 8,4,0,2,0
[C] 2,0,4,8,14
[D] 2,0,4,8,0

14)Consider the followingC-program

```
double foo (double a); /*Line 1*/
 int main () {
 double da, db;
 //input da
 db =foo (da);
 }
double foo (double) {
   returna;
 }
```

The above code compliedwithout any error or warning. If Line 1 is deleted,The above code will show.

1 Marks GATE-CSE/IT-2005( )

[A] no compile warning or error
[B] some complier-warning not leading to unitended results
[C] Some complier-warning due to type-mismatch eventually leading to unitended results
[D] Complier errors

15)Choose the correct option to fill ? 1 and ? 2 so that the program below prints an input string in reverse order. Assume that the input string is terminated by a newline character.

```
void  reverse (void) {
  int c;
 if (?1) reverse ();
 ?2
}
main ( ) {
  print f("Enter Text'); printf ("\n");
  reverse( ); printf("\n");
}
```

1 Marks GATE-CSE/IT-2008( )

[A] ? 1 is (getchar ( ) ! = '\ n')
? 2 is getchar (c) ;
[B] ? 1 is (c= getchar ( )) ! = '\n')
? 2 is getchar (c)
[C] ? 1 is (c ! = ' \n ')
? 2 is putchar (c) ;
[D] ? 1 is ((c= getchar ( )) ! = ' \n')
? 2 is putchar (c) ;

Functions & Parameters

16)Consider the program below:

```
#include
int fun(int n,int*f_p) {
 int t, f;
 if(n <= 1) {
  *f_p =1 ;
 return  1 ;
}
 t= fun (n-1,f_p);
 f= t + *f_p
 *f_p=t;
 return f;
}
int  main ( ) {
  int x = 15 ;
  printf("%d\n",fun (5, &x));
  return  0;
}
```

The value printed is :

1 Marks GATE-CSE/IT-2009( )

[A] 6 | [B] 8
[C] 14 | [D] 15

17)What is the return value of f (p, p) if the value of p is initialized to 5 before the call? Note that the first parameter is passed by reference, whereas the second parameter is passed by value.

```
int f (int &x, int c) {
c = c − 1;
if (c == 0) return 1;
x = x + 1;
return f (x, c) * x;
}
```

2 Marks GATE-CSE/IT-2013( )

[A] 3024 | [B] 6561
[C] 55440 | [D] 161051

18)Consider the following function

```
int unknown (int n) {
int i, j, k = 0;
for (i = n / 2; i <= n; i + + )
for ( j = 2; j <= n; j = j * 2)
k = k + n / 2;
 return (k );
}
```

2 Marks GATE-CSE/IT-2013( )

[A] $\Theta(n^2)$ | [B] $\Theta(n^2 \log n)$
[C] $\Theta(n^3)$ | [D] $\Theta(n^3 \log n)$

Functions & Parameters

Key Paper

1.	D	2.	B	3.	D	4.	C	5.	D
6.	B	7.	B	8.	B	9.	C	10.	C
11.	A	12.	B	13.	D	14.	D	15.	D
16.	B	17.	B	18.	B				

Data Types

1) Consider the C program shown below :

```
# include <stdio.h >
# define print (x) printf ("%d", x)
int x;
void Q (int z ){
        z += x ; print (z);
}
Void p(int*y) {
  int  x = *y + 2;
   Q (x); *y=  - 1;
    Print (x);
}
 main (void) {
        x = 5;
        p(&x);
        print (x);
}
```

The output of this program is

2 Marks GATE-CSE/IT-2003( )

[A] 12 7 6 [B] 22 12 11

[C] 14 6 6 [D] 7 6 6

2) A single array A[1…MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables top 1 and top 2 (top 1 <top 2) point to the location of the topmost element in each of the stacks. If the space is to be used efficiently the condition for " stack full" is

1 Marks GATE-CSE/IT-2004( )

[A] (top 1 = MAXSIZE /2) and (top 2 = MAXSIZE/2 + 1) [B] top 1 + top 2 = MAXSIZE

[C] top 1 = MAXSIZE/2) or (top2 = MAXSIZE [D] top =1 top 2 – 1

3) A variant record in Pascal is defined by

```
type varirec          =     record
number : integer;
case (var1,var2) of
var1: (x,y : integer);
var2: (p.q.: real)
end
end
```

Suppose an array of 100 records was declared on a machine which uses 4 bytes for an integer and 8 bytes for a real. How much space would the compiler have to reserve for the array?

1 Marks GATE-CSE/IT-1995( )

[A] 2800 [B] 2400

[C] 2000 [D] 1200

Data Types

Key Paper

1.	**A**	**2.**	**D**	**3.**	**C**

Stacks, Queues

1) Let S be a stack of size n ≥ 1. Starting with the empty stack, suppose we push the first n natural numbers in sequence, and then perform n pop operations. Assume that Push and Pop operation take X seconds each, and Y seconds elapse between the end of one such stack operation and the start of the next operation. For m ≥ 1, define the stack-life of m cs the time elapsed from the end or Push (m) to the start of the pop operation that removes m from S. The average stack-life of an element of this stack is

2 Marks GATE-CSE/IT-2003( )

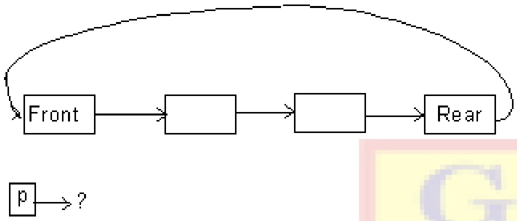
[A] n(X + Y) [B] 3Y + 2X
[C] n(X + Y) –X [D] Y + 2X

2) The best data structure to check whether an arithmetic expression has balanced parentheses is a

1 Marks GATE-CSE/IT-2004( )

[A] queue [B] stack
[C] tree [D] list

3) A circularly linked list is used to represent a queue. A single variable p is used to access the Queue. To which node should p point such that both the operations enQueue and deQueue can be performed in constant time ?



1 Marks GATE-CSE/IT-2004( )

[A] rear node [B] front node
[C] not possible with a single pointer [D] node next to front

4) Assume that the operators +, -, x are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x, +, -, The postfix expression corresponding to the infix expression a + b x c – d ^ e ^ f is

1 Marks GATE-CSE/IT-2004( )

[A] abc x + def ^f ^_ [B] abc x + de ^ f ^
[C] ab + c x d –e ^ f ^ [D] - + a x b c ^ ^ def

5) An implementation of a queue Q, using two stacks S1 and S2, is given below

```
void insert (Q,x) {
push (S1,x);
}
void  delete (Q,x) {
if (stack-empty (S2)) then
        if (stack-empty (S1) then {
         print (Q is empty");
         return :
}
else while(!(stack-empty) (S1))) {
x= pop (s1);
push  (S2,x);
}
x = pop(S2);
}
```

Let n insert and m(≤ n) delete operations be performed in an arbitrary order on an empty queue. Q. Let x and y be the number of push and pop operations performed respectively in the processes. Which one of the following is true for all m and n?

2 Marks GATE-CSE/IT-2006( )

[A] n + m ≤ x< 2n and 2m ≤ n +m [B] n + m ≤ x <2n and 2m ≤y ≤ 2n
[C] 2m ≤ x <2n and 2m ≤y≤ n+m [D] 2m≤ x< 2n and 2m ≤y ≤ 2n

6) The number of elements that can be sorted in Θ (logn) time using heap sort is

2 Marks GATE-CSE/IT-2013( )

[A] Θ (1) [B] $\Theta(\sqrt{logn})$

[C] $\Theta(\frac{log\ n}{log\ log\ n})$ [D] Θ (log n)

7) Which of the following scheduling algorithms is non-preemptive?

1 Marks GATE-CSE/IT-2002( )

[A] Round Robin [B] First-In First-Out

[C] Multilevel Queue Scheduling [D] Multilevel Queue Scheduling with Feedback

8) To evaluate an expression without any embedded function calls

2 Marks GATE-CSE/IT-2002( )

[A] One stack is enough [B] Two stacks are needed

[C] As many stacks as the height of the expression tree are needed [D] A Turning machine is needed in the general case

9) What is the minimum number of stacks of size n required to implement a queue of size n?

2 Marks GATE-CSE/IT-2001( )

[A] One [B] Two

[C] Three [D] Four

10) Consider the following C code segment.

```
 for (i=0 i
         for(J=0; J< N; J ++)
              if (i%2)
                   { x + = (4* j+5 x i);
                   Y + = ( 7 + 4 * j);
                   }
              }
}
```

Which one of the following is false ?

2 Marks GATE-CSE/IT-2006( )

[A] The code contains loop-in variant computation

[B] There is scope of common sub-expression elimination in this code

[C] There is scope strength reduction in this code

[D] There is scope of dead code elimination in this code.

11) Consider the following C code segment.

```
 for (i=0 i
         for(J=0; J< N; J ++)
              if (i%2)
                   { x + = (4* j+5 x i);
                   Y + = ( 7 + 4 * j);
                   }
              }
}
```

Which one of the following is false ?

2 Marks GATE-CSE/IT-2006( )

[A] the code contains loop-in variant computation

[B] there is scope of common sub-expression elimination in this code

[C] There is scope strength reduction in this code

[D] There is scope of dead code elimination in this code.

12) Which of the following is essential for converting an infix expression to the postfix form efficiently?

1 Marks GATE-CSE/IT-1997( )

[A] An operator stack [B] An operand stack

[C] An operand stack and an operator stack [D] A parse tree

Stacks, Queues

13)Consider the following statements :
(i) First-in-first out types of computations are efficiently supported by STACKS.
(ii) Implementing LISTS on linked lists is more efficient than implementing LISTS on an array for almost all the basic LIST operations.
(iii) Implementing QUEUES on a circular array is more efficient than implementing QUEUES on a linear array with two indices.
(iv) Last-in-first-out type of computations are efficiently supported by QUEUES.

2 Marks GATE-CSE/IT-1996( )

[A] (ii) and (iii) are true
[B] (i) and (ii) are true
[C] (iii) and (iv) are true
[D] (ii) and (iv) are true

14)Which of the following statements is true?

1 Marks GATE-CSE/IT-1995( )

[A] ROM is a Read/Write memory
[B] PC points to the last instruction that was executed
[C] Stack works on the principle of LIFO
[D] All instructions affect the flags

15)Thepostfixexpressionfortheinfixexpression _A _+ _B _* (_C _+ _D)_/ _F _+ _D _* _E _i_s

2 Marks GATE-CSE/IT-1995( )

[A] AB+CD+*F/D+E*
[B] ABCD+*F/DE*++
[C] A*B+CD/F*DE++
[D] A+*BCD/F* DE++

16)Which of the following permutations can be obtained in the output (in the same order) using a stack assuming that the input is the sequence 1, 2, 3, 4, 5 in that order?

1 Marks GATE-CSE/IT-1994( )

[A]) 3, 4, 5, 1, 2
[B] 3, 4, 5, 2, 1
[C] 1, 5, 2, 3, 4
[D] 5, 4, 3, 1, 2

17)The following sequence of operations is performed on a stack:
PUSH (10), PUSH (20), POP, PUSH (10), PUSH (20), POP, POP, POP,PUSH (20), POP
The sequence of values popped out is:

1 Marks GATE-CSE/IT-1991( )

[A] 20,10,20,10,20
[B] 20,20,10,10,20
[C] 10,20,20,10,20
[D] 20,20,10,20,10

Statement for Linked answer Q18 and Q19 is given below

18)A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Q.
Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

2 Marks GATE-CSE/IT-2010,GATE-CSE/IT-2010( )

[A] 46, 42, 34, 52, 23, 33
[B] 34, 42, 23, 52, 33, 46
[C] 46, 34, 42, 23, 52, 33
[D] 42, 46, 33, 23, 34, 52

19)A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Q: How many different insertion sequences of the key values using the same hash function and linear probing will result in the hash table shown above?

2 Marks GATE-CSE/IT-2010( )

[A] 10 [B] 20

[C] 30 [D] 40

Stacks, Queues

Key Paper

1.	D	2.	B	3.	C	4.	A	5.	A
6.	C	7.	B	8.	A	9.	B	10.	D
11.	D	12.	A	13.	A	14.	C	15.	B
16.	B	17.	B	18.	C	19.	C		

Linked Lists

1) The following C function takes a singly-linked list of integers as a parameter and rearranges the elements of the list. The function is called with the list containing the integers 1,2,3,4,5,6,7 in the given order. What will be the contents of the list after the function completes execution?

```
struct node {
  int value ;
  struct node * next ;
};
void rearrange (struct node * list) {
    struct node *p, *q;
    int temp;
    if (! list || ! list - >next) return ;
    p= list ; q = list -> next;
   while (q) {
                temp=p -> value ;p -> value = q -> value;
                q - >value=temp ; p= q-> next ;
                q = p?p -> next : 0;
  }
}
```

1 Marks GATE-CSE/IT-2008( )

[A] 1,2,3,4,5,6,7 [B] 2,1,4,3,6,5,7

[C] 1,3,2,5,4,7,6 [D] 2,3,4,5,6,7,1

2)

The following C function takes a simply-linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```
 type defstruct node {
int value;
struct node *next;
}       Node;
Node *move_to_front(Node *head) {
 Node *p, *q;
if ((head = = NULL: || (head->next = = NULL)) return head;
 q = NULL; p = head;
while (p-> next !=NULL) {
 q=P;
p=p->next;
}
______________________

 return head;

}
```

Choose the correct alternative to replace the blank line.

2 Marks GATE-CSE/IT-2010( )

[A] q = NULL; p->next = head; head = p; [B] q->next = NULL; head = p; p->next = head;

[C] head = p; p->next = q; q->next = NULL; [D] q->next = NULL; p->next = head; head = p;

Linked Lists

3) The program below uses six temporary variables a, b, c, d, e, f.

```
a = 1
b = 10
c = 20
d = a + b
 e = c + d
 f = c + e
b = c + e
e = b + f
d = 5 + e
return d + f
```

Assuming that all operations take their operands from registers, what is the minimum number of registers needed to execute t h i s program without spilling?

2 Marks GATE-CSE/IT-2010( )

[A] 2 [B] 3
[C] 4 [D] 6

4) In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is

1 Marks GATE-CSE/IT-2002( )

[A] log n [B] n/2
[C] $log_2^n - 1$ [D] n

5) Which of the following is NOT an advantage of using shared,dynamically linked libraries as opposed to using statically linked libraries?

2 Marks GATE-CSE/IT-2003( )

[A] Smaller sizes of executable [B] Lesser overall page fault rate in the system
[C] Faster program startup [D] Existing programs need not e relinked to take advantage of newer versions of libraries

6) A language with string manipulation facilities uses the following operations
head(s): first character of a string
tail(s): all but the first character of astring
concat(s1,s2):s1 s2
for the string acbc what will be the output of
concat(head(s), head(tail(tail(s))))

2 Marks GATE-CSE/IT-1995( )

[A] ac [B] bc
[C] ab [D] cc

7) Linked lists are not suitable data structures of which one of the following problems?

1 Marks GATE-CSE/IT-1994( )

[A] Insertion sort [B] Binary search
[C] Radix sort [D] Polynomial manipulation

Linked Lists

Key Paper

1.	B	2.	D	3.	C	4.	D	5.	B
6.	C	7.	B						

Trees & Graphs

Common Data for Q1 and Q2 is given below

A 3-ary max heap is like a binary max heap, but instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array as follows. The root is stored in the first location, a[0], nodes in the next level, from left to right, is stored from a [1] to a [3]. The nodes from the second level of the tree from left to right are stored from a[4] location onward. An item x can ge inserted into a 3-ary heap containing n items by [placing x in the location a [n] and pushing it ip the tree to satisfy the heap property.

1) Which one of the following is a valid sequence of elements in an array representing 3-ary max heap ?

2 Marks ( )

[A] 1,3,5,6,8,9 [B] 9,6,3,1,8,5
[C] 9,3,6,8,5,1 [D] 9,5,6,8,3,1

2) Suppose the elements 7,2,10, and 4 are insetrted, in that order, into the vlaid 3-ary max heap found in the above question, Q.87. Which one of the following is the sequence of items in the arrary representing the resultant heap ?

2 Marks GATE-CSE/IT-2006( )

[A] 10,7,9,8,3,1,5,2,6,4 [B] 10,9,8,7,6,5,4,3,2,1
[C] 10,9,4,5,7,6,8,2,1,3 [D] 10,8,6,9,7,2,3,4,1,5

3) The following postfix expression with single digit operands in evaluated using a stack

8 2 3 ^ / 2 3* + 5 1* -

Note that ^ is the exponentation operator. The top two elements of the stack after the first* is evaluated are

2 Marks GATE-CSE/IT-2007( )

[A] 6, 1 [B] 5,7
[C] 3,2 [D] 1,5

4) What is the maximum height of any AVL-tree with 7 nodes ? Assume that the height of a tree with a single node is 0.

2 Marks GATE-CSE/IT-2009( )

[A] 2 [B] 3
[C] 4 [D] 5

5) A process executes the code
fork ();
fork ();
fork ();
The total number of child processes created is

1 Marks GATE-CSE/IT-2012( )

[A] 3 [B] 4
[C] 7 [D] 8

6) The worst case running time to search for an element in a balanced binary search tree with n2n elements is

2 Marks GATE-CSE/IT-2012( )

[A] Θ (n logn) [B] $\Theta(n2^n)$
[C] Θ (n) [D] Θ (logn)

Trees & Graphs

7) The height of a tree is defined as the number of edges on the longest path in the tree. The function shown in the pseudocode below is invoked as height (root) to compute the height of a binary tree rooted at the tree pointer root.

```
int height (treeptr n)
{ if(n==NULL) return -1;
if (n → left == NULL )
if (n → right == NULL ) return 0;
else return [B1];            // Box 1
else { h1 = height (n-->left);
if (n → right == NULL ) return (1 + h1);
else {h2 = height (n → right);
return [B2];                 //Box 2
}
}
}
```

The appropriate expressions for the two boxes B1 and B2 are

2 Marks GATE-CSE/IT-2012( )

[A] B1 : (1 + height (n → right))
B2 : (1 + max (h1,h2))

[B] B1 : (height (n → right))
B2 : (1 + max (h1,h2))

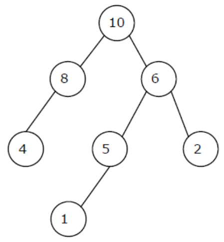
[C] B1 : height (n → right)
B2 : max (h1,h2)

[D] B1 : (1 + height (n → right))
B2 : max (h1,h2)

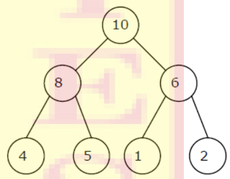
8) A max-heap is a heap where the value of each parent is greater than or equal to the value of its children. Which of the following is a max-heap?

1 Marks GATE-CSE/IT-2011( )

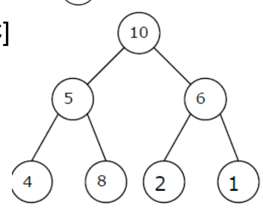
[A]



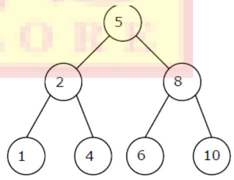
[B]



[C]



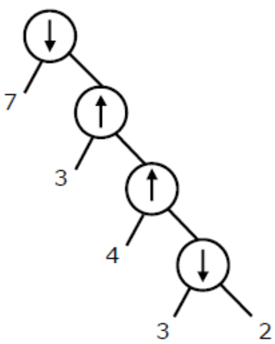
[D]



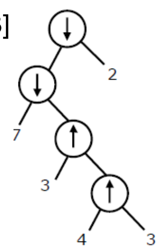
9) Consider two binary operators '↑' and '↓' with the precedence of operator ↓ being lower than that of the operator ↑. Operator ↑ is right associative while operator ↓, is left associative. Which one of the following represents the parse tree for expression (7 ↓ 3 ↑ 4 ↑ 3 ↓ 2) ?

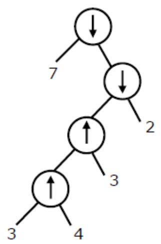
2 Marks GATE-CSE/IT-2011( )

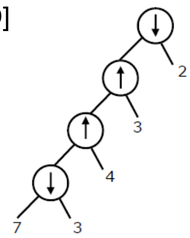
[A]



[B]



[C]


[D]


10)We are given a set of n distinct elements and an unlabeled binary tree with n nodes. In how many ways can we populate the tree with the given set so that it becomes a binary search tree?

1 Marks GATE-CSE/IT-2011( )

[A] 0 [B] 1
[C] n! [D] $\frac{1}{n+1}\cdot {}^{2n}C_n$

11)In a binary tree with n nodes, every node has an odd number of descendants. Every node is considered to be its own descendant. What is the number of nodes in the tree that have exactly one child?

2 Marks GATE-CSE/IT-2010( )

[A] 0 [B] 1
[C] (n-1) / 2 [D] n-1

12)The number of leaf nodes in a rooted tree of n nodes, with each node having 0 or 3 children is:

2 Marks GATE-CSE/IT-2002( )

[A] n/2 [B] (n-1) / 3
[C] (n-1) / 2 [D] (2n+1) / 3

13)Consider the following algorithm for searching for a given number x in an unsorted array A[l..n] having n distinct values:
1. Choose an i uniformly at random from l..nl
2. If A[i]=x then Stop else Goto 1;
Assuming that x is present A, what is the expected number of comparisons made by the algorithm before it terminates?

2 Marks GATE-CSE/IT-2002( )

[A] n [B] n-1
[C] 2n [D] n/2

14)The preorder traversal sequence of a binary search tree is 30, 20, 10, 15, 25, 23, 39, 35, 42. Which one of the following is the postorder traversal sequence of the same tree?

2 Marks GATE-CSE/IT-2013( )

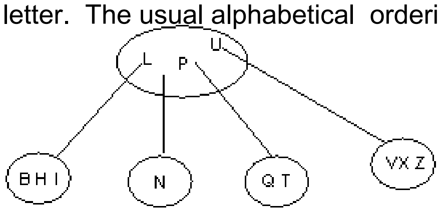
[A] 10, 20,15, 23, 25, 35, 42, 39, 30 [B] 15,10, 25, 23, 20, 42, 35, 39, 30
[C] 15, 20,10, 23, 25, 42, 35, 39, 30 [D] 15,10, 23, 25, 20, 35, 42, 39, 30

15)A binary search tree is generated by inserting in order the following integers:
50, 15, 62, 5, 20, 58, 91, 3, 8, 37, 60, 24
The number of nodes in the left subtree and right subtree of the root respectively is

2 Marks GATE-CSE/IT-1996( )

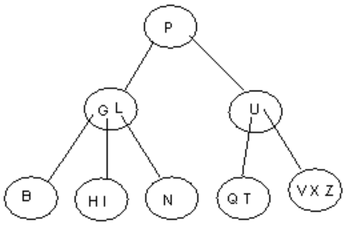
[A] (4,7) [B] (7,4)
[C] (8,3) [D] (3,8)

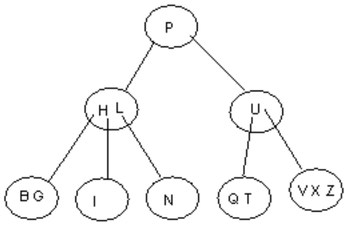
16)Consider the following 2-3-4 tree(i.e., B-tree with a minimum degree of two) in which each data item is a letter. The usual alphabetical ordering of letters is used in constructing the tree

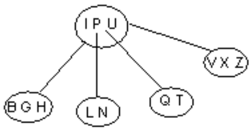


What is the result of inserting G in the above tree ?

2 Marks GATE-CSE/IT-2003( )

[A]


[B]


[C]


[D]None of the above

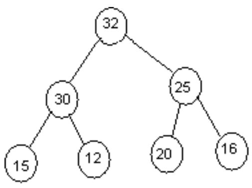
17)The following numbers are insert into an empty binary search tree in the given order: 10,1,3,5,15,12,16. What is the height of the binary search tree(the height is the maximum distance of a leaf node from the root)?

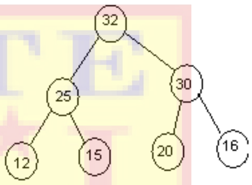
1 Marks GATE-CSE/IT-2004( )

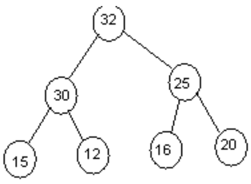
[A]2 [B]3
[C]4 [D]6

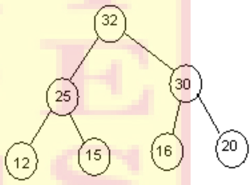
18)The elements 32, 15,20,30,12,35,16 are inserted one by one in the given order into a maxHeap. The resultant maxHeap is

1 Marks GATE-CSE/IT-2004( )

[A]


[B]


[C]


[D]


19)Postorder traversal of a given binary search tree, T produces the following sequence of keys
10,9,23,22,27,25,15,50,95,60,40,29
Which one of the following sequences of keys can be the result of an inorder traversal of the tree T ?

2 Marks GATE-CSE/IT-2006( )

[A]9,10,15,22,23,25,27,29,40,50,60,95 [B]9,10,15,22,40,50,60,95,23,25,27,29
[C]29,15,9,10,25,22,23,27,40,0,50,95 [D]95,50,60,40,27,23,22,25,10,0,15,29

Statement for Linked answer Q20 and Q21 is given below

20)Consider a binary max-heap implemented using an array
Which one of the following array represents a binary max-heap ?

2 Marks GATE-CSE/IT-2009( )

[A]{25,12,16,13,10,8,14} [B]{25,14,13,16,10,8,12}
[C]{25,14,16,13,10,8,12,16} [D]{25,14,12,13,10,8,16}

21)What is the content of the array after two delete operations on the correct answer to the previous question ?

2 Marks GATE-CSE/IT-2009( )

[A]{14,13,12,10,8} [B]{14,12,13,8,10}
[C]{14,13,8,12,10} [D]{14,13,12,8,10}

Trees & Graphs

Key Paper

1.	D	2.	A	3.	A	4.	B	5.	C
6.	C	7.	A	8.	B	9.	B	10.	B
11.	A	12.	B	13.	A	14.	D	15.	B
16.	C	17.	B	18.	A	19.	A	20.	C
21.	D								

Programanalysis

Common Data for Q1 and Q2 is given below

The following code segment is executed on a processor which allows only register operands in its instructions. Each instruction can have almost two source operands and one destination operand. Assume that all variables are dead after this code segment

```
c = a + b;
d = c * a;
e = c + a;
x = c * c;

if (x >a){
y = a * a;
}
else {

d = d * d;
e = e * e;
}
```

1) Suppose the instruction set architecture of the processor has only two registers. The only allowed compiler optimization is code motion, which moves statements from one place to another while preserving correctness. What is the minimum number of spills to memory in the compiled code?

2 Marks GATE-CSE/IT-2013,GATE-CSE/IT-2013( )

[A] 0 | [B] 1
[C] 2 | [D] 3

2) What is the minimum number of registers needed in the instruction set architecture of the processor to compile this code segment without any spill to memory? Do not apply any optimization other than optimizing register allocation

2 Marks GATE-CSE/IT-2013( )

[A] 3 | [B] 4
[C] 5 | [D] 6

Common Data for Q3 and Q4 is given below

The procedure given below is required to find and replace certain characters inside an input character string supplied in array A. The characters to be replaced are supplied in array oldc, while their respective replacement characters are supplied in array newc. Array A has a fixed length of five characters, while arrays oldc and newc contain three characters each. However, the procedure is flawed

```
void find _ and _ replace (char * A, char * oldc, char * newc) {
for (int  i = 0; i <5; i + + )

for (int j = 0; j <3; j + +)

if(A[i]==oldc[j])   A[i]=newc[j];

}
```

The procedure is tested with the following four test cases

(1) oldc = " abc ", newc = " dab "   (2) oldc = " cde ", newc = "bcd "

(3) oldc = " bca", newc = " cda"   (4) oldc = " abc ", newc = "bac"

3) The tester now tests the program on all input strings of length five consisting of characters 'a', 'b', 'c', 'd' and 'e' with duplicates allowed. If the tester carries out this testing with the four test cases given above, how many test cases will be able to capture the flaw?

2 Marks GATE-CSE/IT-2013,GATE-CSE/IT-2013( )

[A] Only one | [B] Only two
[C] Only three | [D] All four

4) If array A is made to hold the string "abcde", which of the above four test cases will be successful in exposing the flaw in this procedure?

2 Marks GATE-CSE/IT-2013( )

[A] None | [B] 2 only
[C] 3 and 4 only | [D] 4 only

Programanalysis

5) Suppose the numbers 7,5,1,8,3,6,0,9,4,2 are inserted in that order into an initially empty binary search tree. The binary search tree uses the usual ordering on natural numbers. What is the in-order traversal sequence of the resultant tree ?

1 Marks GATE-CSE/IT-2003( )

[A] 7 5 1 0 3 2 4 6 8 9
[B] 0 2 4 3 1 6 5 9 8 7
[C] 0 1 2 3 4 5 6 7 8 9
[D] 9 8 6 4 2 3 0 1 5 7

6) In the following C program fragment, j,k, n and Two Log_n are integer variables, and A is an array of integers. The variable n is initialized to an integer 3, and Two Log_n is initialized to the value of 2 * | |$^{log_2 n}$

```
for (k=3; k <= n; k++)
  A[k] =0;
for (k=2; k <= TwoLog_n; k++)
 for (j=k+1 ; j <=n; j++)
   A[j]=A[j]||(j%k);
for (j=3; j <= n; j++)
  if (!A[j]print f("%d",j);
```

The set of numbers printed by this program fragment is

2 Marks GATE-CSE/IT-2003( )

[A] {m | m n, (i) [m=i!]}
[B] {m | m n, (i) [m=i^2]}
[C] {m|m n, m is prime }
[D] { }

7) Consider the function f defined below ;

```
struct item {
        int data;
        struct item * next;
};
int f(struct item * p) {
        return ((P = = NULL)| | ( p- >net = = NULL) ||
                (( P -> data <= p - >next - >data) &&
                        f(p - >next));
}
```

For a given linked list p, the function f returns 1 if and only if

2 Marks GATE-CSE/IT-2003( )

[A] the list is empty or has exactly one element
[B] the elements in the list are sorted in non-decreasing order of data value
[C] the elements in the list are sorted in non-increasing order of data value
[D] not all elements in the list have the same data value.

8) the goal of structured programming is to

2 Marks GATE-CSE/IT-2004( )

[A] have well indented programs
[B] be able to infer the flow of control from the compiled code
[C] be able to infer the flow of control from the program text
[D] avoid the use of GOTO statements

9) Consider tech following C function

```
Void swap (int a, int b)
     {  int temp;
     temp  =    a ;
     a     =    b ;
     b     =    temp ;
     }
```

In order to exchange the values of two variables x and y.

1 Marks GATE-CSE/IT-2004( )

[A] call swap (x,y)
[B] call swap (&x, &y)

[C] swap (x,y) cannot be used as it does not return any value

[D] swap (x,y) cannot be used as the parameters are passed by value

10)Consider the following C function

```
int     f(int n)
{ static  int i = 1 ;
    if (n>=5) return n;
    n = n + 1 ;
    i ++;
   return f (n);
}
```

The value returned by f(1) is

1 Marks GATE-CSE/IT-2004( )

[A] 5

[B] 6

[C] 7

[D] 8

11)Consider the following program fragment for reversing the digits in a given integer to obtain a new integer. Let n = d1d2…, dm.

```
int n, rev;
rev = 0 ;
while(n>0) {
  rev= rev*10 + n % 10;
  n = n / 10 ;
}
```

The loop invariant condition at the end of the ith iteration is

1 Marks GATE-CSE/IT-2004( )

[A] n= d_1 d_2… d_{m-i} and rev=d_m d_{m-1} … d_{m-i+1}

[B] n = d_{m-i+1}…d_{m-1} d_m or rev= d_{m-i} … d_2 d_1

[C] n ≠ rev

[D] n= d_1 d_2 …d_m or rev= d_m…d_2 d_1

12)Consider the following C program segment :

```
char p [20] ;
char * s = " string ' ;
int length= strlen (s);
for    (i=0 ; i < length ; i++)
      p[i] = s[length-i];
print f("%s", p);
```

The output of the program is

1 Marks GATE-CSE/IT-2004( )

[A] gnirts

[B] string

[C] gnirt

[D] no output is printed

13)Consider the following C program

```
main ( )
{   int x,y,m,n ;
    scan f ("%d%d", &x, &y);
   / * Assume  x >0 and y >0* /
  m = x ;                          n= y;
  while  (m! = n)
       {                      if(m> n)
                     m= m – n;
                     else
                     n=n-m;
        }
     Print f("%d", n);
     }
```

The program computes

1 Marks GATE-CSE/IT-2004( )

[A] x / y, using repeated subtraction

[B] x mod y using repeated subtraction

[C] the greatest common divisor of x and y

[D] the least common multiple of x and y

Programanalysis

14). What does the following algorithm approximate ? (Assume m> 1, € >0).

```
x  = m,
        y = 1;
        while (x-y >€ )
                {           x = (x +y)/2;
                             y = m / x ;
                }
        Print (x);
```

1 Marks GATE-CSE/IT-2004(   )

[A] log m
[B] m^2
[C] $m^{\frac{1}{2}}$
[D] $m^{\frac{1}{3}}$

15)Choose the best matching between the programming styles in Group 1 and their characteristics in Group 2

Group –1	Group-2
P. Functional	1. Command-based,procedural
Q. Logic	2. Imperative, abstract data types
R. Object-oriented	3. Side-effect free, declarative, expression evaluation
S. Imperative	4. Declarative, clausal representation, theorem proving

1 Marks GATE-CSE/IT-2004(   )

[A] P-2, Q-3, R-4, S-1
[B] P-4, Q-3, R-2, S-1
[C] P-3, Q-4, R-1, S-2
[D] P-3, Q-4, R-2, S-1

16)What does the following C-statement declare ?
int(*f) (int*);

1 Marks GATE-CSE/IT-2004(   )

[A] A function that takes an integer pointer as argument and returns and interger
[B] A function that takes an integer pointer as argument and return an integer pointer.
[C] A pointer to a function that takes an integer pointer as argument and returns as integer
[D] A function that takes an integer pointer as argument returns a function pointer

17)Which of the following are essential features of an object-oriented programming languages ?
1. Abstraction and encapsulation
2. Strictly-typedness
3. Type-safe property coupled with sub-type rule
4. Polymorphism in the presence of inheritance

1 Marks GATE-CSE/IT-2005(   )

[A] 1 and 2 only
[B] 1 and 4 only
[C] 1,2 and 4 only
[D] 1,3 and 4 only

18)An Abstract Data type (ADT) is

1 Marks GATE-CSE/IT-2005(   )

[A] same as an abstract class
[B] a data type that cannot be instantiated
[C] a data type for which only the operations defined on it can be used, but none else
[D] all of the above

19)A common property of logic programming languages and functional languages is

1 Marks GATE-CSE/IT-2005(   )

[A] both are procedural language
[B] both are based on - calculus
[C] both are declarative
[D] all of the above

20)A program P reads in 500 integers in the range (0, 100) representing the scores of 500 students. It then prints the frequency of each score above 50. What

1 Marks GATE-CSE/IT-2005(   )

[A] An array of 50 numbers
[B] An array of 100 numbers
[C] An array of 500 numbers
[D] A dynamically allocated array of 550 numbers

Programanalysis

21)Consider these two functions and two statements S1 and S2 about them.

```
int work 1(int*a,int i, int j)          intwork 2(int*a,int i, int j)
{                                       {
        int x=a[i+2];                           int t1=i+2;
        a[j]=x+1;                               int t2=a[t1];
        return a[i+2]-3;}                       a[j] = t2 +1;
}                                               return t2 -3;
                                        }
```

S1: The transformation from work 1 to work 2 is valid, ie., for any program state and input arguments, work 2 will compute the same output and have the same effect on program state as work 1

S2: All the transformations applied to work 1 to get work 2 will always improve the performance (i.e., reduce CPU time) of work 2 compared to work 1

2 Marks GATE-CSE/IT-2006( )

[A] S1 is false and S2 is false
[B] S1 is false and S2 is true
[C] S1 is true and S2 is false
[D] S1 is true and S2 is true

22)Consider this C code to swap two integers and these five statements : the code

```
void  swap (int*px, int*py) {
        *px = *px - *py;
        *py = *px + *py ;
        *px = *py - *px ;
}
```

S1 : will generate a compilation error
S2: may generate a segmentation fault at runtime depending on the arguments passed
S3: Correctly implements the swap procedure for all input pointers refereeing to integers stored in memory locations accessible to the process
S4: implements the swap procedure correctly for some but not all valid input pointers
S5: may add or subtract integers and pointers

2 Marks GATE-CSE/IT-2006( )

[A] S_1
[B] $S_2$and S_3
[C] $S_2$and S_4
[D] $S_2$and S_5

23)Consider the followingsegment of C-code

```
int, J, n;
  j =1;
while (j <=n)
    j=j*2;
```

The number of comparisonsmade in the execution of the loop for any n>0 is

1 Marks GATE-CSE/IT-2007( )

[A] [$log_2 n$]+1
[B] n
[C] [$log_2 n$]
[D] | $log_2 n$| + 1

24)Consider the following C function :

```
int  f(int n) {
        static int r =0;
if       (n<=0) return 1;
if       (n>3)
          { r =n;
     return f(n-2) + 2;
}
return f(n-1) + r;
}
```

What is the value of f(5) ?

2 Marks GATE-CSE/IT-2007( )

[A] 5
[B] 7
[C] 9
[D] 18

Programanalysis

25)Consider the following Cprogram segment where Cell Node represents a node in a binary tree

```
struct  CellNode {
struct  CelloNode * leftchild;
int element;
struct CellNode *rightchild;
};
int GetValue (structCellNode * ptr) {
        int value=0;
if (ptr!=NULL){
    if ((ptr-> leftChild = = NULL)&&
          (ptr -> rightChild = = NULL))
          Value  =1 ;
else
value = value + GetValue
                    (ptr->left Child)
          +          Get Value
                    (ptr->right Child);
}
return (value);
}
```

The value returned by GetValue when a pointer to the root of a binary tree is passed as its argument is

2 Marks GATE-CSE/IT-2007(   )

[A] the number of nodes
[B] the number of internal nodes in the tree
[C] the number of leaf nodes in the tree
[D] the height of the tree

26)Which combination of the integer variables x,y and z makes the variable a get the value4 in the following expression ?

a= (x>y) ? ((x>z) ? x :z): ((y>z) ?y:z)

1 Marks GATE-CSE/IT-2008(   )

[A] x =3, y=4, z=2
[B] x= 6, y=5, z=3
[C] x =6, y=3, z=5
[D] x=5, y=4, z=5

27)What will be the output of the following C program segment?

```
Char inChar = 'A' ;
switch (inChar ) {
case 'A' : printf ("Choice A\ n");
case 'B' :
case 'C' : print f("Choice B");
case 'D' :
case 'E' :
default : printf ("No Choice") ; }
```

1 Marks GATE-CSE/IT-2012(   )

[A] No choice
[B] Choice A
[C] Choice A
Choice B is No choice
[D] Program gives no output as it is erroneous

Programanalysis

28)Consider the program given below, in a block-structured pseudo-language with lexical scoping and nesting of procedures permitted.

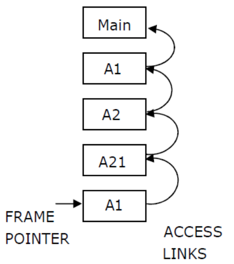
```
Program main;
Var . . .
Procedure A1;
Var ..
Call A2;
End A1
Procedure A2;
Var . . .
Procedure A21;
Var . . .
Call A1;
End A21
Call A21;
End A2
Call A1;
End main.
```

Consider the calling chain: Main → A1 → A2 → A21 → A1

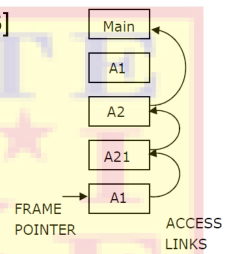
The correct set of activation records along with their access links is given by

2 Marks GATE-CSE/IT-2012( )

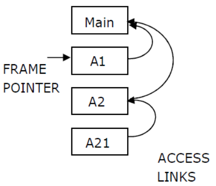
[A]



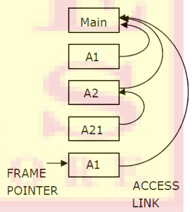
[B]



[C]



[D]



29)What does the following fragment of C-program print?

```
char c [] = " GATE2011";
char *p =c;
printf ("%s", p+p [3] - p [1]);
```

1 Marks GATE-CSE/IT-2011( )

[A] GATE2011 [B] E2011

[C] 2011 [D] 011

30)In a compiler, keywords of a language are recognized during

1 Marks GATE-CSE/IT-2011( )

[A] parsing of the program [B] the code generation

[C] the lexical analysis of the program [D] dataflow analysis

Programanalysis

31)What does the following program print?

```
#include <stdio.h >
void f (int * p, int * q) {
 p = q;
* p = 2;
}
 int i = 0, j = 1;
int main ( ){
f(&i, &j);
pr int f (" %d %d \ n ", i, j);
return 0;
}
```

1 Marks GATE-CSE/IT-2010( )

[A] 2 2
[B] 2 1
[C] 0 1
[D] 0 2

32)Which data structure in a compiler is used for managing information about variables and their attributes?

1 Marks GATE-CSE/IT-2010( )

[A] Abstract syntax tree
[B] Symbol table
[C] Semantic stack
[D] parse table

33)Which languages necessarily need heap allocation in the runtime environment?

1 Marks GATE-CSE/IT-2010( )

[A] Those that support recursion
[B] Those that use dynamic scoping
[C] Those that allow dynamic data structures
[D] Those that use global variables

34)In the C language

1 Marks GATE-CSE/IT-2002( )

[A] At most one activation record exists between the current activation record and the activation record for the main
[B] The number of activation records between the current activation record and the activation record fro the main depends on the actual function calling sequence.
[C] The visibility of global variables depends on the actual function calling sequence.
[D] Recursion requires the activation record for the recursive function to be saved on a different stack before the recursive fraction can be called.

35)The results returned by function under value-result and reference parameter passing conventions

1 Marks GATE-CSE/IT-2002( )

[A] Do not differ
[B] Differ in the presence of loops
[C] Differ in all cases
[D] May differ in the presence of exception

36)The C language is:

2 Marks GATE-CSE/IT-2002( )

[A] A context free language
[B] A context sensitive language
[C] A regular language
[D] Parsable fully only by a Turing machine

37)Dynamic linking can cause security concerns because

2 Marks GATE-CSE/IT-2002( )

[A] Security is dynamic
[B] The path for searching dynamic libraries is not known till runtime
[C] Linking is insecure
[D] Cryptographic procedures are not available for dynamic linking

Programanalysis

38)What is printed by the print statements in the program P1 assuming call by reference parameter passing?

```
Program P1()
{
x=10; y=3;
func1(y,x,x);
print x;
print y;
}
func1(x,y,z)
{
y=y+4;
 z=x+y+z;
}
```

2 Marks GATE-CSE/IT-2001( )

[A] 10,3 [B] 31, 3
[C] 27, 7 [D] None of the above

39)Consider the following three C functions:

```
[P1]    int*g(void)
        {
        intx=10;
        return(&x);
        }
[P2]    int*g(void)
        {
        int*px;
        *px=10;
        return px;
        }
[P3]    int*g(void)
        {
        int*px
        px =(int*)malloc (size of (int));
        *px=10; return px;
        }
```

Which of the above three functions are likely to cause problems with pointers?

2 Marks GATE-CSE/IT-2001( )

[A] Only P3 [B] Only P1 and P3
[C] Only P1 and P2 [D] P1, P2 and P3

40)Consider the following program

```
Program P2
var n:int:
procedure W(var x:int)
begin
x=x+1;
printx;
 end
procedure D
begin
var n:int;
n=3;
W(n);
End
begin                    \\begin P2
n = 10;
D;
end
```

If the language has dynamic scooping and parameters are passed by reference, what will be printed by the program?

2 Marks GATE-CSE/IT-2001( )

[A] 10
[B] 11
[C] 3
[D] None of the above

41)Consider the following C function .

```
Float f , ( float x , int y ) {
float p , s ; int i ;
for ( s = 1 , p = 1 , i = 1 ; i <y ; i++) {
p * = x/i ;
s+ = p ;
}
return s ;
}
```

For large values of y , the return value of the function f best approximates

1 Marks GATE-CSE/IT-2003( )

[A] x^y
[B] e^x
[C] ln(1+x)
[D] x^x

42)Consider the following C-function in which a [n] and b [m]are two sorted integer arrays and c[n + m]be another integer array.

```
void xyz(int a[], int b[], int c []){
    int i,j,k;
   i=j=k=0;
   while ((i
     if(a[i]
    else c [k++] = b[j++];
}
```

Which of the followingcondition (s) hold (s) after the termination of the while loop ?
i,jii, i

2 Marks GATE-CSE/IT-2006( )

[A] Only (i)
[B] Only (ii)
[C] Neither (i) nor (ii)
[D] Either (i) or (ii) but not both

43)Which of the following are true ?

(i) A programming language which does not permit global variables of any kind and has no nesting of procedures / functions, but permits recursion can be implemented with static storage allocation

(ii) Multi-level access link (or display arrangement is needed to arrange activation records only if the programming language being implemented has nesting of procedures/function

(iii) Recursion in programming languages cannot be implemented with dynamic storage allocation

(iv) Nesting of procedures/functions and recursion require a dynamic heap allocation scheme for activation records

(v) Programming languages which permit a function to return a function as its result cannot be implemented with a stack-based storage allocation scheme for activation records

1 Marks GATE-CSE/IT-2008( )

[A] (ii) and (v) only
[B] (i), (iii) and (iv) only
[C] (i), (ii) and (v)
[D] (ii), (iii) and (v) only

44)Consider line number 3 of the following C-program.

```
int main ( ) {                    |* Line 1 * |
int I, N;                         |* line 2 * |
fro (I=0, 1
}
```

Identify the compiler's response about this line while creating the object-module

2 Marks GATE-CSE/IT-2005( )

[A] No compilation error
[B] Only a lexical error
[C] Only syntactic errors
[D] Both lexical and syntactic errors

45)The following C declarations

```
struct  node{
int i: float j;
};
struct node *s[10];
```

define s to be

1 Marks GATE-CSE/IT-2000( )

[A] An array, each element of which is a pointer to a structure of type node
[B] A structure of 2 fields, each field being a pointer to an array of 10 elements
[C] A structure of 3 fields: an integer, a float, and an array of 10 elements
[D] An array, each element of which is a structure of type node

46)The most appropriate matching for the following pairs

X: m=malloc(5); m= NULL;   1: using dangling pointers

Y: free(n); n->value=5;   2: using uninitialized pointers

Z: char *p; *p='a';   3. lost memory

is:

1 Marks GATE-CSE/IT-2000( )

[A] X – 1 Y – 3 Z - 2
[B] X – 2 Y – 1 Z - 3
[C] X – 3 Y – 2 Z - 1
[D] X – 3 Y – 1 Z - 2

47)Aliasing in the context of programming languages refers to

1 Marks GATE-CSE/IT-2000( )

[A] multiple variables having the same memory location
[B] multiple variables having the same value
[C] multiple variables having the same identifier
[D] multiple uses of the same variable

Programanalysis

48)Consider the following C declaration

```
struct {
short s [5]
union {
float y;
long z;
} u;
}t;
```

Assume that objects of the type short, float and long occupy 2 bytes, 4 bytes and 8 bytes, respectively. The memory requirement for variable t, ignoring alignment considerations, is

1 Marks GATE-CSE/IT-2000( )

[A] 22 bytes [B] 14 bytes
[C] 18 bytes [D] 10 bytes

49)The number of tokens in the following C statement

printf(“i=%d, &i=%x”,i,&i);

is

1 Marks GATE-CSE/IT-2000( )

[A] 3 [B] 26
[C] 10 [D] 21

50)The value of j at the end of the execution of the following C program

```
int incr (int i)
{
static int count = 0;
count = count + i;
 return (count);
}
main() {
int i,j;
for(i=0; i<=4; i++)
j=incr(i)
}
```

is

2 Marks GATE-CSE/IT-2000( )

[A] 10 [B] 4
[C] 5 [D] 7

51)Given the programming constructs (i) assignment (ii) for loops where the loop parameter cannot be changed within the loop (iii) if-then-else (iv) forward go to (v) arbitrary go to (vi) non-recursive procedure call (vii) recursive procedure/function call (viii) repeat loop, which constructs will you not include in a programming language such that it should be possible to program the terminates (i.e., halting) function in the same programming language.

2 Marks GATE-CSE/IT-1999( )

[A] (ii), (iii), (iv) [B] (v), (vii), (viii)
[C] (vi), (vii), (viii) [D] (iii), (vii), (viii)

52)Consider the following program in a language that has dynamic scooping:

```
var x: real;
procedure show:
begin print(x);end;
procedure small;
var x: real;
begin x: = 0.125; show; end;
begin x:=0.25;
show; small end.
```

Then the output of the program is:

2 Marks GATE-CSE/IT-1999( )

[A] 0.125 0.125 [B] 0.25 0.25

[C]0.25 0.125 [D]0.125 0.25

53)Consider the following C function definition

```
int Trial (int a, int b, int c)
{
if ((a >= b) &&(c <b) return b;
 else if (a >= b) return Trial (a,c,b);
 else return Trial (b,a,c);
```

The function Trial:

2 Marks GATE-CSE/IT-1999( )

[A] Finds the maximum of a, b, and c
[B] Finds the minimum of a, b and c
[C] Finds the middle number of a, b, c
[D] None of the above

54)Heap allocation is required for languages.

1 Marks GATE-CSE/IT-1997( )

[A] that support recursion
[B] that support dynamic data structures
[C] that use dynamic scope rules
[D] None of the above

55)Assume that X and Y are non-zero positive integers. What does the following Pascal program segment do?

```
while X <>Y do
if        X >Y then
X:=X – Y
else
Y:=Y – X;
write(X);
```

2 Marks GATE-CSE/IT-1995( )

[A] ComputestheLCMoftwonumbers
[B] Dividesthelargernumberbythesmallernumber
[C] ComputestheGCDoftwonumbers
[D] Noneoftheabove

56)Which of the following statements is true?

I. As the number of entries in a hash table increases, the number of collisions increases.
II. Recursive programs are efficient
III. The worst case complexity for Quicksort is O _(n_2 _)
IV. Binary search using a linear linked list is efficient.

2 Marks GATE-CSE/IT-1995( )

[A] IandII
[B] IIandIII
[C] IandIV
[D] IandIII

57)FORTRANimplementationdonotpermitrecursionbecause

1 Marks GATE-CSE/IT-1994( )

[A] theyusestaticallocationforvariables
[B] theyusedynamicallocationforvariables
[C] stacksarenotavailableonallmachines
[D] itisnotpossibletoimplementrecursiononallmachines

58)Anunrestricteduseofthe“goto” statementisharmfulbecause

1 Marks GATE-CSE/IT-1994( )

[A] itmakesitmoredifficulttoverifyprograms
[B] itincreasestherunningtimeoftheprograms
[C] itincreasesthememory required fortheprograms
[D] itresultsinthecompilergeneratinglongermachinecode

Programanalysis

59)For the program segment given below, which of the following are true?

```
program main (output);
type link = ^data;
data = record
d : real;
n : link
end;
var ptr : link;
 begin
new (ptr);
 ptr:=nil;
.ptr^.d:=5.2;
write ln(ptr)
end.
```

2 Marks GATE-CSE/IT-1993(   )

[A] The program leads to compile time error

[B] The program leads to run time error

[C] The program outputs 5.2

[D] The program produces error relating to nil pointer dereferencing

[E] None of the above

Programanalysis

Key Paper

1.	B	2.	B	3.	B	4.	C	5.	A
6.	D	7.	B	8.	C	9.	D	10.	C
11.	A	12.	D	13.	C	14.	C	15.	D
16.	C	17.	B	18.	C	19.	C	20.	A
21.	D	22.	B	23.	D	24.	D	25.	C
26.	A	27.	C	28.	D	29.	C	30.	C
31.	D	32.	B	33.	C	34.	B	35.	D
36.	B	37.	B	38.	B	39.	C	40.	D
41.	B	42.	D	43.	B	44.	C	45.	A
46.	D	47.	A	48.	C	49.	C	50.	A
51.	B	52.	C	53.	C	54.	B	55.	C
56.	D	57.	A	58.	A	59.	E		

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Index- Operating System

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Process management

A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string); 1,2,1,3,7,4,5,6,3,1

1) If optimal page replacement policy is used, how many page faults occur for the above reference string ?
2 Marks GATE-CSE/IT-2007( )

[A] 7 [B] 8
[C] 9 [D] 10

Common Data for Q2 and Q3 is given below

Barrier is a synchronization construct where a set of processes synchronizes globally i.e., each process in the set arrives at the barrier and waits for all others to arrive and then all processes leave the barrier. Let the number of processes in the set be three and S be a binary semaphore with the usual P and V functions. Consider the following C implementation of a barrier with line numbers shown on the left.

```
Void barrier (void) {
1    :    P(S)
2    :    process _ arrived ++ ;
3    :    V(S);
4    :    while(process _ arrived ! = 3);
5    :    P(S);
6    :    process_ left ++;
7    :    if (process _ left = =3)
8    :    process _ arrived = 0;
9    :    process _ left = 0;
10   :    }
11   :    V(S);
}
```

The variables process _ arrived and process _ left are shared among all processes and are initialized to zero. In a concurrent program all the three processes call the barrier function when they need to synchronize globally.

2) 24. The above implementation of barrier is incorrect. Which one of the following is true ?
2 Marks GATE-CSE/IT-2006( )

[A] The barrier implementation is wrong due to the use of binary semaphore S
[B] The barrier implementation may lead to a deadlock if two barrier invocations are used in immediate succession
[C] Lines 6 to 10 need not be inside a critical section
[D] The barrier implementation is correct if there are only two processes instead of three

3) Which one of the following rectifies the problem in the implementation ?
2 Marks GATE-CSE/IT-2006( )

[A] Lines 6 to 10 are simply replaced by process _ arrived
[B] At the beginning of the barrier the first process to enter the barrier waits until process_ arrived becomes zero before proceeding to execute P (S)
[C] Context switch is disabled at the beginning of the barrier and re-enabled at the end
[D] The variable process_ left is made private instead of shared

4) What is the maximum number of reduce moves that can be taken by a bottom- up parser for a grammar with no epsilon- and unit-production (i.e., of type $A \rightarrow \in$ and $A \rightarrow a$) to parse a string with n tokens?
1 Marks GATE-CSE/IT-2013( )

[A] n/2 [B] n-1
[C] 2n-1 [D] 2^n

5) Which one of the following is the tightest upper bound that represents the time complexity of inserting an object into a binary search tree of n nodes?
1 Marks GATE-CSE/IT-2013( )

[A] O(1) [B] O(log n)
[C] O(n) [D] O(n log n)

6) Which one of the following is the tightest upper bound that represents the number of swaps required to sort n numbers using selection sort?

1 Marks GATE-CSE/IT-2013( )

[A] O(log n) [B] O(n)
[C] O(n log n) [D] O(n^2)

7) A shared variable x, initialized to zero, is operated on by four concurrent processes W, X, Y, Z as follows. Each of the processes W and X reads x from memory, increments by one, stores it to memory, and then terminates. Each of the processes Y and Z reads x from memory, decrements by two, stores it to memory, and then terminates. Each process before reading x invokes the P operation (i.e., wait) on a counting semaphore S and invokes the V operation (i.e., signal) on the semaphore S after storing x to memory. Semaphore S is initialized to two. What is the maximum possible value of x after all processes complete execution?

2 Marks GATE-CSE/IT-2013( )

[A] -2 [B] -1
[C] 1 [D] 2

8) Which combination of the following features will suffice to characterize an OS as a multi-programmed OS? (A) More than one program may be loaded into main memory at the same time for execution. (B) If a program waits for certain events such as I/O, another program is immediately scheduled for execution. (C) If the execution of a program terminates, another program is immediately scheduled for execution.

2 Marks GATE-CSE/IT-2002( )

[A] A [B] A and B
[C] A and C [D] A, B and C

9) Consider a set of n tasks with known runtimes r_1, r_2, …. r_n to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput?

1 Marks GATE-CSE/IT-2001( )

[A] Round-Robin [B] Shortest-Job-First
[C] Highest-Response-Ratio-Next [D] First-Come-First-Served

10) Which of the following requires a device driver?

1 Marks GATE-CSE/IT-2001( )

[A] Register [B] Cache
[C] Main memory [D] Disk

11) Which of the following does not interrupt a running process?

2 Marks GATE-CSE/IT-2001( )

[A] A device [B] Timer
[C] Scheduler process [D] Power failure

12) Consider Peterson's algorithm for mutual exclusion between two concurrent processes i and j. The program executed by process is shown below.
repeat
flag[i]=true; turn=j;
while (P) do no-op;
Enter critical section, perform actions, then exit critical section
Flag[i]=false;
Perform other non-critical section actions. Until false;
For the program to guarantee mutual exclusion, the predicate P in the while loop should be

2 Marks GATE-CSE/IT-2001( )

[A] flag[j]=true and turn=i [B] flag[j]=true and turn=j
[C] flag[i]=true and turn=j [D] flag[i]=true and turn=i

13) A system uses FIFO policy for page replacement. It has 4 page frames with no pages loaded to begin with. The system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order. How many page faults will occur?

1 Marks GATE-CSE/IT-2010( )

[A] 196 [B] 192
[C] 197 [D] 195

14) A multi-user, multi-processing operating system cannot be implemented on hardware that does not support

2 Marks GATE-CSE/IT-1999( )

[A] Address translation [B] DMA for disk transfer

[C] At least two modes of CPU execution (privileged and non-privileged)
[D] Demand paging

15) Which of the following actions is/are typically not performed by the operating system when switching context from process A to process B?

2 Marks GATE-CSE/IT-1999( )

[A] Saving current register values and restoring saved register values for process B.
[B] Changing address translation tables.
[C] Swapping out the memory image of process A to the disk.
[D] Invalidating the translation look-aside buffer.

16) Raid configurations of the disks are used to provide

2 Marks GATE-CSE/IT-1999( )

[A] Fault-tolerance
[B] High speed
[C] high data density
[D] None of the above

17) In a resident – OS computer, which of the following systems must reside in the main memory under all situations?

1 Marks GATE-CSE/IT-1998( )

[A] Assembler
[B] Linker
[C] Loader
[D] Compiler

18) I/O redirection

1 Marks GATE-CSE/IT-1997( )

[A] implies changing the name of a file
[B] can be employed to use an existing file as input file for a program
[C] implies connection 2 programs through a pipe
[D] None of the above

19) An operating system contains 3 user processes each requiring 2 units of resource R. the minimum number of units of r such that no deadlocks will ever arise is

2 Marks GATE-CSE/IT-1997( )

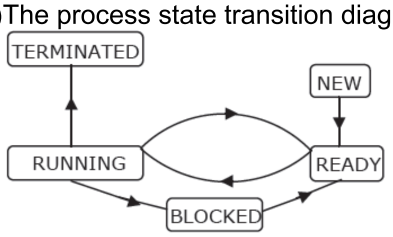
[A] 3
[B] 5
[C] 4
[D] 6

20) Each process Pi,i=1……9 is coded as follows
repeat P(mutex)
{critical section}
v(mutex)
forever
The code foe P10 is identical except that it uses v(mutex) in place of P(mutex).
What is the largest number of processes that can be inside the critical section at any moment?

2 Marks GATE-CSE/IT-1997( )

[A] 1
[B] 2
[C] 3
[D] None of the above

21) The process state transition diagram in Fig.1.8 is representative of



1 Marks GATE-CSE/IT-1996( )

[A] a batch operating system
[B] an operating system with a preemptive scheduler
[C] an operating system with a non-preemptive scheduler
[D] a uni-programmed operating system.

22) For the daisy chain scheme of connecting I/O devices, which of the following statements is true?

1 Marks GATE-CSE/IT-1996( )

[A] It gives non-uniform priority to various devices.
[B] It gives uniform priority to all devices.
[C] It is only useful for connecting slow devices to a processor device.
[D] It requires a separate interrupt pin on the processor for each device.

23)Consider a system having m resources of the same type. These resources are shared by 3 processes A , B and C , Which have peak demands of 3 , 4 and 6 respectively . For what value of m deadlock will not occur?

2 Marks GATE-CSE/IT-1993( )

[A] 7
[B] 9
[C] 10
[D] 13
[E] 15

24)Consider three CPU-intensive processes, whichrequire 10,20 and 30 time units and arrive at times 0,2, and 6,respectively. How many context switchesare needed if the operating system implements a shortest remaining time firstscheduling algorithm ? Do not count the context switches at time zero and atthe end.

1 Marks GATE-CSE/IT-2006( )

[A] 1
[B] 2
[C] 3
[D] 4

25)The atomic feth-and-set x,y instruction unconditionallysets the memory location x to 1 and fetches the old value of x in y without allowing any intervening access to the memory location X. Consider the following implementation of P and Vfunctions on a binary semaphore S.

```
void p (binary_ semaphore *S) {
    unsignedy;
unsigned *x = &(S-> value);}
        do {
       fetch– and – set x,y;
     } while(y);
}
void V(binary_semphore *S) {
        {S-> value = 0 ;
}
```

Which one of the following is true ?

2 Marks GATE-CSE/IT-2006( )

[A] The implementation may not work if context switching is disabled in P
[B] Instead of using fetch-and-set, a pair of normal load/store can be used
[C] The implementation of V is wrong
[D] The code does not implement a binary semaphore

26)A process executes the following code for (i=0' I <n ; i++) fork (); The total number of child processes created is

2 Marks GATE-CSE/IT-2008( )

[A] n
[B] $2^n - 1$
[C] 2^n
[D] $2^{n+1} - 1$

Process management

Key Paper

1.	A	2.	B	3.	B	4.	C	5.	C
6.	B	7.	D	8.	D	9.	B	10.	B
11.	B	12.	B	13.	A	14.	D	15.	D
16.	A	17.	C	18.	B	19.	C	20.	C
21.	B	22.	A	23.	A	24.	D	25.	A
26.	B								

CPU Scheduling

1) Consider n processes sharing the CPU in a round-robin fashion. Assuming that each process switch takes s seconds, what must be the quantum size q such that the overhead resulting from process switching is minimized but at the same time each process is guaranteed to get its turn at the CPU at least every t seconds?

2 Marks GATE-CSE/IT-1998( )

[A] $q \leq \frac{t-ns}{n-1}$
[B] $q \geq \frac{t-ns}{n-1}$
[C] $q \leq \frac{t-ns}{n+1}$
[D] $q \geq \frac{t-ns}{n+1}$

2) The correct matching for the following pairs is:

(A) Disk scheduling	(1) Round robin
(B) Batch processing	(2) SCAN
(C) Time sharing	(3) LIFO
(D) Interrupt processing	(4) FIFO

1 Marks GATE-CSE/IT-1997( )

[A] A – 3 B – 4 C – 2 D - 1
[B] A – 4 B – 3 C – 2 D - 1
[C] A – 2 B – 4 C – 1 D - 3
[D] A – 3 B – 4 C – 3 D - 2

3) When an interrupt occurs, an operating system

1 Marks GATE-CSE/IT-1997( )

[A] ignores the interrupt
[B] always changes state of interrupted process after processing the interrupt
[C] always resumes execution of interrupted process after processing the interrupt
[D] may change state of interrupted process to 'blocked' and schedule another process

4) Four jobs to be executed on a single processor system arrive at time 0+ in the order A, B, C, D. their burst CPU time requirements are 4, 1, 8, 1 time units respectively. The completion time of A under round robin scheduling with time slice of one time unit is

2 Marks GATE-CSE/IT-1996( )

[A] 10
[B] 4
[C] 8
[D] 9

5) Which scheduling policy is most suitable for a time shared operating system?

1 Marks GATE-CSE/IT-1995( )

[A] ShortestJobFirst
[B] RoundRobin
[C] FirstComeFirstServe
[D] Elevator

6) The sequence ....is an optimal non-preemptive scheduling sequence for the following jobs which leaves the CPU idle for .... unit(s) of time.

Job	Arrival time	Burst time
1	0.0	9
2	0.6	5
3	1.0	1

2 Marks GATE-CSE/IT-1995( )

[A] {3, 2, 1}, 1
[B] {2, 1, 3} , 0
[C] {3, 2, 1} , 0
[D] {1, 2, 3} ,5

7) Assume that the following jobs are to be executed on a single processor system

Job Id	CPU Burst time
p	4
q	1
r	8
s	1
t	2

The jobs are assumed to have arrived at time 0_+ and in the order p, q, r, s, t. calculate the departure time (completion time) for job p if scheduling is round robin with time slice 1.

2 Marks GATE-CSE/IT-1993( )

[A] 4 [B] 10
[C] 11 [D] 12
[E] none of the above

8) Consider the following statements with respect touser- level threads and kernel-supported thread
(i) Context switch is faster with kernel-supported threads
(ii) For user-level threads, a system call can block the entire process
(c) Kernel-supported threads can be scheduled in dependently
(iv) User-level threads are transparent to the kernel
Which of the above statements are true ?

1 Marks GATE-CSE/IT-2004( )

[A] (ii), (iii) and (iv) only [B] (ii) and (iii) only
[C] (i) and (iii) only [D] (i) and (ii) only

9) Consider the following set of processes, with the arrival times and the CPU-burst times given in milliseconds

Process	Arrivaltime	Burst time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is the average turnaround time for these processes with the preemptive shortest remaining processing time first (SRPT) algorithm ?

2 Marks GATE-CSE/IT-2004( )

[A] 5.50 [B] 5.75
[C] 6.00 [D] 6.2

10) Consider three processes (process id 0,1,2,respectively) with compute time bursts 2,4,and 8 time units. All processes arrive at time zeo. Consider the longest remaining time first(LRTF) scheduling algorithm. In LRTFties are broken by giving priority to the process with the lowest processid. The average turn around time is

2 Marks GATE-CSE/IT-2006( )

[A] 13 units [B] 14 units
[C] 15 units [D] 16 units

11) Consider three processes, all arriving at time zero,with total execution time of 10,20 and 30 units, respectively. Each process spends the first 20% ofexecution time doing I/O, the next 70%of time doing computation, and the last 10% of time doing I/O again. Theoperating system uses a shortestremaining compute time first schedulingalgorithm and schedules a new processeither when the running process getblocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can beoverlapped as much as possible. For whatpercentage of time does the CPU remainidle ?

2 Marks GATE-CSE/IT-2005( )

[A] 0% [B] 10.6%
[C] 30.0% [D] 89.4%

12) An operating system uses Shortest Remaining Time first (SRT) process scheduling algorithm. Consider the arrival times and execution times for the following processes.

Process	Execution time	Arrival time
P1	20	0
P2	25	15
P3	10	30
P4	15	45

What is the total waiting time for process P2 ?

2 Marks GATE-CSE/IT-2007( )

[A] 5 [B] 15
[C] 40 [D] 55

13)A virtual memory system uses first In first Out (FIFO) page replacement policyand allocates a fixed number of frames to a process. Consider the following statements :
P: Increasing the number of page frames allocated to a process sometimes increases the page faultrate.
Q: Some program do not exhibit locality of reference.
Which one of the following is TRUE ?

1 Marks GATE-CSE/IT-2007( )

[A] Both P and Q are true, and Q is the reason for P
[B] Both P and Q are true, but Q is not the reason for P
[C] P is false, but Q is true
[D] Both P and Q are false

14)A single processor system has three resource typesX,Y, and Z, which are shared by three processes. There are 5 units of each resource type allocated to each process, and the columnrequest denotes the number of units of each resource type requestedby a process in order to complete execution. Which of these processes will finishLAST ?

	alloc	request
	X X X	X Y Z
P0	1 2 1	1 0 3
P1	2 0 1	0 1 2
P2	2 2 1	1 2 0

2 Marks GATE-CSE/IT-2007( )

[A] P0
[B] P1
[C] P2
[D] None of the above, since the system is in a deadlock

15)Two processes,P1 and P2, need to access a criticalsection of code. Consider the following synchronization construct used by theprocesses :

```
/* P1 * /
  while (true)
 {
  wants1 =true ;
  while(wants2= =true);
 /*Critical
   Section * /
   Wants 1 = false;
   }
 /* Re mainder section * /
```

```
/*P2 */
while  (true)
{
    wants2 = true;
      while (wants1 = = true);
  /*Critical
    Section*/
    wants2 = false ;
}
    /* Re mainder sec tion */
```

Here, wants 1 and wants 2 are shared variables,Which are intitilized to false. Whichone of the following statements is TRUE about the above construct ?

2 Marks GATE-CSE/IT-2007( )

[A] It does not ensure mutual exclusion.
[B] It does not ensure bounded waiting
[C] It requires that processes enter the critical section in strict alternation
[D] It does not prevent deadlocks, but ensures mutual exclusion.

16)In which one of the following page replacement policies, Belady's anomaly may occur ?

1 Marks GATE-CSE/IT-2008( )

[A] FIFO
[B] Optimal
[C] LRU
[D] MRU

17)In the following process state transition diagramfor a uniprocessor system, assume that there are always some processes in theready state:
Now consider the following statements:
I.If a process makes a transition D, it would resultin another process making transition A immediately
II. A process P2 in blocked state can make transition E while anotherprocess P1 is in running state
III. The OS uses preemptive scheduling
IV. The OS uses non-preemptive scheduling
Which of the above statements are TRUE ?

2 Marks GATE-CSE/IT-2009( )

[A] I and II
[B] I and III
[C] II and III
[D] II and IV

18)Consider three processes, all arriving at time zero, with total execution time of 10,20 and 30 units, respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process get blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of time does the CPU remain idle ?

2 Marks GATE-CSE/IT-2006( )

[A] 0% [B] 10.6%
[C] 30.0% [D] 89.4%

19)Least Recently Used (LRU) page replacement policy is a practical approximation to optimal page replacement. For the above reference string, how many more page faults occur with LRU than with the optimal page replacement policy ?

2 Marks GATE-CSE/IT-2007( )

[A] 0 [B] 1
[C] 2 [D] 3

20)A scheduling algorithm assigns priority proportional to the waiting time of a process. Every process starts with priority zero(the lowest priority). The scheduler re-evaluates the process priorities every T time units and decides the next process to schedule. Which one of the following is TRUE if the processes have no I/O operations and all arrive at time zero?

1 Marks GATE-CSE/IT-2013( )

[A] This algorithm is equivalent to the first-come-first-serve algorithm.
[B] This algorithm is equivalent to the round-robin algorithm.
[C] This algorithm is equivalent to the shortest-job-first algorithm.
[D] This algorithm is equivalent to the shortest-remaining-time-first algorithm

21)Consider the following operation along with Enqueue and Dequeue operations on queues, where k is a global parameter

```
MultiDequeue (Q) {
m = k
while (Q is not empty) and (m >0) {
Dequeue  (Q)
m = m − 1
}
}
```

What is the worst case time complexity of a sequence of n queue operations on an initially empty queue?

2 Marks GATE-CSE/IT-2013( )

[A] $\Theta(n)$ [B] $\Theta(n+k)$
[C] $\Theta(nk)$ [D] $\Theta(n^2)$

22)Consider the following statements with respect to user-level threads and kernel-supported threads
(i) Context switch is faster with kernel-supported threads
(ii) For user-level threads, a system call can block the entire process
(c) Kernel-supported threads can be scheduled independently
(iv) User-level threads are transparent to the kernel
Which of the above statements are true ?

1 Marks GATE-CSE/IT-2004( )

[A] (ii), (iii) and (iv) only [B] (ii) and (iii) only
[C] (i) and (iii) only [D] (i) and (ii) only

23)Consider the following set of processes, with the arrival times and the CPU-burst times given in milliseconds

Process	Arrival time	Burst time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is the average turnaround time for these processes with the preemptive shortest remaining processing time first (SRPT) algorithm ?

2 Marks GATE-CSE/IT-2004( )

[A] 5.50 [B] 5.75
[C] 6.00 [D] 6.2

24)Consider a system with a two-level paging scheme in which a regular memory access takes 150 nanoseconds, and servicing a page fault takes 8 milliseconds. An average instruction takes 100 nano seconds of CPU time, and two memory accesses. The TLB hit ratio is 99%, and the page fault rate is one in every 10,000 instructions. What is the effective average instruction execution time ?

2 Marks GATE-CSE/IT-2004( )

[A] 645 nanoseconds [B] 1050 nanoseconds
[C] 1215 nanoseconds [D] 1230 nanoseconds

25)Consider three CPU-intensive processes, which require 10,20 and 30 time units and arrive at times 0,2, and 6, respectively. How many context switches are needed if the operating system implements a shortest remaining time first scheduling algorithm ? Do not count the context switches at time zero and at the end.

1 Marks GATE-CSE/IT-2006( )

[A] 1 [B] 2
[C] 3 [D] 4

26)Let W(n) and A(n) denote respectively, the worst case and average case running time of an algorithm executed on an input of size n. Which of the following is ALWAYS TRUE?

1 Marks GATE-CSE/IT-2012( )

[A] $A(n) = \Omega(W(n))$ [B] $A(n) = \Theta(W(n))$
[C] $A(n) = O(W(n))$ [D] $A(n) = o(W(n))$

27)A thread is usually defined as a 'light weight process' because an operating system (OS) maintains smaller data structures for a thread than for a process. In relation to this, which of the followings is TRUE?

1 Marks GATE-CSE/IT-2011( )

[A] On per-thread basis, the OS maintains only CPU register state
[B] The OS does not maintain a separate stack for each thread
[C] On per-thread basis, the OS does not maintain virtual memory state
[D] On per thread basis, the OS maintains only scheduling and accounting information

28)Consider the following table of arrival time and burst time for three processes P0, P1 and P2.

Process	Arrival time	Burst Time
P0	0 ms	9 ms
P1	1 ms	4ms
P2	2 ms	9ms

The pre-emptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. What is the average waiting time for the three processes?

2 Marks GATE-CSE/IT-2011( )

[A] 5.0 ms [B] 4.33 ms
[C] 6.33 ms [D] 7.33 ms

29) Which of the following statements are true?

I. Shortest remaining time first scheduling may cause starvation
II. Preemptive scheduling may cause starvation
III. Round robin is better than FCFS in terms of response time

1 Marks GATE-CSE/IT-2010( )

[A] I only [B] I and III only
[C] II and III only [D] I, II and III

30) Consider the following schedule for transactions T1, T2 and T3:

T1	T2	T3
Read(X)		
	Read(Y)	
		Read(Y)
	Write(Y)	
Write(X)		
		Write(X)
	Read(X)	
	Write(X)	

Which one of the schedules below is the correct serialization of the above?

2 Marks GATE-CSE/IT-2010( )

[A] T1→T3→T2 [B] T2→T1→T3
[C] T2→T3→T1 [D] T3→T1→T2

CPU Scheduling

Key Paper

1.	D	2.	C	3.	D	4.	D	5.	B
6.	A	7.	C	8.	A	9.	A	10.	A
11.	B	12.	B	13.	B	14.	C	15.	D
16.	A	17.	C	18.	B	19.	C	20.	B
21.	C	22.	B	23.	A	24.	D	25.	B
26.	C	27.	A	28.	A	29.	D	30.	A

Inter-process communication

1) Formatting for a floppy disk refers to

2 Marks GATE-CSE/IT-1998( )

[A] arranging the data on the disk in contiguous fashion
[B] writing the directory
[C] erasing the system area
[D] writing identification information on all tracks and sectors

2) Alinkerisgiven object modulesforaset ofprogramsthat were compiledseparately. Whatinformationneedtobeincludedinanobjectmodule?

1 Marks GATE-CSE/IT-1995( )

[A] Object code
[B] Relocationbits
[C] Namesandlocationsofallexternalsymbolsdefinedin theobjectmodule
[D] Absoluteaddressesofinternalsymbols

3) Which of the following system calls results inthe sending of SYN packets ?

1 Marks GATE-CSE/IT-2008( )

[A] socket
[B] bind
[C] listen
[D] connect

4) Which of the following statements about synchronous and asynchronous I/O is NOT true?

2 Marks GATE-CSE/IT-2008( )

[A] An ISR is invoked on completion of I/O in synchronous I/O but not in asynchronous I/O
[B] In both synchronous and asynchronous I/O an ISR (Interrupt Service Routine) is invoked after completion of the I/O
[C] A process making a synchronous I/O call waits until I/O is complete, but a process making an a synchronous I/O call does not wait for completion of the I/O
[D] In the case of synchronous I/O, the process waiting for the completion of I/O is woken up by the ISR that is invoked after the completion of I/O.

5) Register renaming is done is pipelined processors

1 Marks GATE-CSE/IT-2012( )

[A] as an alternative to register allocation at compile time
[B] for efficient access to function parameters and local variables
[C] to handle certain kinds of hazards
[D] as part of address translation

6) A computer handles several interrupt sources of which the following are relevant for this question.
Interrupt from CPU temperature sensor
Interrupt from Mouse
Interrupt from Keyboard
Interrupt from Hard Disk

1 Marks GATE-CSE/IT-2011( )

[A] Interrupt from Hard Disk
[B] Interrupt from Mouse
[C] Interrupt from Keyboard
[D] Interrupt from CPU temp sensor

Inter-process communication

Key Paper

1.	D	2.	D	3.	D	4.	A	5.	C
6.	D								

Deadlocks

1) Let m[0]…m[4] be mutexes (binary semaphores) and P[0] …. P[4] be processes.
Suppose each process P[i] executes the following:
wait (m[i];wait (m[(i+1) mode 4]);
………
release (m[i]); release (m[(i+1)mod 4]);
This could cause

1 Marks GATE-CSE/IT-2000( )

[A] Thrashing
[B] Deadlock
[C] Starvation, but not deadlock
[D] None of the above

2) Which of the following is NOT a valid deadlock prevention scheme?

2 Marks GATE-CSE/IT-2000( )

[A] Release all resources before requesting a new resource
[B] Number the resources uniquely and never request a lower numbered resource than the last one requested.
[C] Never request a resource after releasing any resource
[D] Request and all required resources be allocated before execution.

3) A computer has six tape drives, with n processes competing for them. Each process may need two drives. What is the maximum value of n for the system to be deadlock free?

1 Marks GATE-CSE/IT-1998( )

[A] 6
[B] 5
[C] 4
[D] 3

4) A solution to the Dining Philosophers Problem which avoids deadlock is

2 Marks GATE-CSE/IT-1996( )

[A] ensure that all philosophers pick up the left fork before the right fork
[B] ensure that all philosophers pick up the right fork before the left fork
[C] ensure that one particular philosopher picks up the left fork before the right fork, and that all other philosophers pick up the right fork before the left fork
[D] None of the above

5) Consider two processes P1 and P2 accessing theshared variables X and Y protected by two binary semaphores Sx and Syrespectively , both initialized to 1. P and V denote the usual semaphoreoperators, where P decrements the semaphore value, and V increments the

P1:	P2:
whiletrue do{	whiletrue do {
L1:…………	L3:…………..
L2:…………	L4:…………..
X =X + 1;	Y=Y + 1;
Y =Y – 1;	X= Y -1,
V(SX);	V(SY);
V(SY); }	V(SX); }

In order toavoid deadlock, the correct operators at L1,L2, L3 and L4 are respectively

2 Marks GATE-CSE/IT-2004( )

[A] P(SY), PaSX); P(SX),P(SY)
[B] P(SX), P(SY); P(SY), P(SX)
[C] P(SX), P(SX); P(SY), P(SY)
[D] P(SX), P(SY); P(SX), P(SY)

6) Suppose n processes,P1,…, Pnshare m identical resource units, whichcan be reserved and released one at atime. The maximum resource requirement of process piis sp where si >0. Which one of the following is a sufficient condition for ensuring thatdeadlock does not occur ?

2 Marks GATE-CSE/IT-2005( )

[A] $\forall i, S_i < m$
[B] $\forall i, S_i < n$
[C] $\sum_{i=1}^{n} S_i < (m+n)$
[D] $\sum_{i=1}^{n} S_i < (m*n)$

7) Which of the following is NOT true of deadlock prevention and deadlock avoidance schemes ?

2 Marks GATE-CSE/IT-2008( )

[A] In deadlock prevention, the request for resources is always granted if the resulting state is safe
[B] In deadlock avoidance, the request for resources is always granted if the resulting state is safe
[C] Deadlock avoidance is less restrictive than deadlock prevention
[D] Deadlock avoidance requires knowledge of resource requirements a priori

Deadlocks

8) Consider the following snapshot of a system running n processes. Process I is holding xi instances of a resource R, for 1 I n. Currently, all instances of R are occupied. Further, for all I, process I has placed a request for an additional yi instances while holding the xi instances it already has. There are exactly two processes p and q such that yp= yq= 0. Which one of the following can serve as a necessary condition to guarantee that the system is not approaching a deadlock ?

2 Marks GATE-CSE/IT-2006( )

[A] $\min(x_p, x_q) < \max_{k ? p q} Y_k$

[B] $Xp + Xq \max_{k ? p' q} Y_k$

[C] $\min(X_p, X_q) < 1$

[D] $\min(X_p, X_q) > 1$

9) Suppose n processes,$P_1,\ldots, P_n$ share m identical resource units, which can be reserved and released one at a time. The maximum resource requirement of process p_i is s_p where $s_i > 0$. Which one of the following is a sufficient condition for ensuring that deadlock does not occur ?

2 Marks GATE-CSE/IT-2005( )

[A] $\forall_i s_i < m$

[B] $\forall_i s_i < n$

[C] $\sum_{i=1}^{n} s_i < (m + n)$

[D] $\sum_{i=1}^{n} s_i < (m * n)$

10) Which of the following concurrency control protocols ensure both conflict serializability and freedom from deadlock?

I. 2-phase locking

II. Time-stamp ordering

1 Marks GATE-CSE/IT-2010( )

[A] I only

[B] II only

[C] Both I and II

[D] Neither I nor II

Deadlocks

Key Paper

1.	B	2.	A	3.	A	4.	C	5.	D
6.	C	7.	A	8.	B	9.	C	10.	B

memory management

Common Data for Q1 and Q2 is given below

Suppose we want to synchronize two concurrent processes P and Q using binary semaphores S and T. The code for the processes P and Q is shown below.

```
Process P:                    Process Q:
 while (1) {                  while (1) {
   W:                           Y:
     print'0';                  print '1';
     print '0'                   print '1';
    X:                          Z:
   }                            }
```

Synchronization statements can be inserted only at points W,X,Y and Z.

1) Which of the following will always lead to an output starting with '001100110011'?

2 Marks GATE-CSE/IT-2003( )

[A] P(S) at W, V(S) at X, P(T) at Y, V(T) at Z, S and T initially 1

[B] P(S) at W,V (T) at X,P(T) at Y,V(S) Z, S initially 1, and T initially 0

[C] P(S) at W,V)(T) at X,P (T) at Y,V(S) at Z, S and T initially 1

[D] P(S) at W, V(T) at X,P(T) at Y,V(T) at Z,S initially 1, and T initially 0

2) Which of the following will ensure that the output string never contains a substring of the form 01n0 or 10n1 where n is odd ?

2 Marks GATE-CSE/IT-2003( )

[A] P(S) at W,V(S) at X,P(T) at Y,V(T) at Z,S and T initially 1

[B] P(S) at W,V(T) at X,P(T) at Y,V(S) at Z,S and T initially 1

[C] P(S) at W,V(S) at X,P(S) at Y,V(S) at Z, S initially 1

[D] V(S) at W,V(T) at X,P(S) at Y,P (T) at Z,S and T initially 1

Common Data for Q3 and Q4 is given below

A processor uses 2-level page tables for virtual to physical address translation. Page tables for both levels are stored in the main memory. Virtual and physical addresses are both 32 bits wide. The memory is byte addressable. For virtual to physical address translation, the 10 most significant bits of the virtual address are used as index into the first level page table while the next 10 bits are used as index into the second level page table. The 12 least significant bits of the virtual address are used as offset within the page. Assume that the page table entries in both levels of page tables are 4 bytes wide. Further, the processor has a translation look-aside buffer (TLB), with a hit rate of 96%. The TLB caches recently used virtual page numbers and the corresponding physical page numbers. The processor also has a physically addressed cache with a hit ratio of 90%. Main memory access time is 10ns, cache access time is 1 ns, and TLB access time is also 1ns.

3) Assuming that no page faults occur, the average time taken to access a virtual address is approximately (to the nearest 0.5 ns)

2 Marks GATE-CSE/IT-2003( )

[A] 1.5ns

[B] 2 ns

[C] 3 ns

[D] 4 ns

4) Suppose a process has only the following pages in its virtual address space: two contiguous code pages starting at virtual address 0 x 00000000, two contiguous data pages starting at virtual address 0 x 00400000, and a stack page starting at virtual address 0 x FFFFF000. The amount of memory required for storing the page tables of this process is

2 Marks GATE-CSE/IT-2003( )

[A] 8 KB

[B] 12 KB

[C] 16 KB

[D] 20KB

5) The essential content(s) in each entry of a page table is/are

1 Marks GATE-CSE/IT-2009( )

[A] virtual page number

[B] page frame number

[C] both virtual page number and page fame number

[D] access right information

6) A multilevel page table is preferred in comparison to a single level page table for translating virtual address to physical address because

2 Marks GATE-CSE/IT-2009( )

[A] it reduces the memory access time to read or write a memory location

[B] it helps to reduce the size of page table needed to implement the virtual address space of a process

[C] if is required by the translation lookaside buffer

[D] if helps to reduce the number of page faults in page replacement algorithms.

7) A RAM chip has a capacity of 1024 words of 8 bits each (1K × 8) . The number of2 × 4 decoders with enable line needed to construct a 16K × 16 RAM from 1K × 8 RAM is

2 Marks GATE-CSE/IT-2013( )

[A] 4

[B] 5

[C] 6

[D] 7

8) In a system with 32 bit virtual addresses and 1 KB page size, use of one-level page tables for virtual to physical address translation is not practical because of

1 Marks GATE-CSE/IT-2003( )

[A] the large amount of internal fragmentation

[B] the large amount of external fragmentation

[C] the large memory overhead in maintaining page tables

[D] the large computation overhead in the translation process

9) The minimum number of page frames that must be allocated to a running process in a virtual memory environment is determined by

1 Marks GATE-CSE/IT-2004( )

[A] The instruction set architecture

[B] Page size

[C] Physical memory size

[D] number of processes in memory

10) The atomic feth-and-set x,y instruction unconditionally sets the memory location x to 1 and fetches the old value of x in y without allowing any intervening access to the memory location X. Consider the following implementation of P and V functions on a binary semaphore S.

```
void p (binary_ semaphore *S)
{
unsigned y;
unsigned *x = &(S-> value);}        do {
        fetch – and – set x,y;
      } while (y);
}
void  V(binary_semphore *S) {
          {S-> value = 0 ;
}
```

Which one of the following is true ?

2 Marks GATE-CSE/IT-2006( )

[A] The implementation may not work if context switching is disabled in P

[B] Instead of using fetch-and-set, a pair of normal load/store can be used

[C] The implementation of V is wrong

[D] The code does not implement a binary semaphore

11) A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128 page table entries and is 4-way set associative. The minimum size of the TLB tag is

2 Marks GATE-CSE/IT-2006( )

[A] 11 bits

[B] 13 bits

[C] 15 bits

[D] 20 bits

12) A computer system supports 32-bit virtual addresses as well as 32-bit physical addresses. Since the virtual address space is of the same size as the physical address space, the operating system designers decide to get rid of the virtual memory entirely. Which one of the following is true ?

2 Marks GATE-CSE/IT-2006( )

[A] Efficient implementation of multi-user support is no longer possible

[B] The processor cache organization can be made more efficient now

[C] Hardware support for memory management is no longer needed

[D] CPU scheduling can be made more efficient now

13)Fetch And Add (X, i) is an atomic Read-Modify-Write instruction that reads the value of memory location X, increments it by the value i, and returns the old value of X. It is used in the pseudocode shown below to implement a busy-wait lock. L is an unsigned integer shared variable initialized to 0. The value of 0 corresponds to lock being available, while any non-zero value corresponds to the lock being not available.

```
 AcquireLock(L){
 While (Fetch And Add(L,1))
L = 1;
}
          Release Lock(L){
           L = 0;
      }
```

This implementation

2 Marks GATE-CSE/IT-2012( )

[A] fails as L can overflow
[B] fails as L can take on a non-zero value when the lock is actually available
[C] works correctly but may starve some processes
[D] works correctly without starvation

14)Let the page fault service time be 10ms in a computer with average memory access time being 20ns. If one page fault is generated for every 10^6 memory accesses, what is the effective access time for the memory?

1 Marks GATE-CSE/IT-2011( )

[A] 21ns
[B] 30ns
[C] 23ns
[D] 35ns

15)Consider a hypothetical processor with an instruction of type LW R1, 20(R2), which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by the addition of constant 20 and the contents of register R2. Which of the following best reflects the addressing mode implemented by this instruction for the operand in memory?

1 Marks GATE-CSE/IT-2011( )

[A] Immediate Addressing
[B] Register Addressing
[C] Register Indirect Scaled Addressing
[D] Base Indexed Addressing

16)An 8KB direct mapped write-back cache is organized as multiple blocks, each of size 32-bytes. The processor generates 32-bit addresses. The cache controller maintains the tag information for each cache block comprising of the following.
1 Valid bit
1 Modified bit
As many bits as the minimum needed to identify the memory block mapped in the cache.
What is the total size of memory needed at the cache controller to store meta- data (tags) for the cache?

2 Marks GATE-CSE/IT-2011( )

[A] 4864bits
[B] 6144bits
[C] 6656bits
[D] 5376bits

17)A main memory unit with a capacity of 4 megabytes is built using 1M×1-bit DRAM chips. Each DRAM chip has 1K rows of cells with 1K cells in each row. The time taken for a single refresh operation is 100 nanoseconds. The time required to perform one refresh operation on all the cells in the memory unit is

1 Marks GATE-CSE/IT-2010( )

[A] 100 nanoseconds
[B] 100*2^{10} nanoseconds
[C] 1008$2^{20}$ nanoseconds
[D] 3200*2^{20} nanoseconds

18)Which of the following is not a form of memory?

1 Marks GATE-CSE/IT-2002( )

[A] instruction cache
[B] instruction register
[C] instruction opcode
[D] translation look-a-side buffer

19)The optimal page replacement algorithm will select the page that

1 Marks GATE-CSE/IT-2002( )

[A] Has not been used for the longest time in the past.
[B] Will not be used for the longest time in the future.
[C] Has been used least number of times.
[D] Has been used most number of times.

20)In the index allocation scheme of blocks to a file, the maximum possible size of the file depends on

2 Marks GATE-CSE/IT-2002( )

[A] the size of the blocks, and the size of the address of the blocks.
[B] the number of blocks used for the index, and the size of the blocks.

[C] the size of the blocks, the number of blocks used for the index, and the size of the address of the blocks.
[D] None of the above

21) More than one word are put in one cache block to

1 Marks GATE-CSE/IT-2001( )

[A] exploit the temporal locality of reference in a program
[B] exploit the spatial locality of reference in a program
[C] reduce the miss penalty
[D] none of the above

22) Which of the following statements is false?

1 Marks GATE-CSE/IT-2001( )

[A] Virtual memory implements the translation of a program's address space into physical memory address space
[B] Virtual memory allows each program to exceed the size of the primary memory
[C] Virtual memory increases the degree of multiprogramming
[D] Virtual memory reduces the context switching overhead

23) The process of assigning load addresses to the various parts of the program and adjusting the code and date in the program to reflect the assigned addresses is called

1 Marks GATE-CSE/IT-2001( )

[A] Assembly
[B] parsing
[C] Relocation
[D] Symbol resolution

24) Where does the swap space reside?

1 Marks GATE-CSE/IT-2001( )

[A] RAM
[B] Disk
[C] ROM
[D] On-chip cache

25) Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will

1 Marks GATE-CSE/IT-2001( )

[A] always decrease the number of page faults
[B] always increase the number of page faults
[C] sometimes increase the number of page faults
[D] never affect the number of page faults

26) A graphics card has on board memory of 1 MB. Which of the following modes can the card not support?

2 Marks GATE-CSE/IT-2000( )

[A] 1600 × 400 resolution with 256 colours on a 17 inch monitor
[B] 1600 × 400 resolution with 16 million colours on a 14 inch monitor
[C] 800 × 400 resolution with 16 million colours on a 17 inch monitor
[D] 800 × 800 resolution with 256 colours on a 14 inch monitor

27) Suppose the time to service a page fault is on the average 10 milliseconds, while a memory access takes 1 microsecond. Then a 99.99% hit ratio results in average memory access time of

2 Marks GATE-CSE/IT-2000( )

[A] 1.9999 milliseconds
[B] 1 millisecond
[C] 9.999 microseconds
[D] 1.9999 microseconds

28) Which of the following is/are advantage of virtual memory?

2 Marks GATE-CSE/IT-1999( )

[A] Faster access to memory on an average.
[B] Processes can be given protected address spaces.
[C] Linker can assign addresses independent of where the program will be loaded in physical memory.
[D] Programs larger than the physical memory size can be run.

29) A linker reads four modules whose lengths are 200, 800, 600 and 500 words, respectively. If they are loaded in that order, what are the relocation constants?

1 Marks GATE-CSE/IT-1998( )

[A] 0, 200, 500, 600
[B] 0, 200, 1000, 1600
[C] 200, 500, 600, 800
[D] 200, 700, 1300, 2100

30) A language L allows declaration of arrays whose sizes are not known during compilation. It is required to make efficient use of memory. Which one of the following is true?

memory management

1 Marks GATE-CSE/IT-1997(   )

[A] A compiler using static memory allocation can be written for L
[B] A compiler cannot be written for L; an interpreter must be used.
[C] A compiler using dynamic memory allocation can be written for L
[D] None of the above

31)Thrashing

1 Marks GATE-CSE/IT-1997(   )

[A] reduces page I/O
[B] decreases the degree of multiprogramming
[C] implies excessive page I/O
[D] improve the system performance

32)Dirty bit for a page in a page table

1 Marks GATE-CSE/IT-1997(   )

[A] helps avoid unnecessary writes on a paging device
[B] helps maintain LRU information
[C] allows only read on a page
[D] None of the above

33)A 1000 Kbyte memory is managed using variable partitions but to compaction. It currently has two partitions of sizes 200 Kbytes and 260 Kbytes respectively. The smallest allocation request in Kbytes that could be denied is for

2 Marks GATE-CSE/IT-1996(   )

[A] 151
[B] 181
[C] 231
[D] 541

34)In a paged segmented scheme of memory management, the segment table itself must have a page table because In a paged segmented

1 Marks GATE-CSE/IT-1995(   )

[A] the segment table is often too large to fit in one page
[B] each segment is spread over a number of pages
[C] segment tables point to page table and not to the physical locations of the segment
[D] the processor's description base register points to a page table

35)Which of the following page replacement algorithms suffers from Belady's anamoly?

1 Marks GATE-CSE/IT-1995,GATE-CSE/IT-1995(   )

[A] Optimal replacement
[B] LRU
[C] FIFO
[D] Both (a) and (c)

36)In a virtual memory system the address space specified by the address lines of the CUP must be ________than the physical memory size and _______than the secondary storage size.

2 Marks GATE-CSE/IT-1995(   )

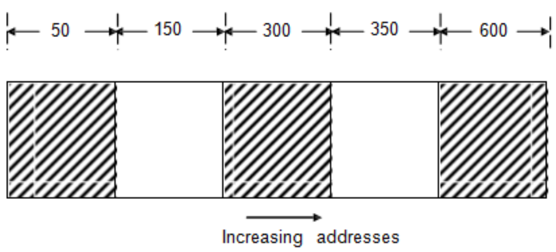
[A] smaller, smaller
[B] smaller, larger
[C] larger, smaller
[D] larger, larger

37)Amemorypagecontainingaheavilyusedvariablethatwasinitializedveryearlyandisinconstantuseisremovedwhen

1 Marks GATE-CSE/IT-1994(   )

[A] LRUpagereplacementalgorithmisused
[B] FIFOpagereplacementalgorithmisused
[C] LFUpagereplacementalgorithmisused
[D] Noneoftheabove

38)Consider the following heap (figure) in which blank regions are not in use and hatched region are in use.



The sequence of requests for blocks of size 300, 25, 125, 50 can be satisfied if we use

1 Marks GATE-CSE/IT-1994(   )

[A] eitherfirstfitorbestfitpolicy(anyone)
[B] firstfitbutnotbestfitpolicy
[C] bestfitbutfirstfitpolicy
[D] Noneoftheabove

memory management

39)A Unix-style I-node has 10 direct pointers and one single, one double and one triple indirect pointers. Disk block size is 1 Kbyte, disk block address is 32 bits, and 48-bit integers are used. What is the maximum possible file size ?

2 Marks GATE-CSE/IT-2004( )

[A] 2^{24} bytes
[B] 2^{32} bytes
[C] 2^{34} bytes
[D] 2^{48} bytes

40)A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer(TLB) which can hold a total of 128 page table entries and is 4-way setassociative. The minimum size of the TLB tag is

2 Marks GATE-CSE/IT-2006( )

[A] 11 bits
[B] 13 bits
[C] 15 bits
[D] 20 bits

41)A computer system supports 32-bit virtualaddresses as well as 32-bit physical addresses. Since the virtual address spaceis of the same size as the physical address space, the operating system designersdecide to get rid of the virtual memoryentirely. Which one of the following is true ?
(a) Efficient implementation of multi-user supportis no longer possible
(b) The processor cache organization can be mademore efficient now
(c)Hardware support for memory management is nolonger needed
(d) CPU scheduling can be made more efficient now

2 Marks GATE-CSE/IT-2006( )

[A] Efficient implementation of multi-user support is no longer possible
[B] The processor cache organization can be made more efficient now
[C] Hardware support for memory management is no longer needed
[D] CPU scheduling can be made more efficient now

42)The data block of a very large file in the Unix file system are allocated using

1 Marks GATE-CSE/IT-2008( )

[A] Contiguous allocation
[B] Linked allocation
[C] Indexed allocation
[D] an extension of indexed allocation

43)A processor uses 36 bit physical addresses and 32bit virtual addresses, with a page frame size of 4 Kbytes. Each page table entry is of size 4 bytes. At hree level page table is used for virtual-to-physical address translation,where the virtual address is used as follows.
· bits 30-31 are used to index into the first level page table,
· bits 21-29 are used to index into the second level page table
· bits 12-20 are used to index into the third level page table
· bits 0-11 are used as offset within the page
The number of bits required for addressing the next level page table (or page frame) in the page table entry of the first, second and third level page tables are respectively.

2 Marks GATE-CSE/IT-2008( )

[A] 20,20 and 20
[B] 24,24 and 24
[C] 24,24 and 20
[D] 25,25 and 24

Statement for Linked answer Q44 and Q45 is given below

44)A computer uses 46–bit virtual address, 32–bit physical address, and a three–level paged page table organization. The page table base register stores the base address of the first–level table (T1) ,which occupies exactly one page. Each entry of T1 stores the base address of a page of the second–level table (T2). Each entry of T2 stores the base address of a page of the third–level table (T3) Each entry of T3 stores a page table entry (PTE). The PTE is 32 bits in size. The processor used in the computer has a 1 MB 16 way set associative virtually indexed physically tagged cache. The cache block size is 64 bytes.

Q. What is the size of a page in KB in this computer?

2 Marks GATE-CSE/IT-2013,GATE-CSE/IT-2013( )

[A] 2
[B] 4
[C] 8
[D] 16

45)What is the minimum number of page colours needed to guarantee that no two synonyms map to different sets in the processor cache of this computer?

2 Marks GATE-CSE/IT-2013( )

[A] 2	[B] 4
[C] 8	[D] 16

memory management

Key Paper

1.	B	2.	C	3.	D	4.	C	5.	B
6.	B	7.	B	8.	C	9.	A	10.	A
11.	A	12.	C	13.	B	14.	B	15.	D
16.	D	17.	B	18.	C	19.	B	20.	B
21.	B	22.	D	23.	D	24.	B	25.	C
26.	A	27.	D	28.	D	29.	C	30.	C
31.	C	32.	A	33.	D	34.	A	35.	C
36.	C	37.	B	38.	B	39.	C	40.	C
41.	C	42.	D	43.	D	44.	C	45.	A

Disk scheduling

1) Which of the following disk scheduling strategies is likely to give the best through put?

1 Marks GATE-CSE/IT-1999( )

[A] Farthest cylinder next
[B] Nearest cylinder next
[C] First come first served
[D] Elevator algorithm

2) The root directory of a disk should be placed

2 Marks GATE-CSE/IT-1993( )

[A] at a fixed address in main memory
[B] at a fixed location on the disk
[C] anywhere on the disk
[D] at a fixed location on the system disk
[E] anywhere on the system disk

3) Consider an operating system capable of loading andexecuting a single sequential user process at a time. The disk head scheduling algorithm usedis First Served (FCFS). If FCFS is replaced by ShortestSeekTimeFirst (SSTF), claimed by the vendor to given 50% better benchmark results, whatis theexpected improvement in the I/Operformance of user programs?

1 Marks GATE-CSE/IT-2004( )

[A] 50%
[B] 40%
[C] 25%
[D] 0%

4) Consider a disk system with 100 cylinders. The requests to access the cylinders occur in following sequence :
4,34,10,7,19,73,2,15,6,20
Assuming that the head is currently at cylinder 50, what is the time taken o satisfy all requests if it takes 1 ms to move from one cylinder to adjacent one and shortest seek time first policy is used ?

2 Marks GATE-CSE/IT-2009( )

[A] 95 ms
[B] 119 ms
[C] 233 ms
[D] 276 ms

5) The enter_ CS ( ) and leave _CS () functions to implement critical section of a process are realized using test-and-set instructions as follows:

```
Void enter _ cs (X)
{
  while  (test –and-set(X)):
}
Void leave_ CS (X)
{
  X=0 ;
}
```

In the above solution, X is a memory location associated with the CS and is initialized to 0. Now consider the following statements
I. The above solution to CS problem is deadlock-free
II. The solution is starvation free
III. The processes enter CS in FIFO order
IV. More than one process can enter CS at the same time
Which of the above statements are TRUE?

2 Marks GATE-CSE/IT-2009( )

[A] I only
[B] I and II
[C] II and III
[D] IV only

6) Using a larger blocks size in a fixed block size file system leads to

1 Marks GATE-CSE/IT-2003( )

[A] Better disk throughput but poorer disk space utilization
[B] Better disk throughput and better disk space utilization
[C] Poorer disk throughput but better disk space utilization
[D] Poorer disk throughput and poorer disk space utilization.

7) Consider an operating system capable of loading and executing a single sequential user process at a time. The disk head scheduling algorithm used is First Served (FCFS). If FCFS is replaced by Shortest Seek Time First (SSTF), claimed by the vendor to given 50% better benchmark results, what is the expected improvement in the I/O performance of user programs?

1 Marks GATE-CSE/IT-2004( )

[A] 50%
[B] 40%

[C] 25% [D] 0%

8) Consider a hard disk with 16 recording surfaces (0 − 15) having 16384 cylinders (0 − 16383) and each cylinder contains 64 sectors (0 − 63) . Data storage capacity in each sector is 512 bytes. Data are organized cylinder–wise and the addressing format is . A file of size 42797 KB is stored in the disk and the starting disk location of the file is <1200, 9, 40>. What is the cylinder number of the last sector of the file, if it is stored in a contiguous manner?

2 Marks GATE-CSE/IT-2013( )

[A] 1281 [B] 1282
[C] 1283 [D] 1284

9) A Unix-style I-node has 10 direct pointers and one single, one double and one triple indirect pointers. Disk block size is 1 Kbyte, disk block address is 32 bits, and 48-bit integers are used. What is the maximum possible file size ?

2 Marks GATE-CSE/IT-2004( )

[A] 2^{24} bytes [B] 2^{32} bytes
[C] 2^{34} bytes [D] 2^{48} bytes

10) A file system with 300 GByte disk uses a file descriptor with 8 direct block addresses, 1 indirect block address and 1 doubly indirect block address. The size of each disk block is 128 Bytes and the size of each disk block address is 8 Bytes. The maximum possible file size in this file system is

2 Marks GATE-CSE/IT-2012( )

[A] 3 KBytes [B] 35 KBytes
[C] 280 KBytes [D] dependent on the size of the disk

11) An application loads 100 libraries at startup. Loading each library requires exactly one disk access. The seek time of the disk to a random location is given as 10ms. Rotational speed of disk is 6000rpm. If all 100 libraries are loaded from random locations on the disk, how long does it take to load all libraries? (The time to transfer data from the disk block once the head has been positioned at the start of the block may be neglected)

2 Marks GATE-CSE/IT-2011( )

[A] 0.50s [B] 1.50s
[C] 1.25s [D] 1.00s

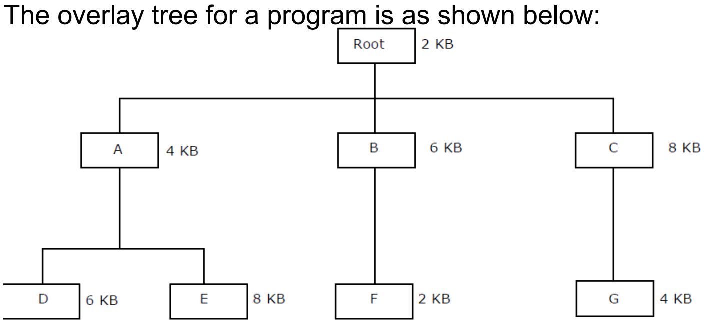
Disk scheduling

Key Paper

1.	C	2.	A	3.	D	4.	B	5.	A
6.	A	7.	D	8.	D	9.	C	10.	B
11.	B								

program evaluation

1) The overlay tree for a program is as shown below:



What will be the size of the partition (in physical memory) required to load (and run) this program?

2 Marks GATE-CSE/IT-1998( )

[A] 12 KB
[B] 14 KB
[C] 10 KB
[D] 8 KB

2) A critical section is a program segment

1 Marks GATE-CSE/IT-1996( )

[A] which should run in a certain specified amount of time
[B] which avoids deadlocks
[C] where shared resources are accessed
[D] which must be enclosed by a pair of semaphore operations, P and V

3) The address sequence generated by tracing a particular program executing in a pure demand paging system with 100 records per page with 1 free main memory frame is recorded as follows.What is the number of page faults?
0100 , 0200 , 0430 , 0499 , 0530 , 0560 , 0120 , 0220 , 0240 , 0260 , 0320 , 0370

2 Marks GATE-CSE/IT-1995( )

[A] 13
[B] 8
[C] 7
[D] 10

4) Which one of the following statements is true?

1 Marks GATE-CSE/IT-1994( )

[A] Macro definitions cannot appear within other macro definitions in assembly language programs
[B] Overlaying is used to run a program which is longer than the address space of computer
[C] Virtual memory can be used to accommodate a program which is longer than the address space of a computer
[D] It is not possible to write interrupt service routines in a high level language

5) A part of the system software, which under all circumstances must reside in the main memory, is

2 Marks GATE-CSE/IT-1993( )

[A] text editor
[B] assembler
[C] linker
[D] loader
[E] none of the above

6) Consider the following code fragment :

```
If (fork ( )= = 0)
{
a= a + 5;
print f(“%d, %d/n” a, &a);
}
Else
{
a- 5;
print f(“%d, %d/n”, a, &a);
}
```

Let u, v be the values printed by the parentprocess, and x,y be the values printed by the child process. Which one of the following is TRUE?

2 Marks GATE-CSE/IT-2005( )

[A] u = x + 10 and v = y
[B] u = x + 10 and v ≠ y
[C] u + 10 = x and v = y
[D] u + 10 = x and v ≠ y

program evaluation

7) The P and V operations on counting semaphores,where s is a counting semaphore, are defined as follows :

P(s): s=s -1;
Ifs <0then wait
V(s): s= s +1 ;
If s< 0 then wakeup a process waiting on s;

Assume that Pb and Vb, the wait and signal operationson binary semaphores are provided. Twobinary semaphores Xb and Yb are used to implement the semaphoreoperations P(s) and V(s) as follows :

```
P(s):Pb (Xb);
    s =s – 1
    if  (s <0) {
       Vb (Xb);
       Pb(Yb);
      }
    elseVb ( Xb) :
P(s) : Pb (Xb) ;
    s=  s  + 1;
    If (s< = 0) {
      Vb( Yb) ;
      Vb(Xb);
```

The initial values of Xb and Ybare respectively

2 Marks GATE-CSE/IT-2008( )

[A] 0 and 0 [B] 0 and 1
[C] 1 and 0 [D] 1 and 1

8) Consider an instruction pipeline with five stages without any branch prediction: Fetch Instruction (FI), Decode Instruction (DI), Fetch Operand (FO), Execute Instruction (EI) and Write Operand (WO). The stage delays for FI, DI, FO, EI and WO are 5 ns, 7 ns, 10 ns, 8 ns and 6 ns, respectively. There are intermediate storage buffers after each stage and the delay of each buffer is 1 ns. A programconsisting of 12 instructions $I_1, I_2, I_3, \ldots I_{12}$ is executed in this pipelined processor. Instruction I_4 is the only branch instruction and its branch target is I_9 .If the branch is taken during the execution of this program, the time (in ns) needed to complete the program is

2 Marks GATE-CSE/IT-2013( )

[A] 132 [B] 165
[C] 176 [D] 328

9) Consider the following code fragment :

```
If (fork ( )= = 0)
{a= a + 5; print f("%d, %d/n" a, &a); }
Else {a- 5; print f("%d, %d/n", a, &a); }
```

Let u, v be the values printed by the parent process, and x,y be the values printed by the child process. Which one of the following is TRUE?

2 Marks GATE-CSE/IT-2005( )

[A] u = x + 10 and v = y [B] u = x + 10 and v ≠ y
[C] u + 10 = x and v = y [D] u + 10 = x and v ≠ y

program evaluation

10)On a non-pipelined sequential processor, a program segment, which is a part of the interrupt service routine, is given to transfer 500 bytes from an I/O device to memory.
Initialize the address register
Initialize the count to 500
LOOP: Load a byte from device
Store in memory at address given by address register
Increment the address register
Decrement the count
If count != 0 go to LOOP
Assume that each statement in this program is equivalent to a machine instruction which takes one clock cycle to execute if it is a non-load/store instruction. The load-store instructions take two clock cycles to execute.
The designer of the system also has an alternate approach of using the DMA controller to implement the same transfer. The DMA controller requires 20 clock cycles for initialization and other overheads. Each DMA transfer cycle takes two clock cycles to transfer one byte of data from the device to the memory.
What is the approximate speedup when the DMA controller based design is used in place of the interrupt driven program based input-output?

2 Marks GATE-CSE/IT-2011( )

[A] 3,4 [B] 4,4
[C] 5,1 [D] 6,7

program evaluation

Key Paper

1.	B	2.	C	3.	C	4.	B	5.	A
6.	C	7.	C	8.	C	9.	D	10.	A

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Index- Databases

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Database Design

1) Which one of the following is a key factor for preferring B^+- trees to binary search trees for indexing database relations ?

2 Marks GATE-CSE/IT-2005( )

[A] Database relations have a large number of record

[B] Database relations are sorted on the primary key

[C] B^+ -trees require less memory than binary search trees

[D] Data transfer from disks is in blocks

2) A B^+ - tree index is to be built on the Name attribute of the relation STUDENT. Assume that all student names are of length 8 bytes, disk blocks are of size 512 bytes, and index pointers are of size 4 bytes. Given this scenario, what would be the best choice of the degree (i.e. the number of pointers per node) of the B+ - tree?

2 Marks GATE-CSE/IT-2002( )

[A] 16

[B] 42

[C] 43

[D] 44

Database Design

Key Paper

1.	D	2.	B

Normal forms

1) Consider a schema R(A,B,C,D) and functional dependencies A → B and C →D. Then the decomposition of R into R1 R_1 (AB) and R_2 (CD) is

1 Marks GATE-CSE/IT-2001( )

[A] dependency preserving and lossless join
[B] lossless join but not dependency preserving
[C] dependency preserving but not lossless join
[D] not dependency preserving and not lossless join

2) R(A,B,C,D) is a relation.Which of the following does not have a loss less join,dependency preserving BCNF decomposition?

2 Marks GATE-CSE/IT-2001( )

[A] A →B, B →CD
[B] A →B, B →C, C →D
[C] AB →C, C →AD
[D] A →BCD

3) Given the following relation instance

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance?

2 Marks GATE-CSE/IT-2000( )

[A] XY -→ Z and Z →Y
[B] YZ →X and Y →Z
[C] YZ →X and X →Z
[D] XZ →Y and Y →X

4) Let R = (a, b, c, d, e, f) be a relation scheme with the following dependencies c →f, e →a, ec →d. a →b. Which of the following is a key for R ?

1 Marks GATE-CSE/IT-1999( )

[A] CD
[B] EC
[C] AE
[D] AC

5) Consider the schema R = (S T U V) and the dependencies S → T, T →U. U →V and V →S. Let R = (R1 and R2) be a decomposition such that R1 ∩ R2 = ∅ . The decomposition is

2 Marks GATE-CSE/IT-1999( )

[A] not in 2NF
[B] in 2NF but not 3NF
[C] in 3NF but not in 2NF
[D] in both 2NF and 3NF

6) Which normal form is considered adequate for normal relational database design?

1 Marks GATE-CSE/IT-1998( )

[A] 2 NF
[B] 5 NF
[C] 4 NF
[D] 3 NF

7) There are five records in a database

Name	Age	Occupation	Category
Rama	27	CON	A
Abdul	22	ENG	A
Jeniffer	28	DOC	B
Maya	32	SER	D
Dev	24	MUS	C

There is an index file associated with this and it contains the values 1,3,2,5 and 4.Which one of the fields is the index built from?

1 Marks GATE-CSE/IT-1998( )

[A] Age
[B] Name
[C] Occupation
[D] Category

8) For a database relation R(a,b,c,d), where the domains of a, b, c, d include only atomic values, only the following functional dependencies and those that can be inferred from them hold:

a →c

b →d This relation is

Normal forms

2 Marks GATE-CSE/IT-1997( )

[A] in first normal form but not in second normal form
[B] in second normal form but not in third normal form
[C] in third normal form
[D] None of the above

9) Let R (a, b, c) and S(d, e, f) be two relations in which d is the foreign key of S that refers to the primary key of R. Consider the following four operations R and S
(a) Insert into R
(b) Insert into S
(c) Delete from R
(d) Delete from S
Which of the following is true about the referential integrity constraint above?

2 Marks GATE-CSE/IT-1997( )

[A] None of (a), (b), (c) or (d) can cause its violation
[B] All of (a), (b), (c) and (d) can cause its violation
[C] Both (a) and (d) can cause its violation
[D] Both (b) and (c) can cause its violation

10) Consider the following functional dependencies in a database:
Data_ of_ Birth Age
Age Eligibility
Name Roll_ number
Roll_number Name
Course_ number Course_ name
Course_number Instructor
(Roll_ number; Course_number) Grade
The relation (Roll_ number;Name, Date_ of_ birth, Age)is

2 Marks GATE-CSE/IT-2003( )

[A] in second normal normal form but not in third normal form
[B] in third normal form but not in BCNF
[C] in BCNF
[D] in none of the above

11) the relation scheme studentPerformance (name, course No, rollNo, grade) has the following functionaldependencies :
Name, course No →grade
RollNo, course No →grade
name → rollNo
rollNo →name
the highest normal form ofthis relation scheme is

2 Marks GATE-CSE/IT-2004( )

[A] 2 NF
[B] 3 NF
[C] BCNF
[D] 4 NF

12) The following functionaldependencies are given :

AB CD, AF D, DE F,C G,F E,G A
which one of the followingoptions is false ?

1 Marks GATE-CSE/IT-2006( )

[A] $\{CF\}^+$= {ACDEFG}
[B] $\{BG\}^+$={ABCDG}
[C] $\{AF\}^+$= {ACDEFG}
[D] $\{AB\}^+$ = { ABCDG}

13) Consider the followingrelational schemes for a librarydatabase:
Book (Title, Author, Catalog_no, Publisher, Year , price)
Collection (Title, Author,Catalog_no)
Which the followingfunctional dependencies :
I. Title Author → Catalog _no
II. Catalog_no → Title Author Publisher Year
III. Publisher TitleYear → Price
Assume {Author, Title} is the key for bothschemes : Which of the following statements is true ?

2 Marks GATE-CSE/IT-2008( )

[A] Both Book and Collection are in BCNF
[B] Both Book and Collection are in 3NF only
[C] Book is in 2NF and Collection is in 3NF
[D] Both Book and Collection are in 2NF only

14) Assume that, in thesuppliers relation above, each supplier and each street within a city has aunique name, and (sname, city) forms a candidate key. No other functional dependencies are impliedother than those implied by primary and candidate keys. Which one of the following is TRUE about theabove schema?

2 Marks GATE-CSE/IT-2009( )

[A] The schema is in BCNF
[B] The schema is in 3NF but not in BCNF
[C] The schema is in 2NF but not in 3 NF
[D] The schema is not in 2NF

15)The relation scheme student Performance (name, course No, rollNo, grade) has the following functional dependencies :

Name, course No →grade
RollNo, course No →grade
name → rollNo
rollNo →name

the highest normal form of this relation scheme is

2 Marks GATE-CSE/IT-2004( )

[A] 2 NF
[B] 3 NF
[C] BCNF
[D] 4 NF

16)Which-one of the following statements about normal forms is FALSE ?

1 Marks GATE-CSE/IT-2005( )

[A] (a) BCNF is stricter than 3 NF
[B] (b) Loss less, dependency-preserving decomposition into 3 NF is always possible
[C] Loss less, dependency-preserving decomposition into BCNF is always possible
[D] Any relation with two attributes is BCNF

17)The following functional dependencies are given :
AB → CD, AF→ D, DE →F,C →G,F→ E, G → A
which one of the following options is false ?

2 Marks GATE-CSE/IT-2006( )

[A] $\{CF\}^+ = \{ACDEFG\}$
[B] $\{BG\}^+ = \{ABCDG\}$
[C] $\{AF\}^+ = \{ACDEFG\}$
[D] $\{AB\}^+ = \{ACDFG\}$

18)Which one of the following statements is FALSE ?

2 Marks GATE-CSE/IT-2007( )

[A] Any relation with two attributes is in BCNF ?
[B] A relation in which every key has only one attribute is in 2NF
[C] A prime attribute can be transitively dependent on a key in 3NF relation
[D] A prime attribute can be transitively dependent on a key in a BCNF relation

19)Consider the following relational schemes for a library database:
Book (Title, Author, Catalog_ no, Publisher, Year, price)
Collection (Title, Author, Catalog_no)
Which the following functional dependencies :
I. Title Author → Catalog _no
II. Catalog_no → Title Author Publisher Year
III. Publisher Title Year → Price
Assume {Author, Title} is the key for both schemes :
Which of the following statements is true ?

2 Marks GATE-CSE/IT-2008( )

[A] Both Book and Collection are in BCNF
[B] Both Book and Collection are in 3NF only
[C] Book is in 2NF and Collection is in 3NF
[D] Both Book and Collection are in 2NF only

20) Which of the following is TRUE?

1 Marks GATE-CSE/IT-2012( )

[A] Every relation is 3NF is also in BCNF
[B] A relation R is in 3NF if every non-prime attribute of R is fully functionally dependent on every key of R
[C] Every relation in BCNF is also in 3NF
[D] No relation can be in both BCNF and 3NF

21)Relation R with an associated set of functional dependencies, F, is decomposed into BCNF. The redundancy (arising out of functional dependencies) in the resulting set of relations is

1 Marks GATE-CSE/IT-2002( )

[A] Zero
[B] More than zero but less than that of an equivalent 3NF decomposition
[C] Proportional to the size of F+
[D] Indetermine

22)With regard to the expressive power of the formal relational query languages, which of the following statements is true?

1 Marks GATE-CSE/IT-2002(   )

[A] Relational algebra is more powerful than relational calculus
[B] Relational algebra has the same power as relational calculus.
[C] Relational algebra has the same power as safe relational calculus.
[D] None of the above

23)The binary relation S = φ (empty set) on set A = {1,2,3} is

2 Marks GATE-CSE/IT-2002(   )

[A] Neither reflexive nor symmetric
[B] Symmetric and reflexive
[C] Transitive and reflexive
[D] Transitive and symmetric

24)Relation R is decomposed using a set of functional dependencies, F, and relation S is decomposed using another set of functional dependencies, G. One decomposition is definitely BCNF, the other is definitely. 3NF, but it is not known which is which. To make a guaranteed identification, which one of the following tests should be used on the decompositions? (Assume that the closures of F and G are available).

2 Marks GATE-CSE/IT-2002(   )

[A] Dependency-preservation
[B] Lossless-join
[C] BCNF definition
[D] 3NF definition

25)From the following instance of a relation schema R(A,B,C), we can conclude that:

A	B	C
1	1	1
1	1	0
2	3	2
2	3	2

2 Marks GATE-CSE/IT-2002(   )

[A] A functionally determines B and B functionally determines C
[B] A functionally determines B and B does not functionally determines C
[C] B does not functionally determines C
[D] A does not functionally determines B and B does not functionally determines C

Normal forms

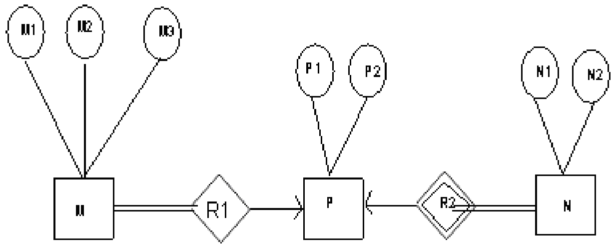
Key Paper

1.	**C**	**2.**	**C**	**3.**	**A**	**4.**	**B**	**5.**	**D**
6.	**D**	**7.**	**C**	**8.**	**A**	**9.**	**D**	**10.**	**D**
11.	**B**	**12.**	**C**	**13.**	**C**	**14.**	**B**	**15.**	**B**
16.	**C**	**17.**	**C**	**18.**	**D**	**19.**	**C**	**20.**	**C**
21.	**B**	**22.**	**B**	**23.**	**D**	**24.**	**C**	**25.**	**B**

ER diagrams

Common Data for Q1 and Q2 is given below

Consider the following ER diagram



1) The minimum number of tables needed to represent M,N,P,R1, R2 is

2 Marks GATE-CSE/IT-2008,GATE-CSE/IT-2008( )

[A] 2 [B] 3
[C] 4 [D] 5

2) Which of the following is a correct attribute set for one of the tables for the correct answer to the above question ?

2 Marks GATE-CSE/IT-2008( )

[A] {M1, M2, M3,P1} [B] {M1, P1, N1, N2}
[C] {M1, P1, N1} [D] {M1, P1}

Consider the following relational schema :

Suppliers (sid:integer, sname: string, city:string, street: string)
Parts(pid:integer, pname: string, color:string)
Catalog(sid:integer, pid:integer, cost:real)

3) Consider the following relational query on the above database:

```
SELECT S.name
FROM  Suppliers S
WHERE S. Sid NOT IN (SELECT C.sid
                     FROM Catalog C
                     WHERE C. Pid NOT IN (SELECT P. pid
                     FROM Parts P
                     WHERE P. color     'blue'))
```

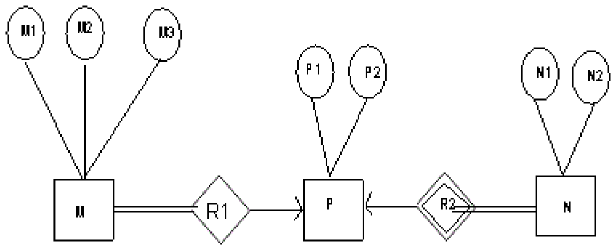
Assume that relations corresponding to the above schema are not empty. Which one of the following is the correct interpretation of the above query?

2 Marks GATE-CSE/IT-2009( )

[A] Find the names of all supplies who have supplied a non-blue part
[B] Find the names of all suppliers who have not supplied a non-blue part
[C] Find the names of all suppliers who have supplied only blue parts
[D] Find the names of all suppliers who have not supplied only blue parts

Common Data for Q5 and Q4 is given below

Consider the following ER diagram



4) The minimum number of tables needed to represent M,N,P,R1, R2 is

2 Marks GATE-CSE/IT-2008( )

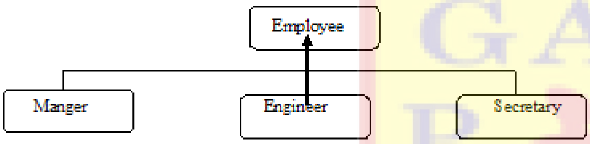
[A] 2 | [B] 3
[C] 4 | [D] 5

5) Which of the following is a correct attribute set for one of the tables for the correct answer to the above question ?

2 Marks GATE-CSE/IT-2008( )

[A] {M1, M2, M3,P1} | [B] {M1, P1, N1, N2}
[C] {M1, P1,N1} | [D] {M1, P1}

6) It is desired to design anobject-oriented employee record system for a company. Each employee has a name,unique id and salary, Employees belongto different categories and their salary is determined by their category. The functions get Name, geld and compute Salaryare required. Given the class hierarchybelow, possible locations for these functions are :
(i) getld is implemented inthe superclass
(ii) Getld is implemented inthe subclass
(iii) get Name is an abstractfunction in the superclass
(iv) get Name is implementedin the superclass
(v) getName is implemented inthe subclass
(vi) getsalary is an abstractfunction in the superclass
(vii) getSalary isimplemented in the superclass
(viii) get Salary isimplemented in the subclass



2 Marks GATE-CSE/IT-2004( )

[A] (i), (iv), (vi), (viii) | [B] (i), (iv), (vii)
[C] (i), (iii), (v), (vi), (viii) | [D] (ii), (v), (vii)

7) Le E1 and E2 be two entities in an E/R diagram with simple single valued attributes. R1 and R2 are two relationships between E1 and E2, where R1 is one-to-many and R2 is many-to-many. R1 and R2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model ?

2 Marks GATE-CSE/IT-2005( )

[A] 2 | [B] 3
[C] 4 | [D] 5

8) Le E_1 and E_2 be two entities in an E/R diagram with simple single valued attributes. R_1 and R_2 are two relationships between E_1 and E_2, where R_1 is one-to-many and R_2 is many-to-many. R_1 and R_2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model ?

2 Marks GATE-CSE/IT-2005( )

[A] 2 | [B] 3
[C] 4 | [D] 5

9) Consider a relation scheme R= (A,B,C,D,E,H) on which the following functional dependencies hold: {A→ B, BC→ D,E→ C, D→ A}. What are the candidate keys of R ?

2 Marks GATE-CSE/IT-2005( )

[A] AE, BE | [B] AE, BE, DE
[C] AEH, BEH, BCH | [D] AEH, BEH, DEH

10)Consider the following log sequence of two transactions on a bank account, with initial balance 12000, that transfer 2000 to a mortgage payment and, then apply a 5% interest.

1. T1 start
2. T1 B old = 12000 new = 10000
3. T1 M old = 0 ne= 2000
4. T1 commit
5. T2 start
6. T2 B old = 10000 new = 10500
7. T2 commit

Suppose the database system crashed just before log record 7 is written. When the system is restarted, which one statement is true of the recovery procedure ?

1 Marks GATE-CSE/IT-2006( )

[A] We must redo log record 6 to set B to 10500
[B] We must undo log record 6 to set B to 10000 and then redo log record 2 and 3
[C] We need not redo log records 2 and 3 because transaction T1 has committed
[D] We can apply redo and undo operations in arbitrary order because they are idempotent

11) The following key values are inserted into a B+ - tree in which order of the internal nodes is 3, and that of the leaf nodes is 2, in the sequence given below. The order of internal nodes is the maximum number of data items that can be stored in it. The B+ - tree is initially empty.

10,3, 6, 8, 4, 2,1

The maximum number of times leaf nodes would get split up as a result of these insertions is

2 Marks GATE-CSE/IT-2009( )

[A] 2
[B] 3
[C] 4
[D] 5

12)Given the basic ER and relational models, which of the following is INCORRECT?

1 Marks GATE-CSE/IT-2012( )

[A] An attribute of an entity can have more than one value
[B] An attribute of an entity can be composite
[C] In a row of a relational table, an attribute can have more than one value
[D] In a row of a relational table, an attribute can have exactly one value or a NULL value

13)Given max heap with level order elements as 10, 8, 5, 3, 2 in order. Insert 1 and 7 into the heap tree and the BFS of resultant tree.

2 Marks GATE-CSE/IT-2014( )

[A] #
[B] #
[C] 10, 8, 7, 3, 2, 1, 5
[D] #

ER diagrams

Key Paper

1.	B	2.	A	3.	A	4.	B	5.	A
6.	A	7.	B	8.	B	9.	D	10.	C
11.	B	12.	C	13.	C				

Transaction management

1) For the schedule given below, which of the following is correct:

1	Read	
2		Read B
3	Write A	
4		Read A
5		Write A
6		Write B
7	Read B	
8	Write B	

2 Marks GATE-CSE/IT-1999( )

[A] This schedule is serialized and can occur in a scheme using 2PL protocol

[B] This schedule is serializable but cannot occur in a scheme using 2PL protocol

[C] This schedule is not serialiable but can occur in a scheme using 2PL protocol

[D] This schedule is not seralisable and cannot occur in a scheme using 2PL protocol.

2) Consider the following logsequence of two transactions on a bank account, with initial balance 12000,that transfer 2000 to a mortgage payment and, then apply a 5% interest.

1. T1 start
2. T1 B old = 12000 new =10000
3. T1 M old = 0 ne= 2000
4. T1 commit
5. T2 start
6. T2 B old = 10000 new =10500
7. T2 commit

Suppose the database systemcrashed just before log record 7 is written. When the system is restarted,which one statement is true of the recovery procedure ?

2 Marks GATE-CSE/IT-2006( )

[A] We must undo log record 6 to set B to 10000 and then redo log record 2 and 3

[B] We need not redo log records 2 and 3 because transaction T1 has committed

[C] We can apply redo and undo operations in arbitrary order because they are idempotent

[D] We must redo log record 6 to set B to 10500

3) Consider the followingschedules involving two transactions.Which one of the following statements is TRUE ?

S1 : r1(X);r1(Y); r2(X); r2 (Y); w2(Y); w1(X)

S2 : r1(X); r2(X); r2(Y); W2(Y);r1(Y); w1(X)

2 Marks GATE-CSE/IT-2007( )

[A] both S_1 and $S_2$are conflict serializable

[B] S_1 is conflict serializable and S_2 is not conflict serializable

[C] S_1 is not conflict serializable and S_2 is conflict serializable

[D] Both S_1 and $S_2$are not conflict serializable

4) Consider three data items D1, D2, and D3, and the following execution schedule of transactions T1, T2 and T3. In the diagram, R(D) and W(D) denote the actions reading and writing the data item D respectively.

T1	T2	T3
	R(D3);	
	R(D2);	
	W(D2);	
		R(D2);
		R(D3)
R(D1);		
W(D1);		W(D2);
		W(D3);
	R(D1);	
R(D2);		
W(D2);		
	W(D1);	

2 Marks GATE-CSE/IT-2003( )

[A] The schedule is serializable as T2;T3; T1;

[B] The schedule is serializable as T2;T1;T3;

[C] The schedule is serializable as T3; T2;T1;

[D] The schedule is not serializable

5) Consider the following schedules involving two transactions.
Which one of the following statements is TRUE ?
S_1 : $r_1(X)$; $r_1(Y)$; $r_2(X)$; r_2 (Y); $w_2(Y)$; $w_1(X)$
S_2 : $r_1(X)$; $r_2(X)$; $r_2(Y)$; $W_2(Y)$; $r_1(Y)$; $w_1(X)$

2 Marks GATE-CSE/IT-2007( )

[A] both S_1 and S_2 are conflict serializable

[B] S_1 is conflict serializable and S_2 is not conflict serializable

[C] S_1 is not conflict serializable and S_2 is conflict serializable

[D] Both S_1 and S_2 are not conflict serializable

6) Consider two transactions T_1 and T_2, and four schedules S_1, S_2, S_3, S_4 of T_1 and T_2 as given below :

T_1: $R_1[x]$ $W_1[x]$ $W_1[y]$
T_2: $R_2[x]$ $R_2[y]$ $W_2[y]$
S_1: $R_1[x]$ $R_2[x]$ $R_2[y]$ $W_1[x]$ $W_1[y]$ $W_2[y]$
S_2: $R_1[x]$ $R_2[x]$ $R_2[y]$ $W_1[x]$ W_2 [y] $W_1[y]$
S_3: $R_1[x]$ $W_1[x]$ $R_2[x]$ $W_1[y]$ $W_1[y]$
S_4: $R_2[x]$ $R_2[y]$ $R_1[x]$ $W_1[x]$ W_1 [y] $W_2[y]$

Which of the above schedules are conflict – serializable ?

2 Marks GATE-CSE/IT-2009( )

[A] S_1 and S_2

[B] S_2 and S_3

[C] S_3 only

[D] S_4 only

Transaction management

Key Paper

1.	D	2.	B	3.	C	4.	D	5.	C
6.	B								

File structure in DBMS

1) The order of a leaf node in aB+- tree is the maximum number of (value, data record pointer) pairsit can hold. Given that the block size is 1K bytes. Data record pointer is 7bytes long, the value field is 9 bytes long and a block pointer is 6 byteslong, what is the order of the leaf node ?

2 Marks GATE-CSE/IT-2007( )

[A] 63 [B] 64
[C] 67 [D] 68

2) A clustering index is definedon the fields which are of type

1 Marks GATE-CSE/IT-2008( )

[A] Non-key and ordering [B] Non-key and non-ordering
[C] Key and ordering [D] Key and non-ordering

3) Consider a file of 1684 records. Each record is32 bytes long and its key field is of size 6 bytes. The file is ordered on a non-key field, andthe file organization is unspanned. Thefile is stored in a file system with block size 1024 bytes, and the size of ablock pointer is 10 bytes. If thesecondary index is built on the key field of the file, and a multi-level index scheme is used to store the secondaryindex, the number of first-level and second-level blocks in the multi-level indexare respectively

2 Marks GATE-CSE/IT-2008( )

[A] 8 and 0 [B] 128 and 6
[C] 256 and 4 [D] 512 and 5

4) Which one of the following is a key factor for preferring B+- trees to binary search trees for indexing database relations ?

2 Marks GATE-CSE/IT-2005,GATE-CSE/IT-2005( )

[A] Database relations have a large number of record [B] Database relations are sorted on the primary key
[C] B^+ -trees require less memory than binary search trees [D] Data transfer from disks is in blocks

5) The order of a leaf node in a B^+- tree is the maximum number of (value, data record pointer) pairs it can hold. Given that the block size is 1K bytes. Data record pointer is 7 bytes long, the value field is 9 bytes long and a block pointer is 6 bytes long, what is the order of the leaf node ?

2 Marks GATE-CSE/IT-2007( )

[A] 63 [B] 64
[C] 67 [D] 68

6) A clustering index is defined on the fields which are of type

1 Marks GATE-CSE/IT-2008( )

[A] Non-key and ordering [B] Non-key and non-ordering
[C] Key and ordering [D] Key and non-ordering

7) Consider a file of 1684 records. Each record is 32 bytes long and its key field is of size 6 bytes. The file is ordered on a non-key field, and the file organization is unspanned. The file is stored in a file system with block size 1024 bytes, and the size of a block pointer is 10 bytes. If the secondary index is built on the key field of the file, and a multi-level index scheme is used to store the secondary index, the number of first-level and second-level blocks in the multi-level index are respectively

2 Marks GATE-CSE/IT-2008( )

[A] 8 and 0 [B] 128 and 6
[C] 256 and 4 [D] 512 and 5

File structure in DBMS

Key Paper

1.	A	2.	A	3.	C	4.	D	5.	B
6.	A	7.	C						

Relationa Algera & Calculus

1) The relational algebra expression equivalent to the following tuple calculus expression
{t | t ∈ r ∧ (t [A] = 10 ∧ t [B] = 20)} is

1 Marks GATE-CSE/IT-1999( )

[A] $\sigma_{(A=10 \vee B=20)}(r)$
[B] $\sigma_{(A=10)}(r) \cup \sigma_{(B=20)}(r)$
[C] $\sigma_{(A=10)}(r) \cap \sigma_{(B=20)}(r)$
[D] $\sigma_{(A=10)}(r) - \sigma_{(B=20)}(r)$

2) Given two union compatible relations R_1(A,B) and R_2(C,D), what is the result of the operation R_1A = CAB = DR_2(a)

1 Marks GATE-CSE/IT-1998( )

[A] $R_1 \cup R_2$
[B] $R_1 \times R_2$
[C] $R_1 - R_2$
[D] $R_1 \cap R_2$

3) Let R1 (A,B,C) and R2(D,E)be two relation schema, where the primary keys are shown underlined, and let Cbe a foreign key in R1 referring to R2. Si[[pse tjee os mp violation of theabove referential integrity constraint in the corresponding relation
instances r1 and r2. Which one of the following relational algebraexpressions would necessarily produce an empty relation ?

2 Marks GATE-CSE/IT-2004( )

[A] (r_2) - (r_1)
[B] (r_1) - (r_2)
[C] $(r_1 R_2)$ - (r_1)
[D] $(r_1 R_2)$

4) Let R and S be two relationswith the following schema
R(P,Q,R1,R2,R3)
S(P,Q,S1 S2)
Where{P,Q} is the key for both schemas. Which of thefollowing queries are equivalent ?

I. (S)
II. (R) (S)
III. ((R) (S))
IV. ((R)- ((R) - (S)))

2 Marks GATE-CSE/IT-2008( )

[A] Only I and II
[B] Only I and III
[C] Only I, II and III
[D] Only I, III, and IV

5) Consider the following SQL query
select distinct a1, a2,….,an
from r1, r2…, rm
where P
For an arbitrary predicate P, this query is equivalent to which of the following relational algebra expressions ?

1 Marks GATE-CSE/IT-2003( )

[A] $a_1,a_2,\ldots\pi,a_n\ \sigma_P(r_1 \times r_2 \times \ldots \times r_m)$
[B] $a_1,a_2,\ldots\pi,a_n\ \sigma_P(r_1 \bowtie r_2 \bowtie \ldots \bowtie r_m)$
[C] $a_1 a_2,\ldots\pi,\ \sigma_P(r_1 \cup r_2 \cup \ldots \cup r_m)$
[D] $a_1,a_2,\ldots\pi,\ \sigma_P(r_1 \cap r_2 \cap \ldots \cap r_m)$

6) An index is clustered, if

1 Marks GATE-CSE/IT-2013( )

[A] it is on a set of fields that form a candidate key.
[B] it is on a set of fields that include the primary key.
[C] the data records of the file are organized in the same order as the data entries of the index.
[D] the data records of the file are organized not in the same order as the data entries of the index

7) Let R_1 (A,B,C) and R_2(D,E) be two relation schema, where the primary keys are shown underlined, and let C be a foreign key in R_1 referring to R_2. Suppose there is no violation of the above referential integrity constraint in the corresponding relation
instances r_1 and r_2. Which one of the following relational algebra expressions would necessarily produce an empty relation ?

1 Marks GATE-CSE/IT-2004( )

[A] $\pi_D(r_2) - \pi_C(r_1)$
[B] $\pi_C(r_1) - \pi_D(r_2)$
[C] $\pi_D(r_1 \bowtie_{c=d} R_2) - \pi_C(r1)$
[D] $\pi_C(r_1 \bowtie_{c=d} R_2)$

Relationa Algera & Calculus

8) Consider the relation Student(name, sex, marks) where the primary key is shown underlined, pertaining to students in a class that has at least one boy and one girl. What does the following relational algebra expression produce ?

$$\pi_{name}(\sigma_{sex=female}(Student)) - \pi_{name}(Student \bowtie_{(sex=female \wedge x=male \wedge marks \leq m)} \rho_{n,x,m}(Student))$$

2 Marks GATE-CSE/IT-2004( )

[A] names of girl students with the highest marks

[B] names of girl students with more marks than some boy student

[C] names of girl students with marks not less than some boy student

[D] names of girl students with more marks than all the boy students

9) The order of an internal node in a B* tree index is the maximum number of children it can have. Suppose that a child pointer takes 6 bytes, the search field value takes 14 bytes, and the block size is 512 bytes. What is the order of the internal node ?

2 Marks GATE-CSE/IT-2004( )

[A] 24

[B] 25

[C] 26

[D] 27

10) Let r be a relation instance with schema R= (A, B,C,D). We define $r_1 = \pi_{A,B,C}(r)$ and $r_2 = \pi_{A,D}(r)$. let $S = r_1 * r_2$ where * denotes natural join. Given that the decomposition of r into r_1 and r_2 is lossy, which one of he following is TRUE ?

1 Marks GATE-CSE/IT-2004( )

[A] $s \subset r$

[B] $r \cup s = r$

[C] $r \subset s$

[D] $r * s = s$

11) Information about a collection of students is given by the relation studInfo(studId, name, sex0 The relation enroll (studID, CoursId) gives which student has enrolled for (or taken) what course(s).Assume that every course is taken by at least one male and at least one female student. What does the following relational algebra expression represent ?

$$\prod_{courseId}((\prod_{studId}(\sigma_{sex="female"}(studInfo)) \times \prod_{courseId}(enroll)) - enroll)$$

2 Marks GATE-CSE/IT-2007( )

[A] Courses in which all the female students are enrolled

[B] Courses in which a proper subset of female students are enrolled

[C] Courses in which only male students are enrolled

[D] None of the above

12) Consider the relation employee (name, sex, supervisor Name(with name as the key. Supervisor Name- gives the name of the supervisor of the employee under consideration. What does the following Tuple {e.name | employee (e)$\vee$

$(\forall x)[\neg employee(x) \vee x.supervisorName$

$\neq e.name \vee x.sex =$"male"]}

2 Marks GATE-CSE/IT-2007( )

[A] names of employees with a male supervisor

[B] Names of employees with no immediate male subordinates

[C] Names of employees with no immediate female subordinates

[D] Names of employees with a female supervisor

Relationa Algera & Calculus

13)Let R and S be two relations with the following schema
R(P,Q,R1,R2,R3)
S(P,Q,S1 S2)
Where{P,Q} is the key for both schemas. Which of the following queries are equivalent ?

I. $\prod_{P}(\bowtie S)$

II. $\prod_{P}(R) \bowtie \prod_{P}(S)$

III. $\prod_{P}(\prod_{P,Q,}(R) \bigcap \prod_{P,Q}(S))$

IV. $\prod_{P}(\prod_{P,Q,}(R)(\prod_{P,Q,}(R), \prod_{P,Q}(S)))$

2 Marks GATE-CSE/IT-2008( )

[A] Only I and II
[B] Only I and III
[C] Only I, II and III
[D] Only I, II, and IV

14)Suppose R_1 (A, B) and R_2 (C, D) are two relation schemas. Let r_1 and r_2 be the corresponding relation instances. B is a foreign key that refers to C in R_2. If data in r_1 and r_2 satisfy referential integrity constrains, which of the following is ALWAYS TRUE?

2 Marks GATE-CSE/IT-2012( )

[A] $\Pi_B(r_1) - \Pi_C(r_2) = \varnothing$
[B] $\Pi_C(r_2) - \Pi_B(r_1) = \varnothing$
[C] $\Pi_B(r_1) = \Pi_C(r_2)$
[D] $\Pi_B(r_1) - \Pi_C(r_2) \neq \varnothing$

15)Consider a relational table r with sufficient number of records, having attributes A_1, A_2,..., $A_n$and let $1 \leq p \leq n$. Two queries Q1 and Q2 are given below.
Q1 : $\pi_{A_1 \ldots A_n}(\sigma_{A_p = c}(r))$where c is a const
Q2 : $\pi_{A_1 \ldots A_n}(\sigma_{c_1 \leq A_p \leq c_2}(r))$where c1 and c2 are constants
The database can be configured to do ordered indexing on A_p or hashing on A_p. Which of the following statements is TRUE?

2 Marks GATE-CSE/IT-2011( )

[A] Ordered indexing will always outperform hashing for both queries
[B] Hashing will always outperform ordered indexing for both queries
[C] Hashing will outperform ordered indexing on Q1, but not on Q2
[D] Hashing will outperform ordered indexing on Q2, but not on Q1

16)Let r and s be two relations over the relation schemes R and S respectively, and let A be an attribute in R. then the relational algebra expression $\sigma_{A=a}(r \bowtie s)$always equal to

1 Marks GATE-CSE/IT-2001( )

[A] $\sigma_{A=a}(r)$
[B] r
[C] $\sigma_{A=a}(r) \bowtie s$
[D] None of the above

Relationa Algera & Calculus

Key Paper

1.	**C**	**2.**	**D**	**3.**	**B**	**4.**	**D**	**5.**	**A**
6.	**C**	**7.**	**A**	**8.**	**D**	**9.**	**C**	**10.**	**C**
11.	**C**	**12.**	**C**	**13.**	**C**	**14.**	**A**	**15.**	**C**
16.	**C**								

SQL queries

Common Data for Q1 and Q2 is given below

Consider the following relations A, B and C:

A

Id	Name	Age
12	Arun	60
15	Shreya	24
99	Rohit	11

B

Id	Name	Age
15	Shreya	24
25	Hari	40
98	Rohit	20
99	Rohit	11

C

Id	Phone	Area
10	220	02
99	2100	01

1) How many tuples does the result of the following SQL query contain?

```
SELECT A.Id
 FROM A

WHERE A.Age >ALL(SELECT B.Age
 FROM B
 WHERE B.Name = 'Arun')
```

2 Marks GATE-CSE/IT-2012,GATE-CSE/IT-2012(   )

[A] 4 [B] 3

[C] 0 [D] 1

2) How many tuples does the result of the following relational algebra expression contain? Assume that the schema of A ∪ B is the same as that of A.

$(A \cup B) \bowtie_{A.Id>40 \ \vee \ C.Id<15} C$

2 Marks GATE-CSE/IT-2012(   )

[A] 7 [B] 4

[C] 5 [D] 9

3) Consider a relational table with a single record for each registered student with the following attributes.

1. Registration_Number: Unique registration number for each registered student
2. UID: Unique Identity number, unique at the national level for each citizen
3. BankAccount_Number: Unique account number at the bank. A student can have multiple accounts or joint accounts. This attributes stores the primary account number
4. Name: Name of the Student
5. Hostel_Room: Room number of the hostel

Which of the following options is INCORRECT?

1 Marks GATE-CSE/IT-2011(   )

[A] BankAccount_Number is a candidate key

[B] Registration_Number can be a primary key

[C] UID is a candidate key if all students are from the same country

[D] If S is a superkey such that S ∩ UID is NULL then S ∪ UID is also a superkey

SQL queries

4) Database table by name Loan_Records is given below.

Borrower	Bank_Manager	Loan_ Amount
Ramesh	Sunderajan	10000.00
Suresh	Ramgopal	5000.00
Mahesh	Sunderajan	7000.00

What is the output of the following SQL query? SELECT count(*)
FROM(
(SELECT Borrower. Bank_Manager FROM Loan_Records) AS S
NATURAL JOIN
(SELECT Bank_Manager, Loan_Amount FROM Loan_Records) AS T
);

2 Marks GATE-CSE/IT-2011( )

[A] 3 [B] 9
[C] 5 [D] 6

5) Consider a database table T containing two columns X and Y each of type integer. After the creation of the table, one record (X= 1, Y=l) is inserted in the table.
Let MX and MY denote the respective maximum values of X and Y among all records in the table at any point in time. Using MX and MY, new records are inserted in the table 128 times with X and Y values being MX+1, 2*MY+1 respectively. It may be noted that each time after the insertion, values of MX and MY change.

What will be the output of the following SQL query after the steps mentioned above are carried out?

SELECT Y FROM T WHERE X=7;

2 Marks GATE-CSE/IT-2011( )

[A] 127 [B] 255
[C] 129 [D] 257

6) A relational schema for a train reservation database is given below
Passenger (pid, pname, age)
Reservation (pid, cass, tid)

Table : Passenger

pid	'pname	Age
0	'Sachin'	65
1	'Rahul'	66
2	'Sourav'	67
3	'Anil'	69

Table : Re servation

pid	class	tid
0	'AC'	8200
1	'AC'	8201
2	'SC'	8201
5	'AC'	8203
1	'SC'	8204
3	'AC'	8202

What pids are returned by the following SQL query for the above instance of the tables?
SELECT pid
FROM Re servation
WHERE class = ' AC ' AND

EXISTS (SELECT *

FROM Passenger

WHERE age >65 AND
Passenger.pid = Reservation.pid)

1 Marks GATE-CSE/IT-2010( )

[A] 1,0 [B] 1,2
[C] 1,3 [D] 1,5

SQL queries

7) The following functional dependencies hold for relations R(A, B, C) and S(B, D, E)
$B \rightarrow A$,
$A \rightarrow C$
The relation R contains 200tuples and the relation S contains 100tuples. What is the maximum number of tuples possible in the natural join $R \bowtie S$?

2 Marks GATE-CSE/IT-2010( )

[A] 100
[B] 200
[C] 300
[D] 2000

8) Which of the following relational calculus expressions is not safe?

2 Marks GATE-CSE/IT-2001( )

[A] $\{t \mid \exists u \in R_1(t[A] = u[A]) \wedge \neg \exists s \in R_2(t[A] = s[A])\}$
[B] $\{t \mid \forall u \in R_1(u[A] = "x" \Rightarrow \exists s \in R_2(t[A] = s[A] \wedge s[A] = u[A]))\}$
[C] $\{t \mid \neg (t \in R_1)\}$
[D] $\{t \mid \exists u \in R_1(t[A] = u[A]) \wedge \exists s \in R_2(t[A] = s[A])\}$

9) Consider a relation geq which represents "greater than or equal to", that is, (x,y)∈ geq only if y≥x.

```
create table geq
(
lb        integer     not null
ub        integer     not null
primary key 1b
foreign key (ub) references geq on delete cascade )
```

Which of the following is possible if a tuple (x,y) is deleted?

2 Marks GATE-CSE/IT-2001( )

[A] A tuple (z,w) with z >y is deleted
[B] A tuple (z,w) with z >x is deleted
[C] A tuple (z,w) with w <x is deleted
[D] The deletion of (x,y) is prohibited

10) Given relations r(w,x) and s(y,z), the result of

```
select distinct w,x
from r, s
```

is guaranteed to be same as r, provided

2 Marks GATE-CSE/IT-2000( )

[A] r has no duplicates and s is non-empty
[B] r and s have no duplicates
[C] s has no duplicates and r is non-empty
[D] r and s have the same number of tuples

11) In SQL, relations can contain null values, and comparisons with null values are treated as unknown. Suppose all comparisons with a null value are treated as false. Which of the following pairs is not equivalent?

2 Marks GATE-CSE/IT-2000( )

[A] x = 5   not (not (x = 5)
[B] x = 5   x >4 and x <6, where x is an integer
[C] x ≠ 5   not (x = 5)
[D] None of the above

12) Consider the join of a relation R with a relation S. If R has m tuples and S has n tuples then the maximum and minimum sizes of the join respectively are

1 Marks GATE-CSE/IT-1999( )

[A] m + n and 0
[B] mn and 0
[C] m + n and $|m - n|$
[D] mn and m + n

13) Which of the following is/are correct?

2 Marks GATE-CSE/IT-1999( )

[A] An SQL query automatically eliminates duplicates
[B] An SQL query will not work if there are no indexes on the relations
[C] SQL permits attribute names to be repeated in the same relation
[D] None of the above

SQL queries

14)Consider the set of relationsshown below and the SQL query that follow;
Students: Roll_ number, Name,Date_ of_ birth)
Courses : (Course_ number, Course_name, Instructor)
Grades: (Roll_ number,Course_ number, Grade)
Select distinct Name
From Students, courses,Grades
Where Students. Roll_number=Grades. Roll_ number
And Courses. Instructor = Korth
And courses. Course _number=Grades. Course _ number
And Grades. Grade =A
Which of the following sets is computed by the above query ?

2 Marks GATE-CSE/IT-2003( )

[A] Names of students who have got an A grade in all courses taught by Korth
[B] Names of students who have got an A graded in all courses
[C] Name of students who have got an A grade in at least one of the courses taught by Korth
[D] None of the above.

15)The order of an internal node in a B* tree index is the maximum number of children it can have. Suppose that a child pointer takes 6 bytes, the search field value takes14 bytes, and the block size is 512 bytes. What is the order of the internal node ?

2 Marks GATE-CSE/IT-2004( )

[A] 24
[B] 25
[C] 26
[D] 27

16)The relation book (title,price) contains the titles and prices of different books. Assuming that no two books have the same price,
What does the following sQL

```
select title
from book as B
where (selectcount(*)
         from book as T
          where T. price >B. Price) <5
```

2 Marks GATE-CSE/IT-2005( )

[A] Titles of the four most expensive books
[B] Title of the fifth most inexpensive book
[C] Title of the fifth most expensive book
[D] Title of the five most expensive books

17)Consider the relation account(customer, balance) where customer is a primary key and there are no nullvalues. We would like to rank customersaccording to decreasing balance. Thecustomer with the largest balance gets rank. 1. Ties are not broken but ranks are skipped: if exactly two customers have the largest balance theyeach get rank 1 and rank 2 is not assigned.
Query 1: Select A. customer, count (B. customer)fromaccount A, account B where A. customer
Query 2 : Select A. customer,1 + count (B. customer) from account
A, account Bwhere A. balance <B. balance 7 group by A. customer
Consider these statementsabout Query 1 and Query 2.
1. Query 1 will produce thesame row set as Query 2 for some but not all databases
2. Both Query 1 Query 2 are correct implementations of thespecification
3. Query 1 is a correctimplementation of the specification but Query 2 is not
4. Neither Query 1 nor Query2 is a correct implementation of the specification
5. Assigning rank with a purerelational Query takes less time than scanning in decreasing balance order andassigning ranks using ODBC
Which two of the abovestatements are correct ?

2 Marks GATE-CSE/IT-2006( )

[A] 1 and 3
[B] 1 and 4
[C] 3 and 5
[D] 2 and 5

SQL queries

18)Consider the relationenrolled (student, course) in which (student, course) is the primary key, andthe relation paid(Student,amount) wherestudent is the primary key. Assume nonull values and no foreign key. Assumeno null values and no foreign keys or integrity constraints, Given the following four queries :
Query 1: select student fromenrolled where student in select student form paid)
Query 2: Select student frompaid where student in (select student from enrolled)
Query 3: Select E. studentfrom enrolled E, paid P where E. student= P student
Query 4: Select student frompaid where exists (select * from enrolled where enrolled. Student = paid. student
Which one of the followingstatements is correct ?

2 Marks GATE-CSE/IT-2006( )

[A] All queries return identical row sets for any database
[B] Query 2 and Query 4 return identical row sets for all databases but there exist databases for which Query 1 and Query 2 return different row sets
[C] There exist databases for which Query 3 returns strictly fewer rows than Query 2
[D] There exist databases for which Query 4 will encounter an integrity violation at runtime.

19)Information about a collection of students is given by the relation studInfo(studId, name, sex0 The relation enroll (studID, CoursId) gives which student has enrolled for (or taken) what course(s). Assume that every course is taken by at least one male and at least one female student. What does the following relational algebra expression represent ?

2 Marks GATE-CSE/IT-2007( )

[A] Courses in which all the female students are enrolled
[B] Courses in which a proper subset of female students are enrolled
[C] Courses in which only male students are enrolled
[D] None of the above

20)Consider the relation employee (name, sex, supervisor Name(with name as the key. Supervisor Name- gives the name of the supervisor of the employee under consideration. What does the following Tuple
{e.name | employee (e)

__(x) [employee (x) x. supervisor Name

e.name x.sex = “male”]}

2 Marks GATE-CSE/IT-2007( )

[A] Names of employees with no immediate male subordinates
[B] Names of employees with no immediate female subordinates
[C] Names of employees with a female supervisor
[D] names of employees with a male supervisor

21)Consider the table employee(empId, name, department, salary) and the two queries Q1, Q2 below. Assuming that department 5 has more than one employee, and we want to find the employees who get higher salary than anyone in the department 5, which one of the statements is TRUE for any arbitrary employee table ?

```
Q1 :    Select e. empId
        From employee e
        Where not exists
(Select * Fro employee s Where s. department = “5” and
        s. salary >= e. salary)
Q2:     Select e. empId
      From employee e
      Where e. salary >Any

      (Select distinct salary From employee s Where s. department= “5”)
```

2 Marks GATE-CSE/IT-2007( )

[A] Q_1 is the correct query.
[B] Q_2 is the correct query
[C] Both Q_1 and Q_2 produce the same answer
[D] Neither Q_1 nor Q_2 is the correct query

22)Which one of the following statements is FALSE ?

2 Marks GATE-CSE/IT-2007( )

[A] Any relation with two attributes is in BCNF ?
[B] A relation in which every key has only one attribute is in 2NF
[C] A prime attribute can be transitively dependent on a key in 3NF relation
[D] A prime attribute can be transitively dependent on a key in a BCNF relation

SQL queries

23)Consider the relation Student(name, sex, marks) where the primary key is shown underlined, pertaining to students in a class that has at least one boy and one girl. What does the following relational algebra expression produce ?
$\Pi_{nsme}(r_{sex=femals}))P_{name}(Student) \bowtie_{(sex=female)} r_{nxm}(Student))$

^ x=male
^ marks <= m)

2 Marks GATE-CSE/IT-2004( )

[A] names of girl students with the highest marks
[B] names of girl students with more marks than some boy student
[C] names of girl students with marks not less than some boy student
[D] names of girl students with more marks than all the boy students

24)Which-one of the following statements about normal forms is FALSE ?

1 Marks GATE-CSE/IT-2005( )

[A] BCNF is stricter than 3 NF
[B] Loss less, dependency-preserving decomposition into 3 NF is always possible
[C] Loss less, dependency-preserving decomposition into BCNF is always possible
[D] Any relation with two attributes is BCNF

25)Let r be a relation instance with schema R= (A, B,C,D). We define $r_1 = \Pi_{A,B,C}(r)$ and $r_1 = \Pi_{A,D}(r)$ let S= r1 * r2 where * denotes natural join. Given that the decomposition of r into r1 and r2 is lossy, which one of he following is TRUE ?

1 Marks GATE-CSE/IT-2005( )

[A] s⊂ r
[B] r U s = r
[C] r ⊂s
[D] r*s =s

26)The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A	B
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is :

2 Marks GATE-CSE/IT-2005( )

[A] (3,4) and (6,4)
[B] (5,2) and (7,2)
[C] (5,2) (7,2) and (9,5)
[D] 1

27)Consider the following relation schema pertaining to a students database;
Student (rollno, name, address)
Enroll(rollno, courseno, coursename)
Where the primary keys are shown underlined. The number of tuples in the student and Enroll tables are 120 and 8 respectively. What are the maximum and minimum number of tuples that can be present in (Student*enroll), where '*' denotes natural join ?

1 Marks GATE-CSE/IT-2004( )

[A] 8,8
[B] 120,8
[C] 960,8
[D] 960,120

28)The employee information in a company is stored in the relation Employee(name, sex, salary, dept Name)
Consider the following SQL query

```
Select dept Name
        From Employee
        where  sex = 'M'
   group by dept Name
   having avg (salary)
        (select avg(salary) from Employee)
```

It returns the names of the department in which

2 Marks GATE-CSE/IT-2004( )

[A] the average salary is more than the average salary in the company

[B] the average salary of male employees is more than the average salary of all male employees in the company

[C] the average salary of male employees is more than the average salary of employees in the same department

[D] the average salary of male employees is more than the average salary in the company.

29)The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A	B
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is :

2 Marks GATE-CSE/IT-2005( )

[A] (3,4) and (6,4)

[B] (5,2) and (7,2)

[C] (5,2) (7,2) and (9,5)

[D] 1

30)The relation book (title, price) contains the titles and prices of different books. Assuming that no two books have the same price,
What does the following sQL

```
select title
 from book as B
 where (select count(*)
 from book as T
            where T. price >B. Price) <5
```

2 Marks GATE-CSE/IT-2005( )

[A] Titles of the four most expensive books

[B] Title of the fifth most inexpensive book

[C] Title of the fifth most expensive book

[D] Title of the five most expensive books

SQL queries

31)Consider the relation enrolled (student, course) in which (student, course) is the primary key, and the relation paid(Student,amount) where student is the primary key. Assume no null values and no foreign key. Assume no null values and no foreign keys or integrity constraints, Given the following four queries :
Query 1: select student from enrolled where student in select student form paid)
Query 2: Select student from paid where student in (select student from enrolled)
Query 3: Select E. student from enrolled E, paid P where E. student = P student
Query 4: Select student from paid where exists (select * from enrolled where enrolled. Student = paid. student
Which one of the following statements is correct ?

2 Marks GATE-CSE/IT-2006( )

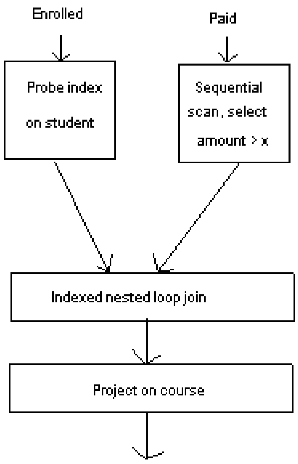
[A] All queries return identical row sets for any database

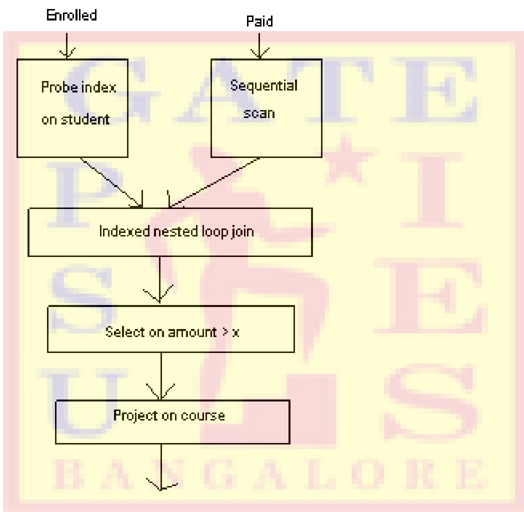
[B] Query 2 and Query 4 return identical row sets for all databases but there exist databases for which Query 1 and Query 2 return different row sets

[C] There exist databases for which Query 3 returns strictly fewer rows than Query 2

[D] There exist databases for which Query 4 will encounter an integrity violation at runtime.

32)Consider the relation enrolled (student, course) in which (student, course) is the primary key, and the relation paid (student, amount) where student is the primary key. Assume no null values and no foreign keys or integrity constraints. Assume that amounts 6000, 7000, 8000, 9000 and 10000 were each paid by 20% of the students. Consider these query plans (Plan 1 on left, Plan 2 on right) to " list all courses taken by students who have paid more than x".





A disk seek takes 4 ms. Disk data transfer bandwidth is 300 MB/s and checking a tuple to see if amount us greater than x takes 10 s Which of the following statements is correct ?

2 Marks GATE-CSE/IT-2006( )

[A] plan 1 and Plan 2 will not output identical row sets for all databases

[B] A course may be listed more than once in the output of Plan 1 for some databases

[C] For x = 5000, Plan 1 executes faster than Plan 2 for all databases

[D] For x = 9000, Plan 1 executes slower than plan 2 for all databases

33)Consider the table employee (empId, name, department, salary) and the two queries Q_1, Q_2 below. Assuming that department 5 has more than one employee, and we want to find the employees who get higher salary than anyone in the department 5, which one of the statements is TRUE for any arbitrary employee table ?

Q_1 : Select e. empId
From employee
Where not exists
(Select * Fro employee s Where s. department = "5" and s. salary >= e. salary)

Q_2: Select e. empId
From employee
Where e. salary >Any
(Select distinct salary From employee s Where s. department = "5")

2 Marks GATE-CSE/IT-2007( )

[A] Q1 is the correct query.
[B] Q2 is the correct query
[C] Both Q1 and Q2 produce the same answer
[D] Neither Q_1 nor Q_2 is the correct query

34) Consider the following relational schema.
Students(rollno:integer, sname: string)
Courses(courseno:integer, cname: string)
Registration(rollno:integer,courseno;integer, percent: real)
Which of the following queries are equivalent to this query in English?
"Find the distinct names of all students who score more than 90% in the course numbered 107"
(I) SELECT DISTINCT S.sname
FROM Students as S, Registration as R
WHERE R.rollno=S.rollno AND R.Courseno=107 AND R.percent>90
(II) $\Pi_{sname}(\sigma_{courseno=107} \wedge percent > 90(Registration \quad Student))$
(III) {T | ∃S ∈ Students, ∃R ∈ Registration (S.rollno = R.rollno ∧R.courseno = 107 ∧ R.percent >90 ∧ T.sname = S.name)}
(IV) $\{< S_N >| \exists S_R \exists R_P (< S_R , S_N > \in Students \wedge < S_R, 107, R_P > \in Registration \wedge R_P > 90)\}$

2 Marks GATE-CSE/IT-2013( )

[A] I, II, III and IV
[B] I, II and III only
[C] I, II and IV only
[D] II, III and IV only

35) Which of the following statements are TRUE about an SQL query?
P : An SQL query can contain a HAVING clause even if it does not have a GROUP BY clause
Q : An SQL query can contain a HAVING clause only if it has GROUP BY clause
R : All attributes used in the GROUP BY clause must appear in the SELECT clause
S : Not all attributes used in the GROUP BY clause need to appear in the SELECT clause

1 Marks GATE-CSE/IT-2012( )

[A] P and R
[B] P and S
[C] Q and R
[D] Q and S

36) Suppose a circular queue of capacity (n - 1) elements is implemented with an array of n elements. Assume that the insertion and deletion operations are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR = FRONT = 0. The conditions to detect queue full and queue empty are

2 Marks GATE-CSE/IT-2012( )

[A] full: (REAR+1) mod n==FRONT
empty: REAR ==FRONT
[B] full:(REAR+1)mod n==FRONT
empty: (FRONT+1)mod n==REAR
[C] full:
REAR==FRONT
empty: (REAR+1) mod n ==FRONT
[D] full:(FRONT+1)mod n==REAR
empty: REAR ==FRONT

Statement for Linked answer Q37 and Q38 is given below

37) Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.
F = {CH → G, A → BC, B → CFH, E → A, F → EG} is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R

Q.How many candidate keys does the relation R have?

2 Marks GATE-CSE/IT-2013,GATE-CSE/IT-2013( )

[A] 3
[B] 4
[C] 5
[D] 6

38) The relation R is

2 Marks GATE-CSE/IT-2013( )

[A] in INF, but not in 2NF
[B] in 2NF, but not in 3NF
[C] in 3NF, but not in BCNF
[D] in BCNF

SQL queries

Key Paper

1.	B	2.	A	3.	A	4.	C	5.	A
6.	C	7.	A	8.	C	9.	B	10.	A
11.	C	12.	B	13.	D	14.	C	15.	D
16.	D	17.	B	18.	B	19.	C	20.	B
21.	B	22.	D	23.	D	24.	C	25.	C
26.	C	27.	A	28.	D	29.	C	30.	D
31.	A	32.	C	33.	B	34.	A	35.	A
36.	A	37.	B	38.	A						

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Index- Computer Organization and Architecture

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CO Intro

Common Data for Q1 Q2 and Q3 is given below

Consider a machine a 2-way set associative data cache of size 64 kbytes and block size 16 bytes. The cache is managed using 32 bit virtual addressed and the page size is 4 Kbytes. A program to be run on this machine begins as follows.

double APR[1024] [1024]
int i,j;
/* initalize array APR to 0.0*/
for [i=0; i <1024 ; i ++)
for (j=0; k <1024;j++
ARR [i][j]=0.0;

The size of double 8 bytes. Array APR is in memory starting at the beginning of virtual page 0 x FF000 and
stored in row major order. The cache is initially empty and no pre-fetching is done. The only data memory references made by the program are those to array APR..

1) The total size of the tags in the cache directory is

2 Marks GATE-CSE/IT-2008,GATE-CSE/IT-2008,GATE-CSE/IT-2008,GATE-CSE/IT-2008( )

[A] 32kbits [B] 34kbits
[C] 64kbits [D] 68kbits

2) Which of the following array elements has the same cache index as APR[0] [0]?

2 Marks GATE-CSE/IT-2008( )

[A] APR[0] [4] [B] APR[4] [0]
[C] ARR[0][5] [D] APR[5][0]

3) The cache hit ratio for this initialization loop is

2 Marks GATE-CSE/IT-2008,GATE-CSE/IT-2008( )

[A] 0% [B] 25%
[C] 50% [D] 75%

Common Data for Q4 and Q5 is given below

Consider a machine with a byte addressable main memory of 2^{16}bytes. Assume that a direct mapped data cache consisting of 32 lines of 64 bytes each is used in the system.
A 50 x 50 two-dimensional array of bytes is stored in the main memory starting from memory location 1100 H. Assume that the data cache is initially empty. The complete array is accessed twice. Assume that the contents of the data cache do not change in between the two accesses.

4) How many data cache misses will occur in total ?

2 Marks GATE-CSE/IT-2007( )

[A] 40 [B] 50
[C] 56 [D] 59

5) Which of the following lines of the data cache will be replaced by new blocks in accessing the array

2 Marks GATE-CSE/IT-2007,GATE-CSE/IT-2007( )

[A] line 4 to line 11 [B] line 4 to line 12
[C] line 0 to line 7 [D] line 0 to line 8

Common Data for Q7 and Q6 is given below

A CPU has a 32 KB direct mapped cache with 128-byte block size. Suppose A is a two dimensional array of size 512 x 512 with elements that occupy 8-bytes each/ Consider the following two C code segments, P1 and P2.

```
P1 : for (i=0;i< 512; i ++)          {
      for (j=0; j <512; j++)              {
                x+ = A[i] [j];
         }
}
P2: for (i=0; i <512; i++)           {
            for (j=0 ; j <512 ; j++)    {
         {x + = A[j] [i];}
         }
}
```

P1 and P2 are executed independently with the same initial state, namely, the array A is not in the cache and i,j, x are in registers.

Let the number of cache misses experienced by P1 be M_1 and that for P2 be M_2.

6)The value of M_1 is

2 Marks GATE-CSE/IT-2006( )

[A] 0 [B] 2048
[C] 16384 [D] 262144

7)The value of the ratio M_1 / M_2 is

2 Marks GATE-CSE/IT-2006,GATE-CSE/IT-2006( )

[A] 0 [B] 1/16
[C] 1/8 [D] 16

Common Data for Q8 and Q9 is given below

Consider two cache organizations : The first one is 32 KB 2-way set associative with 32-byte block size. The second one is of the same size but direct mapped. The size of an address is 32 bits in both cases A 2-to 1 multiplexer has latency of 0.6ns while a k-bit comparator has a latency of k/10-ns. The hit latency of the set associative organization is h_1 while that of the direct mapped one is h_2.

8)The value of h1 is

2 Marks GATE-CSE/IT-2006,GATE-CSE/IT-2006( )

[A] 2.4ns [B] 2.3ns
[C] 1.8ns [D] 1.7ns

9)The value of h_2 is

2 Marks GATE-CSE/IT-2006( )

[A] 2.4ns [B] 2.3ns
[C] 1.8ns [D] 1.7ns

Common Data for Q10 and Q11 is given below

Consider two cache organizations : The first one is 32 KB 2-way set associative with 32-byte block size. The second one is of the same size but direct mapped. The size of an address is 32 bits in both cases A 2-to 1 multiplexer has latency of 0.6ns while a k-bit comparator has a latency of k/1-ns. The hit latency of the set associative organization is h1 while that of the direct mapped one is h2.

10)The value of h1 is

2 Marks GATE-CSE/IT-2006( )

[A] 2.4ns [B] 2.3ns
[C] 1.8ns [D] 1.7ns

11)The value of h2 is

2 Marks GATE-CSE/IT-2006( )

[A] 2.4ns [B] 2.3ns
[C] 1.8ns [D] 1.7ns

12)Consider a small two-way set-associative cache memory, consitsting of four blocks. For choosing the block to be replace, use the least recently used (LRU) scheme. The number of cache misses for the following sequence of block addresses is 8, 12, 0, 12, 8

2 Marks GATE-CSE/IT-2004( )

[A] 2 [B] 3
[C] 4 [D] 5

13)Increasing the RAM of a computer typically improves performance because

1 Marks GATE-CSE/IT-2005( )

[A] Virtual memory increases [B] Larger RAMs are faster
[C] Fewer page faults occur [D] Fewer segmentation faults occur

14)Consider a direct mapped cache of size 32 KB with block size 32 bytes. The CPU generates 32 bit addresses. The number of bits needed for cache indexing and the number of tag bits are respectively.

2 Marks GATE-CSE/IT-2005( )

[A] 10,17 [B] 10,22
[C] 15,17 [D] 5,17

15)A CPU has a cache with block size 64 bytes. The main memory has k banks, each bank being c bytes wide. Consecutive c-byte chunks are mapped on consecutive banks with warp-around. All the k banks can be accessed in parallel, but two accesses to the same bank must be serialized. A cache block access ay involve multiple iterations of parallel bank accesses depending on the amount of data obtained by accessing all the k banks in parallel. Each iteration requires decoding the bank numbers to be accessed in parallel and this takes k/2 ns. The latency of one bank access is 80 ns. If c=2 and k=24, then latency of retrieving a cache block starting at address zero from main memory is

2 Marks GATE-CSE/IT-2006( )

[A] 92ns [B] 104ns
[C] 172ns [D] 184ns

16)Consider a small two-way set-associative cache memory, consitsting of four blocks. For choosing the block to be replace, use the least recently used (LRU) scheme. The number of cache misses for the following sequence of block addresses is 8, 12, 0, 12, 8

2 Marks GATE-CSE/IT-2004( )

[A] 2 [B] 3
[C] 4 [D] 5

17)Increasing the RAM of a computer typically improves performance because

1 Marks GATE-CSE/IT-2005( )

[A] Virtual memory increases [B] Larger RAMs are faster
[C] Fewer page faults occur [D] Fewer segmentation faults occur

18)Consider a direct mapped cache of size 32 KB with block size 32 bytes. The CPU generates 32 bit addresses. The number of bits needed for cache indexing and the number of tag bits are respectively.

2 Marks GATE-CSE/IT-2005( )

[A] 10,17 [B] 10,22
[C] 15,17 [D] 5,17

19)A CPU has a cache with block size 64 bytes. The main memory has k banks, each bank being c bytes wide. Consecutive c-byte chunks are mapped on consecutive banks with warp-around. All the k banks can be accessed in parallel, but two accesses to the same bank must be serialized. A cache block access ay involve multiple interations of parallel bank accesses depending on the amount of data obtained by accessing all the k banks in parallel. Each iteration requires decoding the bank numbers to be accessed in parallel and this takes k/2 ns. The latency of one bank access is 80 ns. If c=2 and k=24, then latency of retrieving a cache block starting at address zero from main memory is

2 Marks GATE-CSE/IT-2006( )

[A] 92ns [B] 104ns
[C] 172 ns [D] 184 ns

20)Consider 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. The number of bits in the TAG,LINE and WORD fields are respectively

1 Marks GATE-CSE/IT-2007( )

[A] 9,6,5 [B] 7,7,6
[C] 7,5,8 [D] 9,5,6

21)For inclusion to hold between two cache level L1 and L2 in a multilevel cache hierarchy, which of the following
are necessary ?
1. L1 must be a write-through cache
2. L2 must be write-through cache
3. The associativity of L2 must be greater that of L1
4. The L2 cache must be at least as large as the L1 cache.

2 Marks GATE-CSE/IT-2008( )

[A] 4 only
[B] and 2 only
[C] 1,2 and 4 only
[D] 1,2,3 and 4

22)How many 32K x 1 RAM chips are needed to provide a memory capacity of 256 K-bytes ?

1 Marks GATE-CSE/IT-2009( )

[A] 8
[B] 32
[C] 64
[D] 128

23)How many 32K x 1 RAM chips are needed to provide a memory capacity of 256 K-bytes ?

1 Marks GATE-CSE/IT-2008( )

[A] 8
[B] 32
[C] 64
[D] 128

24)Consider a 4 way set associative cache (initially empty) with total 16 cache blocks. The main memory consists of 256 blocks and the request for memory blocks is in the following order :
0,255, 1,4,3,8,133, 159, 216, 129, 63, 8,48,32,73, 92, 155
Which one of the following memory block will NOT be in cache if LRU replacement policy is used ?

2 Marks GATE-CSE/IT-2009( )

[A] 3
[B] 8
[C] 129
[D] 216

25)The main memory of a computer has 2 cm blocks while the cache has 2 c blocks. If the cache uses the set associative mapping scheme with 2 blocks per set, then block k of the main memory maps to the set

1 Marks GATE-CSE/IT-1999( )

[A] (k mod m) of the cache
[B] (k mod c) of the cache
[C] (k mod 2c) of the cache
[D] (k mod 2 cm) of the cache

26)Which of the following devices should get higher priority in assigning interrupts?

1 Marks GATE-CSE/IT-1998( )

[A] Hard disk
[B] Printer
[C] keyboard
[D] Floppy disk

27)Locality of reference implies that the page reference being made by a process

1 Marks GATE-CSE/IT-1997( )

[A] will always be to the page used in the previous page reference
[B] is likely to be to one of the pages used in the last few page references
[C] will always be to one of the pages existing in memory
[D] will always lead to a page fault

28)A ROM is sued to store the table for multiplication of two 8-bit unsigned integers.The size of ROM required is

1 Marks GATE-CSE/IT-1996( )

[A] 256 * 16
[B] 64 k * 8
[C] 4k * 16
[D] 64k * 16

29)Both's algorithm for integer multiplication gives worst performance when the multiplier pattern is

1 Marks GATE-CSE/IT-1996( )

[A] 101010 …..1010
[B] 100000 …..0001
[C] 111111 …..1111
[D] 011111 …..1110

30)The principle of locality justifies the use of

1 Marks GATE-CSE/IT-1995( )

[A] interrupts
[B] DMA
[C] polling
[D] cache memory

31)A computer system has a 4k word cache organized in block set associative manner with 4 blocks per set , 64 words per block. The number of bits in the SET and WORD fields of the main memory address format is:

2 Marks GATE-CSE/IT-1995( )

[A] 15, 40 [B] 6,4
[C] 7, 2 [D] 4, 6

32)Consider 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. The number of bits in the TAG,LINE and WORD fields are respectively

1 Marks GATE-CSE/IT-2007( )

[A] 9,6,5 [B] 7,7,6
[C] 7,5,8 [D] 9,5,6

33)For inclusion to hold between two cache level L1 and L2 in a multilevel cache hierarchy, which of the following are necessary ?
1. L1 must be a write-through cache
2. L2 must be write-through cache
3. The associativity of L2 must be greater that of L1
4. The L2 cache must be at least as large as the L1 cache.

2 Marks GATE-CSE/IT-2008( )

[A] 4 only [B] and 2 only
[C] 1,2 and 4 only [D] 1,2,3 and 4

CO Intro

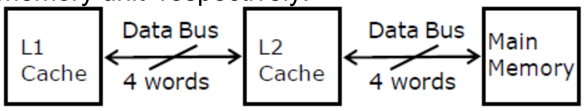
Key Paper

1.	D	2.	B	3.	C	4.	A	5.	C
6.	C	7.	B	8.	A	9.	B	10.	A
11.	B	12.	C	13.	C	14.	A	15.	D
16.	C	17.	C	18.	A	19.	D	20.	D
21.	A	22.	C	23.	C	24.	D	25.	B
26.	C	27.	B	28.	D	29.	A	30.	D
31.	D	32.	D	33.	A				

Memory interface

Common Data for Q1 and Q2 is given below

A computer system has an L1 cache, an L2 cache, and a main memory unit connected as shown below. The block size in L1 cache is 4 words. The block size in L2 cache is 16 words. The memory access times are 2 nanoseconds. 20 nanoseconds and 200 nanoseconds for L1 cache, L2 cache and main memory unit respectively.



1) When there is a miss in L1 cache and a hit in L2 cache, a block is transferred from L2 cache to L1 cache. What is the time taken for this transfer?

2 Marks GATE-CSE/IT-2010,GATE-CSE/IT-2010( )

[A] 2 nanoseconds [B] 20 nanoseconds
[C] 22 nanoseconds [D] 88 nanoseconds

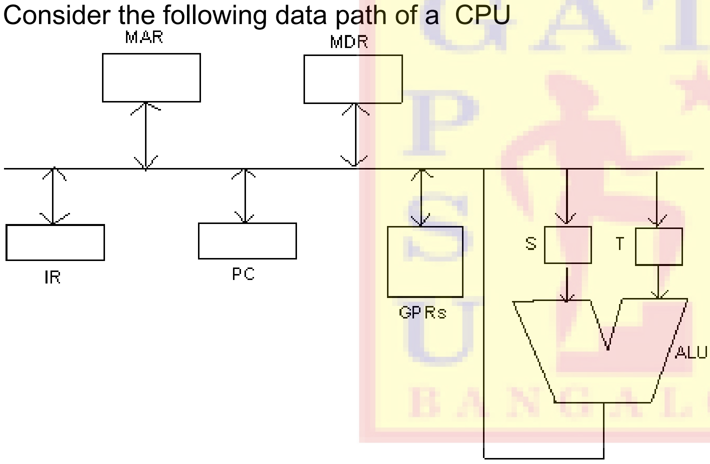
2) When there is a miss in both L1 cache and L2 cache, first a block is transferred from main memory to L2 cache, and then a block is transferred from L2 cache to L1 cache. What is the total time taken for these transfers?

2 Marks GATE-CSE/IT-2010( )

[A] 222 nanoseconds [B] 888 nanoseconds
[C] 902 nanoseconds [D] 968 nanoseconds

Common Data for Q3 and Q4 is given below

Consider the following data path of a CPU



The, ALU, the bus and all the registers in the data path are of identical size. All operations including incrementation of the PC and the GPRs are to be carried out in the ALU. Two clock cycle are needed for memory read operation- the first one for loading address in the MAR and the next one for loading data from the memory but into the MDR.

3) The instruction "add R0, R1" has the register transfer in terpretation R0 <= R0 + R1. The minimum number of clock cycles needed for execution cycle of this instruction is

2 Marks GATE-CSE/IT-2005( )

[A] 2 [B] 3
[C] 4 [D] 5

4) The instruction " call Rn, sub " is a two word instruction. Assuming that PC is incremented during the fetch cycle of the first word of the instruction, its register transfer interpretation is
Rn <= PC + 1 ;
PC <= M [PC];
The minimum number of CPU clock cycles needed during the execution cycle of this instruction is

2 Marks GATE-CSE/IT-2005,GATE-CSE/IT-2005( )

[A] 2 [B] 3
[C] 4 [D] 5

Common Data for Q5 and Q6 is given below

Memory interface

Consider the following program segment for a hypothetical CPU having three user registers R1, R2 and R3

Instruction	operation	Instruction size (in words)
_MOV R1,5000	; R1 ←Memory [5000]	2
_MOVR2,(R1)	;R2←Memory[(R1)]	1
_ADD R2, R3	; R2 ←R2R3	1
_MOV 6000, R2	; Memory [6000] ←R2	2
HALT	; Machine halts	1

5) Consider that the memory is byte addressable with size 32 bits, and the program has been loaded starting from memory location 1000(decimal). If an interrupt occurs while the CPU has been halted after executing the HALT instruction, the return address(in decimal saved in the stack will be

2 Marks GATE-CSE/IT-2004( )

[A] 1007　　[B] 1020
[C] 1024　　[D] 1028

6) Let the clock cycles required for various operations be as follows:
Register to / from memory transfer: 3 clock cycles
ADD with both operands in register: 1 clock cycle
Instruction fetch and decode: 2 clock cycle per word
The total number of clock cycles required to execute the program is

2 Marks GATE-CSE/IT-2004,GATE-CSE/IT-2004( )

[A] 29　　[B] 24
[C] 23　　[D] 20

Common Data for Q7 and Q8 is given below

Consider the following assembly language program for a hypothetical processor. A, B and C are 8 bit registers. The meanings of various instructions are shown as comments.

MOV B, # 0 : B 0
MOV C, # 8 : C 8Z
CMP C, # 0 : Compare C with 0
JZX : Jump to X if zero flag is set
SUB C, # 1 : C C – 1
RRCA, # 1 : right rotate A through carry by one bit. Thus :
; if the initial values of A and the carry
Flag are a7…a0 and
; c0 respectively, their values after the execution of this
; instruction will be c0 a7…a1 and a0 respectively.
JCY : Jump to Y if carry flag is set
JMPZ : Jump to ZY
ADDB, # 1 ; B B + 1
JMPZ : Jump to ZX:

7) If the initial value of register A is A0, the value of register B after the program execution will be

2 Marks GATE-CSE/IT-2003,GATE-CSE/IT-2003( )

[A] the number of 0 bits in A_0　　[B] the number of 1 bits in A0
[C] A_0　　[D] 8

8) Which of the following instructions when inserted at location X will ensure that the value of register A after program execution is the same as its initial value?

2 Marks GATE-CSE/IT-2003( )

[A] RRCA, # 1　　[B] NOP ; no operation
[C] LRCA # 1, ; left rotate A through carry flag by one bit　　[D] ADDA, # 1

9) Normally user programs are prevented from handling I/O directly by I/O instructions in them. For CPU having explicit I/O instructions, such I/O protection is ensured by having the I/O instructions privileged. In a CPU with memory mapped I/O, there is no explicit I/O instruction. Which one of the following is true for a CPU with memory mapped I/O?

1 Marks GATE-CSE/IT-2005( )

[A] I/O protection is ensured by operating system routine(s)　　[B] I/O protection is ensured by a hardware trap

[C] I/O protection is ensured during system configuration

[D] I/O protection is not possible

10)A low memory can be connected to 8085 by using

1 Marks GATE-CSE/IT-2001( )

[A] INTER

[B] $\overline{RESET\ IN}$

[C] HOLD

[D] READY

11)Normally user programs are prevented from handling I/O directly by I/O instructions in them. For CPU having explicit I/O instructions, such I/O protection is ensured by having the I/O instructions privileged. In a CPU with memory mapped I/O, there is no explicit I/O instruction. Which one of the following is true for a CPU with memory mapped I/O?

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Memory interface

Key Paper

1.	D	2.	D	3.	C	4.	B	5.	C
6.	B	7.	B	8.	A	9.	A	10.	D
11.	A								

Storage manager

Common Data for Q1 and Q2 is given below

A hard disk has 63 sectors per track. 10 platters each with 2 recording surfaces and 1000 cylinders. The address of a sector is given as a triple $< c, h, s >$where is the cylinder number, h is the surface number and s is the sector number. This, the 0^{th} sector is addressed as $< 0, 0, 0 >$ the 1^{st} sector as $< 0, 0, 1 >$ and so on.

1) The address$< 400, 16, 29 >$ corresponds to sector number :

2 Marks GATE-CSE/IT-2009( )

[A] 505035 [B] 505036
[C] 505037 [D] 505038

2) The address of 1039^{th}sector is

2 Marks GATE-CSE/IT-2009,GATE-CSE/IT-2009( )

[A] $< 0, 15, 31 >$ [B] $< 0, 16, 30 >$
[C] $< 0, 16, 31 >$ [D] $< 0, 17, 31 >$

3) The minimum number of record movements required to merge five files A (with 10 records), B (with 20 records), C (with 15 records), D (with 5 records) and E (with 25 records) is:

2 Marks GATE-CSE/IT-1999( )

[A] 165 [B] 90
[C] 75 [D] 65

4) What is the swap space in the disk used for ?

1 Marks GATE-CSE/IT-2005( )

[A] Saving temporary html pages [B] Saving process data
[C] Storing the super-block [D] Storing device drivers

5) Consider a disk drive with the following specifications. 16 surfaces, 512 tracks/surface, 512 sectors/track, 1 KB /sector, rotation speed 3000 rpm. The disk is operated in cycle stealing mode whereby whenever one byte word is ready it is sent to memory; similarly, for writing, the disk interface reads a 4 byte word from the memory in each DMA cycle. Memory cycle time is 40 nsec. The maximum percentage of time that the CPU gets blocked during DMA operation is

2 Marks GATE-CSE/IT-2005( )

[A] 10 [B] 25
[C] 40 [D] 50

6) Consider a disk pack with 16 surface, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively

1 Marks GATE-CSE/IT-2007( )

[A] 256 Mbyte, 19 bits [B] 256 Mbyte, 28 bits
[C] 512 Mbyte, 20 bits [D] 64 Gbyte, 28 bits

7) For a magnetic disk with concentric circular tracks, the latency is not linearly proportional to the seek distance due to

2 Marks GATE-CSE/IT-2008( )

[A] non-uniform distribution of requests [B] arm starting and stopping inertia
[C] higher capacity of tracks on the periphery of the platter [D] use of unfair arm scheduling policies.

8) What is the swap space in the disk used for ?

1 Marks GATE-CSE/IT-2005( )

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Storage manager

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Storage manager

Key Paper

1.	C	2.	C	3.	A	4.	B	5.	B
6.	A	7.	C	8.	B	9.	B	10.	A
11.	C								

Addressing modes

1)Which of the following addressing modes are suitable for program relocation at run time ?
1.Absolute addressing
2. Based addressing
3. Relative addressing 4. Indirect addressing

2 Marks GATE-CSE/IT-2004( )

[A] 1 and 4 [B] 1 and 2
[C] 2 and 3 [D] 1, 2 and 4

2)consider a three word machine instruction
ADD A[R0], @ B
The first operand (destination) " A [R0]" uses indexed addressing mode with R0 as the index register. The second operand(source) "@B" uses indirect addressing mode. A and B are memory address residing at the second and the third words, respectively. The first word of the instruction specifies the opcode, the index register designation and the source and destination addressing modes. During execution of ADD instruction,the two operands are added and stored in the destination (first operand).
The number of memory cycles needed during the execution cycle of the instruction is

2 Marks GATE-CSE/IT-2005( )

[A] 3 [B] 4
[C] 5 [D] 6

3)Match List-I with List-II and select the correct answer using the codes given below the lists :

LIST –I	LIST-II
A. A[1]=B[J];	1. Indirect addressing
B. While[*A++];	2. Indexed addressing
C. int temp = *x;	3. Auto increment

Codes :
A B C

2 Marks GATE-CSE/IT-2005( )

[A] 3 2 1 [B] 1 3 2
[C] 2 3 1 [D] 1 2 3

4)Which of the following is/are true of the auto increment addressing mode ?
1. It is useful in creating self relocating code
2. If it is included in an Instruction Set Architecture, then an additional ALU is required for effective address calculation.
3. The amount of increment depends on the size of the data item accessed.

2 Marks GATE-CSE/IT-2008( )

[A] 1 only [B] 2 only
[C] 3 only [D] 2 and 3 only

5)consider a three word machine instruction
ADD A[R_0], @ B
The first operand (destination) " A [R0]" uses indexed addressing mode with R0 as the index register. The second operand(source) "@B" uses indirect addressing mode. A and B are memory address residing at the second and the third words, respectively. The first word of the instruction specifies the opcode, the index register designation and the source and destination addressing modes. During execution of ADD instruction, the two operands are added and stored in the destination (first operand).
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2 Marks GATE-CSE/IT-2005( )

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[C] 5 [D] 6

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A. A[1]=B[J];	1.Indirect addressing
B. While[*A++];	2.Indexed addressing
C. int temp = *x;	3.Autoincrement

2 Marks GATE-CSE/IT-2005( )

[A] A-3 B- 2 C-1 [B] A- 1 B- 3 C-2
[C] A- 2 B- 3 C-1 [D] A- 1 B- 2 C-3

Addressing modes

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1. It is useful in creating self relocating code
2. If it is included in an Instruction Set Architecture, then an additional ALU is required for effective address calculation.
3. The amount of increment depends on the size of the data item accessed.

2 Marks GATE-CSE/IT-2008( )

[A] 1 only
[B] 2 only
[C] 3 only
[D] 2 and 3 only

8) In the absolute addressing mode

1 Marks GATE-CSE/IT-2002( )

[A] the operand is inside the instruction
[B] the address of the operand is inside the instruction
[C] The register containing the address of the operand is specified inside the instruction
[D] the location of the operand is implicit

9) The main differences(s) between a CSIC and A RISC processor is/are that a RISC processor typically

2 Marks GATE-CSE/IT-1999( )

[A] has fewer instructions
[B] has fewer addressing modes
[C] has more registers
[D] is easier to implement using hard-wired control logic

10) A certain processor supports only the immediate and the direct addressing modes. Which of the following programming language features cannot be implemented on this processor?

2 Marks GATE-CSE/IT-1999( )

[A] Pointers
[B] Pointers
[C] Records
[D] Recursive procedures with local variable

11) Which of the following addressing modes permits relocation without any change whatsoever in the code?

1 Marks GATE-CSE/IT-1998( )

[A] Indirect addressing
[B] Indexed addressing
[C] Base register addressing
[D] PC relative addressing

12) Relative mode of addressing is most relevant to writing

1 Marks GATE-CSE/IT-1996( )

[A] coroutines
[B] position – independent code
[C] shareable code
[D] interrupt handlers

13) A device employing INTR line for device interrupt puts the CALL instruction on the data bus while

1 Marks GATE-CSE/IT-2002( )

[A] $\overline{INTA}$ is active
[B] HOLD is active
[C] READY is active
[D] None of the above

Addressing modes

Key Paper

1.	C	2.	D	3.	C	4.	C	5.	D
6.	C	7.	C	8.	B	9.	A	10.	A
11.	C	12.	B	13.	A				

DMA

1) A hard disk with a transfer rate of 10M bytes/ second is constantly transferring data to memory using DMA. The processor runs at 600 MHz., and takes 300 and 900 clock cycles to initiate and complete DMA transfer respectively. If the size of the transfer is 20 K bytes, what is the percentage of processor time consumed for the transfer operations ?

2 Marks GATE-CSE/IT-2004( )

[A] 5.0% [B] 1.0%
[C] 0.5% [D] 0.1%

2) Which one of the following is true for a CPU having a single interrupt request line and a single interrupt grant line ?

1 Marks GATE-CSE/IT-2005( )

[A] Neither vectored interrupt nor multiple interrupting devices are possible
[B] vectored interrupts are not possible but multiple interrupting devices are possible,
[C] Vectored interrupts and multiple interrupting devices are both possible
[D] Vectored interrupt is possible but multiple interrupting devices are not possible

3) A device with a data transfer rate 10 KB/sec is connected to a CPU. Data is transferred byte-wise. Let the interrupt overhead be 4 sec. The byte transfer time between the device interface register and CPU or memory is negligible. What is the minimum performance gain of operating the device under interrupt mode over operating it under program controlled mode ?

2 Marks GATE-CSE/IT-2005( )

[A] 15 [B] 25
[C] 35 [D] 45

4) The use of multiple register windows with overlap causes a reduction in thenumber of memory accesses for
1. function locals and parameters
2. register saves and restores
3. instruction fetches

2 Marks GATE-CSE/IT-2008( )

[A] 1 only [B] 2 only
[C] 3 only [D] 1,2 and 3

5) A CPU generally handles an interrupt by executing an interrupt service routine

1 Marks GATE-CSE/IT-2009( )

[A] as soon as an interrupt is raised
[B] by checking the interrupt register at the end of fetch cycle
[C] by checking the interrupt register after finishing the execution of the current instruction
[D] by checking the interrupt register at fixed time intervals

6) A hard disk with a transfer rate of 10M bytes/ second is constantly transferring data to memory using DMA. The processor runs at 600 MHz., and takes 300 and 900 clock cycles to initiate and complete DMA transfer respectively. If the size of the transfer is 20 K bytes, what is the percentage of processor time consumed for the transfer operations ?

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DMA

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1. function locals and parameters
2. register saves and restores
3. instruction fetches

2 Marks GATE-CSE/IT-2008( )

[A] 1 only
[B] 2 only
[C] 3 only
[D] 1,2 and 3

10) The correct matching for the following pairs is

(A) DMA I/O	(1) High speed RAM
(B) Cache	(2) Disk
(C) Interrupt I/O	(3) Printer
(D) Condition Code Register	(4) ALU

2 Marks GATE-CSE/IT-1997( )

[A] A – 4 B – 3 C – 1 D - 2
[B] A – 2 B – 1 C – 3 D - 4
[C] A – 4 B – 3 C – 2 D - 1
[D] A – 2 B – 3 C – 4 D - 1

DMA

Key Paper

1.	D	2.	B	3.	B	4.	A	5.	C
6.	D	7.	C	8.	B	9.	A	10.	B

Instruction pipelining

Common Data for Q1 and Q2 is given below

Delayed branching can help in the handling of control hazardous

1) For all delayed conditional branch instructions, irrespective of weather the condition evato true or false, A

2 Marks GATE-CSE/IT-2008( )

[A] the instruction following the conditional branch instruction in memory is executed
[B] the first instruction in the fall through path is executed
[C] the first instruction in the taken path is executed.
[D] the branch takes longer to execute than any other instruction

2) The following code is to run on a pipelined processor with one branch delay slot

11: ADDR2 ← R7 + R8

12: SUB R4 ←R5 - R5x

13 : AD R1 ← R2 + R3

14 : STORE Memory [R4} ← R1
BRANCH to Label if R1= = 0

Which of the instruction 11,12,13 or 14 can legitimately occupy the delay slot without any other program modification ?

2 Marks GATE-CSE/IT-2008,GATE-CSE/IT-2008( )

[A] 11
[B] 12
[C] 13
[D] 14

Common Data for Q4 Q3 and Q5 is given below

Instruction		Operation	Instruction size (no. of words)
MOV	R1, (3000)	R1 ← M[3000]	2
LOOP:			
MOV	R2, R1	R2 ← M[R3]	1
ADD	R2, R1	R2 ← R1 + R2	1
MOV	(R3), R2	M(R3] ← R2	1
INC	R3	R3 ← R3 + 1	1
DEC	R1	R1 ← R1 - 1	1
BNZ	LOOP	Branch on not zero	2
HALT		Stop	

Assume that the content of memory location 3000is 10 and the content of the register R3 is 2000. The content of each of the memory locations from 2000 to 2010 is 100. The program is loaded from the memory location 100. All the numbers are in decimal.

3) Assume that the memory is word addressable. The number of memory references for accessing the data in executing the program completely is

2 Marks GATE-CSE/IT-2007,GATE-CSE/IT-2007,GATE-CSE/IT-2007( )

[A] 10
[B] 11
[C] 20
[D] 21

4) Assume that the memory is word addressable. After the execution of this program, the content of memory location 2010 is

2 Marks GATE-CSE/IT-2007,GATE-CSE/IT-2007( )

[A] 100
[B] 101
[C] 102
[D] 110

5) Assume that the memory is byte addressable and the word size is 32 bits. If an interrupt occur during the execution of the instruction “INC R3”, what return address will be pushed on to the stack ?

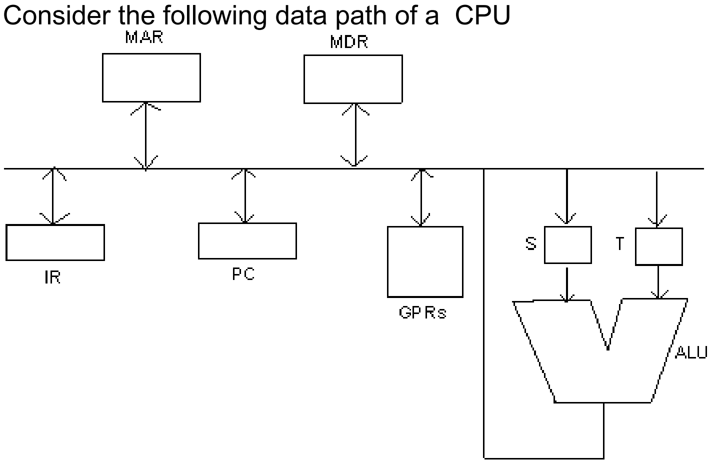
2 Marks GATE-CSE/IT-2007( )

[A] 1005
[B] 1020
[C] 1024
[D] 1040

Common Data for Q6 and Q7 is given below

Instruction pipelining

Consider the following data path of a CPU



The, ALU, the bus and all the registers in the data path are of identical size. All operations including incrementation of the PC and the GPRs are to be carried out in the ALU. Two clock cycle are needed for memory read operation- the first one for loading address in the MAR and the next one for loading data from the memory but into the MDR.

6) The instruction "add R0, R1" has the register transfer in terpretation R0 <= R0 + R1. The minimum number of clock cycles needed for execution cycle of this instruction is

2 Marks GATE-CSE/IT-2005( )

[A] 2 [B] 3
[C] 4 [D] 5

7) The instruction " call Rn, sub "is a two word instruction. Assuming thatPC is incremented during the fetch cycle of the first word of the instruction,its register transfer interpretation is

Rn <= PC + 1 ;

PC <= M [PC];

The minimum number of CPU clockcycles needed during the execution cycle of this instruction is

2 Marks GATE-CSE/IT-2005( )

[A] 2 [B] 3
[C] 4 [D] 5

8) A 4-stage pipeline has the stage delays as 150, 120, 160 and 140 nanoseconds respectively. Registers that are used between the stages have a delay of 5 nanoseconds each.Assuming constant clocking rate, the total time taken to process 1000 data items on this pipeline will be

2 Marks GATE-CSE/IT-2004( )

[A] 120.4 microseconds [B] 160.5 microseconds
[C] 165.5 microseconds [D] 590.0 microseconds

9) A 5 stage pipelined CPU has the following sequence of stages
IF – Instruction fetch from instruction memory.
RD- Instruction decode and register read,
EX- Execute: ALU operation for data and address computation,
MA – Data memory access – for write access the register read at
RD- Stage it used,
WB- Register write backConsider the following sequence of instructions :
I_1: L R0 Locl; R0 <= M[Locl]
I_2 : A R0, R0; R0< = R0 + R0
I_3: A R2, R0; R2< = R2- R0Let each stage take one clock cycle
What is the number of clock cycles taken to complete the above sequence of instructions starting from the fetch of I_1 ?

Instruction pipelining

2 Marks GATE-CSE/IT-2005( )

[A] 8 [B] 10
[C] 12 [D] 15

10) A CPU has 24 – bit instructions. A program starts at address 300(in decimal). Which one of the following is a legal program counter (all values in decimal) ?

2 Marks GATE-CSE/IT-2005( )

[A] 400 [B] 500
[C] 600 [D] 700

11) A CPU has five –stages pipeline and runs at 1 GHz frequency. Instruction fetch happens in the first stage of the pipeline. A conditional branch instruction computes the target address and evaluates the condition in the third stage of the pipeline. The processor stops fetching new instructions following a conditional branch until the branch outcome is known. A program executes 109 instruction out of which 20% are conditional branches. If each instruction takes one cycle to complete on average, then total execution time of the program is

2 Marks GATE-CSE/IT-2006( )

[A] 1.0second [B] 1.2second
[C] 1.4second [D] 1.6second

12) Consider a pipelined processor with the following four stages
IF : Instruction Fetch
ID: Instruction decode and Operand Fetch
EX: Execute
WB: Write Back
The IF, ID and WB stages take one clock cycle each to complete the operation. The number of clock cycles for the EX stage depends on the instruction. The ADD and SUB instructions need 1 clock cycle and the MUL instruction need 3 clock cycles in the EX stage. Operand forwarding is used in the pipelined processor What is the number of clock cycles taken to complete the following sequence of instructions?.

ADD	R2,	R1,	R0	R2 ← R1+R0
MUL	R4,	R3,	R2	R4 ← R3* R2
SUB	R6,	R5,	R4	R6 ← R5- R4

2 Marks GATE-CSE/IT-2007( )

[A] 7 [B] 8
[C] 10 [D] 14

13) Which of the following are NOT true in a pipelined processor ?
(a) Bypassing can handle all Raw hazards
(b) Register renaming can eliminate all register carried WAR hazards
(c) Control hazard penalties can be eliminated by dynamic branch prediction

2 Marks GATE-CSE/IT-2008( )

[A] 1 and 2 only [B] 1 and 3 only
[C] 2 and 3 only [D] 1,2 and 3

14) In an instruction execution pipeline, the earliest that the data TLB (Translation Lookaside Buffer)can be accessed is

2 Marks GATE-CSE/IT-2008( )

[A] before effective address calculation has started [B] during effective address calculation
[C] after effective address calculation has completed [D] after data cache lookup has completed

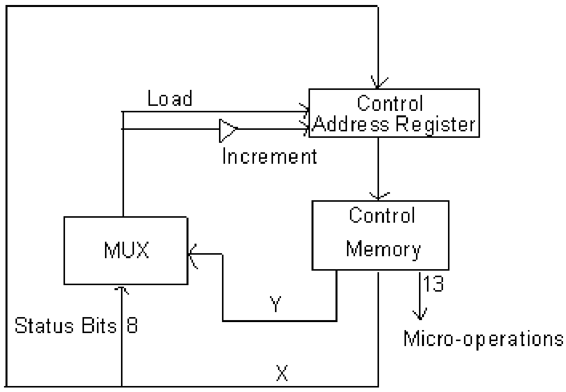
15) For a pipelined CPU with a single ALU, consider the following situations
1. The j + 1- st instruction uses the result of the j-th instruction as an operand
2. The execution of a conditional jump instruction
3. The j-th and j + 1-st instructions require the ALU at the same time
Which of the above can cause a hazard ?

1 Marks GATE-CSE/IT-2003( )

[A] 1 and 2 only [B] 2 and 3 only
[C] 3 only [D] All the three

Instruction pipelining

16)The microinstructions stored in the control memory of a processor have a width of 26 bits. Each microinstruction is divided into three fields: a micro- operation filed of 13 bits, a next address field (X), and a MUX select field(Y). There are 8 Status bits in the inputs of the MUX.



How many bits are there in the X and Y fields, and hat is the size of the control memory in number of words ?

2 Marks GATE-CSE/IT-2004( )

[A] 10,3, 1024 [B] 8,5,256
[C] 5,8,2048 [D] 10,3,512

17)A 4-stage pipeline has the stage delays as 150, 120, 160 and 140 nanoseconds respectively. Registers that are used between the stages have a delay of 5 nanoseconds each. Assuming constant clocking rate, the total time taken to process 1000 data items on this pipeline will be

2 Marks GATE-CSE/IT-2004( )

[A] 120.4 microseconds [B] 160.5 microseconds
[C] 165.5 microseconds [D] 590.0 microseconds

18)A 5 stage pipelined CPU has the following sequence of stages
IF – Instruction fetch from instruction memory.
RD- Instruction decode and register read,
EX- Execute: ALU operation for data and address computation,
MA – Data memory access – for write access the register read at
RD- Stage it used,
WB- Register write back
Consider the following sequence of instructions :
I1: L R0 Locl; R0 <= M[Locl]
I2 : A R0, R0; R0< = R0 + R0
I3: A R2, R0; R2< = R2- R0
Let each stage take one clock cycle
What is the number of clock cycles taken to complete the above sequence of instructions starting from the fetch of I1 ?

2 Marks GATE-CSE/IT-2005( )

[A] 8 [B] 10
[C] 12 [D] 15

19)A CPU has 24 – bit instructions. A program starts at address 300(in decimal). Which one of the following is a legal program counter (all values in decimal) ?

2 Marks GATE-CSE/IT-2006( )

[A] 400 [B] 500
[C] 600 [D] 700

20)A CPU has five –stages pipeline and runs at 1 GHz frequency. Instruction fetch happens in the first stage of the pipeline. A conditional branch instruction computes the target address and evaluates the condition in the third stage of the pipeline. The processor stops fetching new instructions following a conditional branch until the branch outcome is known. A program executes 109 instruction out of which 20% are conditional branches. If each instruction takes one cycle to complete on average, then total execution time of the program is

2 Marks GATE-CSE/IT-2006( )

[A] 1.0 second [B] 1.2 seconds
[C] 1.4 seconds [D] 1.6 seconds

21)Consider a pipelined processor with the following four stages
IF : Instruction Fetch
ID: Instruction decode and Operand Fetch
EX: Execute
WB: Write Back

The IF, ID and WB stages take one clock cycle each to complete the operation. The number of clock cycles for the EX stage depends on the instruction. The ADD and SUB instructions need 1 clock cycle and the MUL instruction need 3 clock cycles in the EX stage. Operand forwarding is used in the pipelined processor What is the number of clock cycles taken to complete the following sequence of instructions?

ADD	R2,	R1,	R0	R2 ← R1+R0
MUL	R4,	R3,	R2	R4 ← R3* R2
SUB	R6,	R5,	R4	R6 ← R5- R4

1 Marks GATE-CSE/IT-2007( )

[A] 7 [B] 8
[C] 10 [D] 14

22)Which of the following are NOT true in a pipelined processor ?
(a) Bypassing can handle all Raw hazards
(b) Register renaming can eliminate all register carried WAR hazards
(c) Control hazard penalties can be eliminated by dynamic branch prediction

2 Marks GATE-CSE/IT-2008( )

[A] 1 and 2 only (b) (c) (c) [B] 1 and 3 only
[C] 2 and 3 only [D] 1,2 and 3

23)Consider a 4 stage pipeline processor. The number of cycles needed by the four instructions I1, I2, I3, I4 in
stages S1, S2, S3, S4 is shown below :

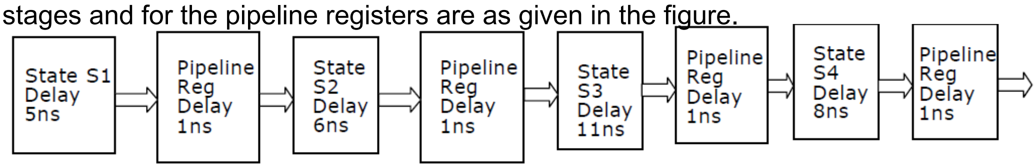
	S1	S2	S3	S4
I1	2	1	1	1
I2	1	3	2	2
I3	2	1	1	3
I4	1	2	2	2

What is the number or cycles needed to execute the following loop ?
For (i=1 to 2) { I1; I2;I3; I4;}

2 Marks GATE-CSE/IT-2009( )

[A] 16 [B] 23
[C] 28 [D] 30

24)Consider an instruction pipeline with four stages (S1, S2, S3 and S4) each with combinational circuit only. The pipeline registers are required between each stage and at the end of the last stage. Delays for the stages and for the pipeline registers are as given in the figure.



What is the approximate speed up of the pipeline in steady state under ideal conditions when compared to the corresponding non-pipeline implementation?

2 Marks GATE-CSE/IT-2011( )

[A] 4.0 [B] 2.5
[C] 1.1 [D] 3.0

25)A micro instruction is to be designed to specify
(a) none or one of the three micro operations of one kind and
(b) none or upto six micro operations of another kind
The minimum number of bits in the micro-instruction is

Instruction pipelining

2 Marks GATE-CSE/IT-1997( )

[A] 9 [B] 5
[C] 8 [D] None of the above

Instruction pipelining

Key Paper

1.	B	2.	B	3.	D	4.	A	5.	C
6.	B	7.	B	8.	C	9.	B	10.	C
11.	C	12.	B	13.	D	14.	B	15.	D
16.	A	17.	C	18.	B	19.	C	20.	C
21.	B	22.	D	23.	B	24.	B	25.	C

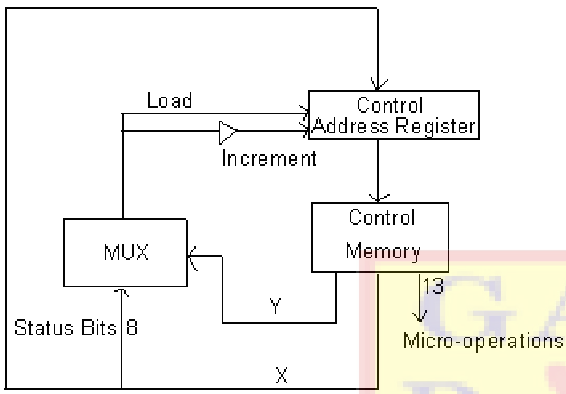
Data & Control modes

1) Consider a new instruction named branch-on-bit-set(mnemonic bbs). The instruction "bbs reg, pos, label" jumps to label if bits wide and the bits are numbered 0 to 31, bit in position 0 being the least significant. Consider the following emulation of this instruction on a processor that does not have bbs implemented.
Temp reg and mask
Branch to label if temp is non-zero
The variable temp is a temporary register. For correct emulation, the variable mask must be generated by

2 Marks GATE-CSE/IT-2006( )

[A] mask <-- Ox1 << pos
[B] mask <-- 0xffffffff >>pos
[C] mask <-- pos
[D] mask <-- 0xf

2) The microinstructions stored in the control memory of a processor have a width of 26 bits. Each microinstruction is divided into three fields: a micro- operation filed of 13 bits, a next address field (X), and a MUX select field(Y). There are 8 Status bits in the inputs of the MUX.



How many bits are there in the X and Y fields, and hat is the size of the control memory in number of words ?

2 Marks GATE-CSE/IT-2004( )

[A] 10,3, 1024
[B] 8,5,256
[C] 5,8,2048
[D] 10,3,512

3) Consider a new instruction named branch-on-bit-set(mnemonic bbs). The instruction "bbs reg, pos, label" jumps to label if bits wide and the bits are numbered 0 to 31, bit in position 0 being the least significant. Consider the following emulation of this instruction on a processor that does not have bbs implemented.
Temp $\leftarrow$ reg and mask
Branch to label if temp is non-zero
The variable temp is a temporary register. For correct emulation, the variable mask must be generated by

2 Marks GATE-CSE/IT-2006( )

[A] mask $\leftarrow$ Ox$_1$ << pos
[B] mask $\leftarrow$ 0xffffffff >>pos
[C] mask $\leftarrow$ pos
[D] mask $\leftarrow$ 0xf

4) Which of the following must be true for the RFE (Return from Exception) instruction on a general purpose processor.
1. It must be a trap instruction
2. It must be a privileged instruction
3. An exception can not be allowed to occur during execution of an RFE instruction

2 Marks GATE-CSE/IT-2008( )

[A] 1 only
[B] 2 only
[C] 1 and 2 only
[D] 1, 2 and 3 only

5) Arrange the following configuration for CPU in decreasing order of operating speeds: Hard wired control, vertical microprogramming, horizontal microprogramming.

2 Marks GATE-CSE/IT-1999( )

[A] Hard wired control, vertical micro-programming, horizontal micro- programming.
[B] Hard wired control, horizontal micro-programming, vertical micro- programming.
[C] horizontal micro-programming, vertical micro-programming, Hard wired control.
[D] vertical micro-programming, horizontal micro-programming, hard wired control.

Data & Control modes

6) Which of the following is true?

1 Marks GATE-CSE/IT-1998( )

[A] Unless enabled, a CPU will not be able to process interrupts.
[B] Loop instructions cannot be interrupted till they complete.
[C] A processor checks for interrupts before executing a new instruction.
[D] Only level triggered interrupts are possible on microprocessors

7) The address space of 8086 CPU is

2 Marks GATE-CSE/IT-1998( )

[A] One Megabyte
[B] 256 Kilobytes
[C] 1 K Megabytes
[D] 64 Kilobytes

8) If an instruction takes i microseconds and a page fault takes an additional j microseconds, the effective instruction time if on the average a page fault occurs every k instruction is:

2 Marks GATE-CSE/IT-1998( )

[A] i + j/k
[B] i + j * k
[C] i+j /k
[D] (i+j)*k

9) A micro program control unit is required to generate a total of 25 control signals. Assume that during any microinstruction, at most two control signals are active. Minimum number of bits required in the control word to generate the required control signals will be

2 Marks GATE-CSE/IT-1996( )

[A] 2
[B] 2.5
[C] 10
[D] 12

10) The performance of a pipelined processor suffers if

2 Marks GATE-CSE/IT-2002( )

[A] the pipeline stages have different delays
[B] consecutive instructions are dependent on each other
[C] the pipeline stages share hardware resources
[D] All of the above

Data & Control modes

Key Paper

1.	A	2.	A	3.	A	4.	D	5.	B
6.	A	7.	A	8.	A	9.	C	10.	D

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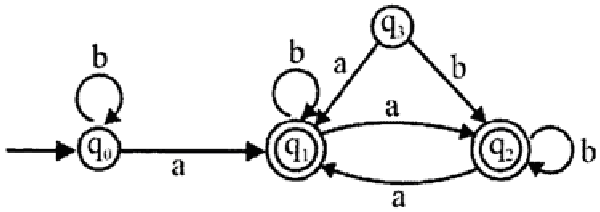
Reg. Lang & FA

Common Data for Q1 and Q2 is given below

Consider the following Finite State Automation



1) The language accepted by this automaton is given by the regular expression

2 Marks GATE-CSE/IT-2007,GATE-CSE/IT-2007( )

[A] b * ab * ab * ab*
[B] (a+b)*
[C] b* a (a+b)*
[D] b* ab* ab*

2) The minimum state auto maton equivalent to the above FSA has the following number of states

2 Marks GATE-CSE/IT-2007( )

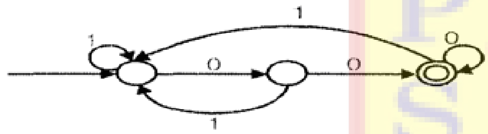
[A] 1
[B] 2
[C] 3
[D] 4

3) Which one of the following languages over the alphabet {0,1} is described by the regular expression : (0 + 1) * 0(0 + 1)*0(0 + 1)* ?

1 Marks GATE-CSE/IT-2009( )

[A] The set of all strings containing the substring 00
[B] The set of all strings containing at most two 0's
[C] The set of all strings containing at least two 0's
[D] The set of all strings that begin and end with either 0 or 1

4) The following DFA accepts the set of all strings over {0,1} that



2 Marks GATE-CSE/IT-2009( )

[A] begin either with 0 or 1
[B] end with 0
[C] end with 00
[D] contain the substring 00

5) Consider the following languages
$L_1 = \{0^p 1^q 0^r \mid p, q, r \geq 0\}$
$L_2 = \{0^p 1^q 0^r \mid p, q, r \geq 0 , p \neq r\}$
Which one of the following statements is FALSE?

2 Marks GATE-CSE/IT-2013( )

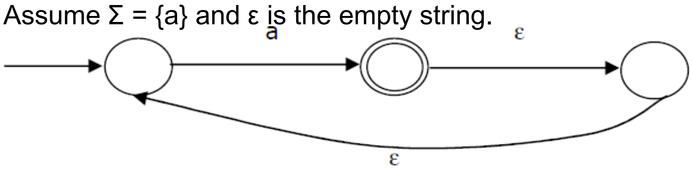
[A] L_2 is context-free
[B] $L_1 \cap L_2$ is context-free
[C] Complement of L_2 is recursive
[D] Complement of L_1 is context-free but not regular

6) Given the language L-{ab, aa, baa}, which of the following strings are in L*?
1) abaabaaabaa
2) aaaabaaaa
3) baaaaabaaaab
4) baaaaabaa

1 Marks GATE-CSE/IT-2012( )

[A] 1, 2 and 3
[B] 2, 3 and 4
[C] 1, 2 and 4
[D] 1, 3 and 4

7) What is the complement of the language accepted by the NFA show below? Assume Σ = {a} and ε is the empty string.



1 Marks GATE-CSE/IT-2012,GATE-CSE/IT-2012( )

[A] $\varnothing$ [B] {ε}

[C] a * [D] (a, ε)

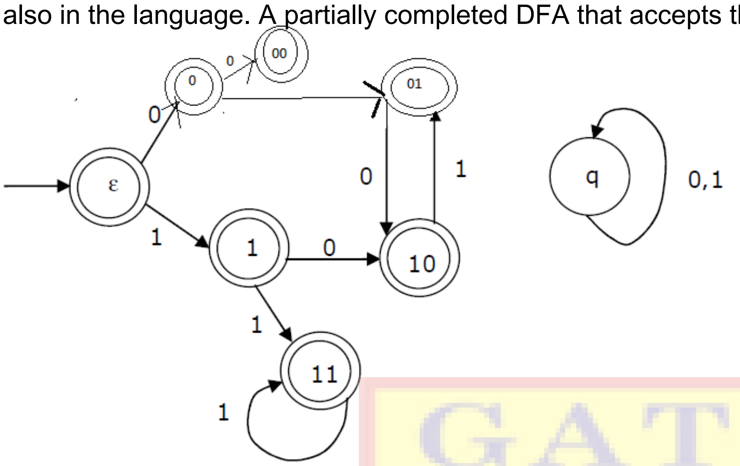
8) Consider the language $L_1 = \phi$ and $L_2 = a$, which one of the following represents $L_1 L_2^* \cup L_1^*$?

1 Marks GATE-CSE/IT-2013( )

[A] {ϵ} [B] ϕ

[C] a* [D] {ϵ, a}

9) Consider the set of strings on {0,1} in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language. A partially completed DFA that accepts this language is shown below.



The missing arcs in the DFA are

2 Marks GATE-CSE/IT-2012( )

[A]

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

[B]

	00	01	10	11	q
00		0			1
01		1			
10				0	
11		0			

[C]

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

[D]

	00	01	10	11	q
00		1			0
01				1	
10	0				
11			0		

10) Definition of a language L with alphabet {a} is given as following
L = { a^{nk} | k >0, and n is a positive integer constant}

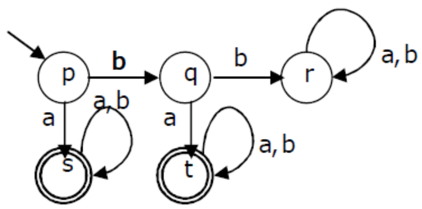
What is the minimum number of states needed in a DFA to recognize L?

2 Marks GATE-CSE/IT-2011( )

[A] k+1 [B] n+1

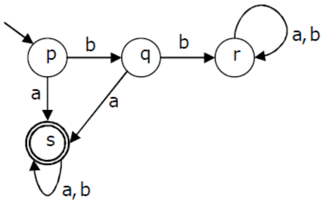
[C] 2^{n+1} [D] 2^{k+1}

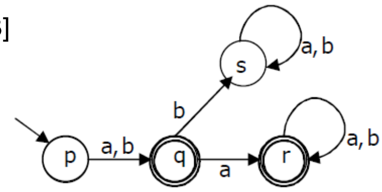
11) A deterministic finite automation (DFA) D with alphabet Σ= {a, b} is given below

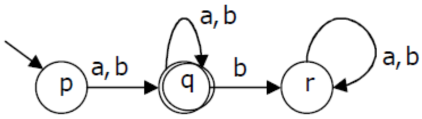


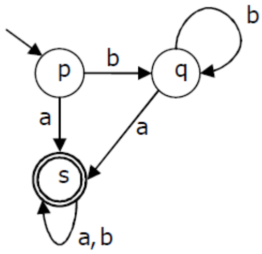
Which of the following finite state machines is a valid minimal DFA which accepts the same language as D?

2 Marks GATE-CSE/IT-2011( )

[A]


[B]


[C]


[D]


12)Let L = {$L = w\epsilon(0+1)* \mid w$ has even number of 1s}, i.e. L is the set of all bit strings with even number of 1s. Which one of the regular expressions below represents L?

2 Marks GATE-CSE/IT-2010( )

[A] (0 * 10 * 1) *
[B] 0 * (10 * 10 *) *
[C] 0 * (10 * 1 *) * 0 *
[D] 0 * 1 (10 * 1) * 10 *

13)Let w be any string of length n in {0, 1}*. Let L be the set of all substrings of w. What is the minimum number of states in a non-deterministic finite automaton that accepts L?

2 Marks GATE-CSE/IT-2010( )

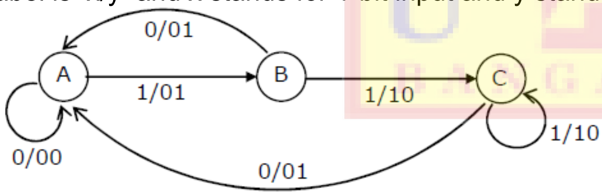
[A] n-1
[B] n
[C] n+1
[D] 2^{n-1}

14)The language accepted by a Push down Automaton in which the stack is limited to 10 items is best described as

1 Marks GATE-CSE/IT-2002( )

[A] Context free
[B] Regular
[C] Deterministic Context free
[D] Recursive

15)The finite state machine described by the following state diagram with A as starting state, where an arc label is x/y and x stands for 1-bit input and y stands for 2-bit output



2 Marks GATE-CSE/IT-2002( )

[A] Outputs the sum of the present and the previous bits of the input.
[B] Outputs 01 whenever the input sequence contains 11
[C] Outputs 00 whenever the input sequence contains 10
[D] None of the above

16)Which of the following is true?

2 Marks GATE-CSE/IT-2002( )

[A] The complement of a recursive language is recursive.
[B] The complement of a recursively enumerable language is recursively enumerable.
[C] The complement of a recursive language is either recursive or recursively enumerable.
[D] The complement of a context-free language is context-free

17)Which of the following statements s true?

1 Marks GATE-CSE/IT-2001( )

[A] If a language is context free it can always be accepted by a deterministic push-down automaton
[B] The union of two context free languages is context free
[C] The intersection of two context free languages is context free
[D] The complement of a context free language is context free

18)Given an arbitary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least

1 Marks GATE-CSE/IT-2001( )

[A] N^2 [B] 2^N
[C] 2N [D] N!

19)Let S and T be language over Σ={a,b} represented by the regular expressions (a+b*)* and (a+b)*, respectively. Which of the following is true?

1 Marks GATE-CSE/IT-2000( )

[A] S ⊂ T [B] T ⊂ S
[C] S = T [D] S ∩T = φ

20)What can be said about a regular language L over {a} whose minimal finite state automation has two states?

2 Marks GATE-CSE/IT-2000( )

[A] L must be {a^n|n is odd} [B] L must be {a^n|n is even}
[C] L must be {a^n|≥0} [D] Either L must be {a^n|n is odd}, or L must be {an| n is even}

21)Consider the regular expression (0 + 1) (0 + 1)…. N times. The minimum state finite automation that recognizes the language represented by this regular expression contains

1 Marks GATE-CSE/IT-1999( )

[A] n states [B] n+1 states
[C] n+2 states [D] None of the above

22)If the regular set A is represented by A = (01 + 1)* and the regular set 'B' is represented by B = ((01)*1*)*, which of the following is true?

1 Marks GATE-CSE/IT-1998( )

[A] A ⊂ B [B] B ⊂ A
[C] A and B are incomparable [D] A = B

23)Which of the following set can be recognized by a Deterministic Finite state Automaton?

1 Marks GATE-CSE/IT-1998( )

[A] The numbers 1, 2, 4, 8, ……………. 2^n, ……….. written in binary [B] The numbers 1, 2, 4, ………………., 2^n, …………..written in unary
[C] The set of binary string in which the number of zeros is the same as the number of ones. [D] The set {1, 101, 11011, 1110111, ……….}

24)The string 1101 does not belong to the set represented by

1 Marks GATE-CSE/IT-1998( )

[A] 110*(0 + 1) [B] 1 (0 + 1)* 101
[C] (10)* (01)* (00 + 11)* [D] (00 + (11)*0)*

25)Which of the following statements is false?

2 Marks GATE-CSE/IT-1998( )

[A] Every finite subset of a non-regular set is regular [B] Every subset of a regular set is regular
[C] Every finite subset of a regular set is regular [D] The intersection of two regular sets is regular

26)Which one of the following regular expressions over {0,1} denotes the set of all strings not containing 100 as a substring?

2 Marks GATE-CSE/IT-1997( )

[A] 0*(1+0)* [B] 0*1010*
[C] 0*1*01 [D] 0(10+1)*

27)Which two of the following four regular expressions are equivalent? (ε is the empty string).
(i) (00) * (ε + 0)
(ii) (00)*
(iii) 0*
(iv) 0(00)*

1 Marks GATE-CSE/IT-1996( )

[A] (i) and (ii) [B] (ii) and (iii)
[C] (i) and (iii) [D] (iii) and (iv)

28)Let L ⊆ Σ* where Σ = {a, b}. which of the following is true?

1 Marks GATE-CSE/IT-1996( )

[A] L = {x | x has an equal number of a's and b's } is regular
[B] L = {$a^n b^n$ | n ≥ 1} is regular
[C] L = {x |x has more a's and b's } is regular
[D] L = {$a^m b^n$ |m ≥, n ≥ 1} is regular

29)In some programming languages, an identifier is permitted to be a letter following by any number of letters or digits. If L and D denote the sets of letters and digits respectively, which of the following expressions defines an identifier?

1 Marks GATE-CSE/IT-1995( )

[A] $(L \cup D)^+$
[B] L (L ∪ D)*
[C] (L .D)*
[D] L.(L.D)*

30)Afinitestatemachinewiththefollowingstatetablehasasingleinputxandasingleoutz.

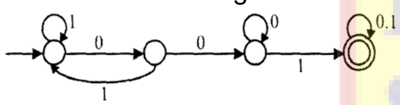
present state	next state, z	
	x=1	x=0
A	D, 0	B, 0
B	B, 1	C, 1
C	B, 0	D, 1
D	B, 1	C, 0

If the initial state is unknown, then the shortest input sequence to reach the final state C is:

2 Marks GATE-CSE/IT-1995( )

[A] 01
[B] 10
[C] 101
[D] 110

31)Consider the following deterministic finite state automation M.

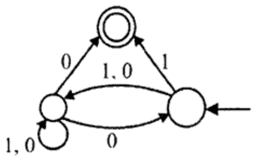


Let S denote the set of seven bit binary strings in which the first, the fourth, and the last bits are 1. The number of strings in S that are accepted by M is

2 Marks GATE-CSE/IT-2003( )

[A] 1
[B] 5
[C] 7
[D] 8

32)Consider the NFAM shown below.



Let the language accepted by M be L. Let L1 be the language accepted by the NFAM1, obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting state of M to accepting states. Which of the following statements is true ?

2 Marks GATE-CSE/IT-2003( )

[A] L1 = {0, 1}* - L
[B] L1 = {0, 1}*
[C] L1 ⊆ L
[D] L1 = L

33)The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively

2 Marks GATE-CSE/IT-2004( )

[A] divisible by 3 and 2
[B] odd and even
[C] even and odd
[D] divisible by 2 and 3

34)Which of the following statements is false ?

2 Marks GATE-CSE/IT-2008( )

[A] Every NFA can be converted to an equivalent DFA
[B] Every non-deterministic Turing machine can be converted to an equivalent deterministic Turing machine

[C] Every regular language is also a context-free language

[D] Every subset of a recursively enumerable set is recursive

35)Given below are two finite state automata (--> indicates the start and F indicates a final state)

Y:

	a	b
→1	1	2
2(F)	2	1

Z:

	a	b
→1	2	2
2(F)	1	1

Which of the following represents the product automaton Z x Y ?

1 Marks GATE-CSE/IT-2008( )

[A]

	a	b
→P	S	R
Q	R	S
R(F)	Q	P
S	Q	P

[B]

	a	b
→P	S	Q
Q	R	S
R(F)	Q	P
S	P	Q

[C]

	a	b
→P	Q	S
Q	R	S
R(F)	Q	P
S	Q	P

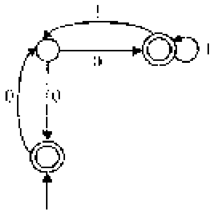
[D]

	a	b
→P	Q	S
Q	R	S
R(F)	Q	P
S	Q	P

36)Match List – I with List-II and select the correct answer using the codes given below the lists :

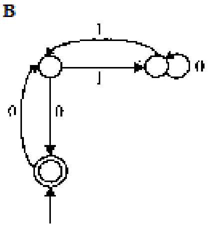
List – I | **List –II**

A



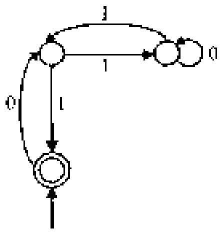
1. $\varepsilon + 0(01^*1 + 00)^*01^*$

B



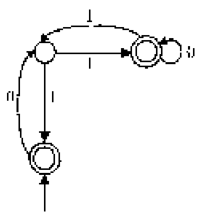
2. $\varepsilon + 0(10^*1 + 00)^*0$

C.



3. $\varepsilon + 0(10^*1 + 10)^*1$

D.



4. $\varepsilon + 0(10^*1 + 10)^*10^*$

Code :

	A	B	C	D
[A]	2	1	3	4
[B]	1	3	2	4
[C]	1	2	3	4
[D]	3	2	1	4

1 Marks GATE-CSE/IT-2008( )

37)Which of the following are regular sets ?

1. $\{a^n b^{2m} \mid n \geq 0, m \geq 0\}$
2. $\{a^n b^m \mid n = 2m\}$
3. $\{a^n b^m \mid n \neq m\}$
4. $\{xcy \mid x, y \in \{a,b\}^*\}$

2 Marks GATE-CSE/IT-2008( )

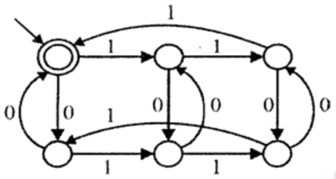
[A] 1 and 4 only
[B] 1 and 3 only
[C] 1 only
[D] 4 only

38)The regular expression 0*(10*)* denotes the same set as

1 Marks GATE-CSE/IT-2003( )

[A] (1 * 0)* 1*
[B] 0 + (0 + 10)*
[C] (0 + 1) * 10(0+1)*
[D] None of the above

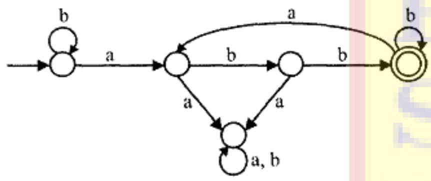
39)The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively



2 Marks GATE-CSE/IT-2004( )

[A] divisible by 3 and 2
[B] odd and even
[C] even and odd
[D] divisible by 2 and 3

40)Consider the machine M



The language recognized by M is

2 Marks GATE-CSE/IT-2005( )

[A] { w $\in$ {a,b}*/ every a in w is followed by exactly two b's}
[B] {w $\in${a,b}* every a in w is followed by at least two b's}
[C] {w $\in$ {a,b}* w contains the substring 'abb'
[D] { w $\in${a, b}* w does not contain 'aa' as a substring}

41)If s is a string over (0 + 1)*, then let $n_0(s)$ denote the number of 0's in s and $n_1(s)$ the number of 1's in s. Which one of the following languages is not regular ?

2 Marks GATE-CSE/IT-2006( )

[A] L = {s $\in$ (0+1)* | $n_0(s)$ is a 3-digit prime}
[B] L={s $\in$ (0+1)* | for every prefix s' of s, | $n_0(s)'$ - $n_1(s)'$ | $\leq$ 2}
[C] L = {s $\in$ (0+1)* |$n_0(s)$ - $n_1(s)$$\leq$ 4}
[D] L = { s$\in$ (0+1)* | $n_0(s)$ mod 7 = $n_1(s)$ mod 5 = 0}

42)Consider the regular language L= (111 + 11111)*. The minimum number of states in any DFA accepting this languages is

2 Marks GATE-CSE/IT-2006( )

[A] 3
[B] 5
[C] 8
[D] 9

43)Which of the following is TRUE ?

1 Marks GATE-CSE/IT-2007( )

[A] Every subset of a regular set is regular
[B] Every finite subset of a non-regular set is regular
[C] The union of two non-regular sets is not regular
[D] Infinite union of finite sets is regular

44)A minimum state deterministic finite automation accepting the language L = {w | w (0,1)*, number of 0's &1's in w are divisible by 3 and 5, respectively} has

2 Marks GATE-CSE/IT-2007( )

[A] 15 states
[B] 11 states
[C] 10 states
[D] 9 states

45)The language $L = \{0^i 2 1^i \mid i \geq 0\}$ over the alphabet {0,1,2} is

2 Marks GATE-CSE/IT-2007( )

[A] not recursive
[B] is recursive and is a deterministic CFL
[C] is a regular language
[D] is not a deterministic CF1 but a CFL

Reg. Lang & FA

Key Paper

1.	C	2.	B	3.	C	4.	C	5.	D
6.	C	7.	B	8.	A	9.	D	10.	B
11.	A	12.	A	13.	C	14.	B	15.	A
16.	A	17.	B	18.	C	19.	C	20.	D
21.	C	22.	D	23.	A	24.	C	25.	B
26.	B	27.	C	28.	D	29.	B	30.	B
31.	C	32.	C	33.	A	34.	D	35.	A
36.	C	37.	A	38.	B	39.	A	40.	B
41.	C	42.	D	43.	B	44.	A	45.	B

CFL & PDA

1) Let P be a regular language and Q be a context free language such that $Q \subseteq P$. (For example, let P be the language represented by the regular expression p*q* and Q be $\{p^n q^n \mid n \in N\}$). Then which of the following is ALWAYS regular?

1 Marks GATE-CSE/IT-2011( )

[A] $P \cap Q$ [B] P - Q
[C] $\sum^* - P$ [D] $\sum^* - Q$

2) Consider the languages L1=$(0^i1^j \mid i \neq j\}$. L2=$(0^i1^j \mid i=j\}$. L3=$\{0^i1^j \mid i = 2j+1\}$. L4=$\{0^i1^j \mid i \neq 2\}$. Which one of the following statements is true?

2 Marks GATE-CSE/IT-2010( )

[A] Only L2 is context free [B] Only L2 and L3 are context free
[C] Only L1 and L2 are context free [D] All are context free

3) The smallest finite automaton which accepts the language {x | length of x is divisible by 3} has

2 Marks GATE-CSE/IT-2002( )

[A] 2 states [B] 3 states
[C] 4 states [D] 5 states

4) Which of the following derivations does a top-down parser use while parsing an input string? The input is assumed to be scanned in left to right order.

1 Marks GATE-CSE/IT-2000( )

[A] Leftmost derivation [B] Leftmost derivation traced out in reverse
[C] Rightmost derivation [D] Rightmost derivation traced out in reverse

5) Given the following expression grammar:
E $\rightarrow$ E * F | F + E | F
F $\rightarrow$ F - | id
Which of the following is true?

2 Marks GATE-CSE/IT-2000( )

[A] * has higher precedence than + [B] - has higher precedence than *
[C] + and – have same precedence [D] + has higher precedence than *

6) Context-free languages are closed under:

1 Marks GATE-CSE/IT-1999( )

[A] Union, intersection [B] Union, Kleene closure
[C] Intersection, complement [D] Complement, Kleene closure

7) Let L_D be the set of all languages accepted by a PDA by final state and L_E the set of all languages accepted by empty stack. Which of the following is true?

1 Marks GATE-CSE/IT-1999( )

[A] $L_D = L_E$ [B] $L_D \supset L_E$
[C] $L_E = L_D$ [D] None of the above

8) Which of the following language over {a,b,c} is accepted by a deterministic pushdown automata?

2 Marks GATE-CSE/IT-1997( )

[A] {w ⊂ w^R | w ∈ {a, b} *} [B] {ww^R | w ∈ {a, b, c} *}
[C] $\{a^n b^n c^n \mid n \geq 0\}$ [D] {w | w is a palindrome over{a, b, c}}

Note: w^R is the string obtained by reversing 'w'.

9) If L_1 and L_2 are context free languages and R a regular set, one of the languages below is not necessarily a context free language. Which one?

2 Marks GATE-CSE/IT-1996( )

[A] L_1L_2 [B] $L_1 \cap L_2$
[C] $L_1 \cap R$ [D] $L_1 \cup L_2$

10) Define a context free languages L ≤ {0,1} init (L) = {u/uv ∈ L for some v in {{0,1}} (in other words, init(L) is the set of prefixes of L) Let L {w/w is nonempty and has on equal number of 0's and 1's Then init (L) is

2 Marks GATE-CSE/IT-1996( )

[A] the set of all binary strings with unequal number of 0's and 1's
[B] the set of all binary strings including the null string
[C] the set of all binary strings with exactly one more 0's than the number of 1's or one more 1 than the number of 0's.
[D] None of the above

11)Consider a grammar with the following productions
S → a ∝ b| b ∝ c| aB
S →∝ S| b
S →∝ b b| ab
S ∝→ bd b| b
The above grammar is:

1 Marks GATE-CSE/IT-1995( )

[A] Context free
[B] regular
[C] Context sensitive
[D] LR(k)

12)Which of the following definitions below generates the same language as L, where L = { x_ny _n such that n >= 1}?
I. E → xE y |xy
II. x y |_(x_+ xyy _+ _)
III. x _+ y _+

2 Marks GATE-CSE/IT-1995( )

[A] I only
[B] I and II
[C] II and III
[D] II only

13)Whichofthefollowingfeaturescannotbecapturedbycontext-freegrammars?

1 Marks GATE-CSE/IT-1994( )

[A] Syntaxofif-then-elsestatements
[B] Syntaxofrecursiveprocedures
[C] Whetheravariablehasbeendeclaredbeforeitsuse
[D] Variable names of arbitrary length

14)S →aSa | bSb | a | b The language generated by the above grammar over the alphabet {a,b} is the set of

1 Marks GATE-CSE/IT-2008( )

[A] all palindromes
[B] all odd length palindromes
[C] strings that begin and end with the same symbol
[D] all even length palindromes

15)Consider the languages.
$L_1 = \{ww^R \mid w \epsilon \{0,1\}^*\}$
$\boldsymbol{L_2 = \{w\#w \mid w \epsilon \{0,1\}^*\}}$ where # is a special symbol
$L_3 = \{ww \mid w \epsilon \{0,1\}^*\}$
Which one of the following is TRUE?

2 Marks GATE-CSE/IT-2005( )

[A] L_1 is a deterministic CFL
[B] L_2 is a deterministic CFL
[C] L_3 is a CFL, but not a deterministic CFL
[D] L_3 is a deterministic CFL

16)Let $L_1 = \{0^{n+m}1^n0^m \mid n,m \geq 0\}$ $L_2 = \{0^{n+m}1^{n+m}0^m \mid n,m \geq 0\}$,and $L_3 = \{0^{n+m}1^{n+m}0^{n+m} \mid n,m \geq 0\}$. Which of these languages are NOT context free ?

1 Marks GATE-CSE/IT-2006( )

[A] L_1only
[B] L_3only
[C] $L_1$and L_2
[D] $L_2$and L_3

17)For s ϵ (0 +1)* let d(s) denote the decimal value of s(e.g.d(101) = 5).
Let L = {s ϵ(0+1)* |d(s) mod 5 = 2 and d(s) mod 7 ≠ 4}
Which one of the following statements is true ?

2 Marks GATE-CSE/IT-2006( )

[A] L is recursively enumerable, but not recursive
[B] L is recursive, but not context-free
[C] L is context-free, but not regular
[D] L is regular

18)Consider the following statements about the context-free grammar, G = {S →SS, S →ab, S →ba, S →ϵ}
1. G is ambiguous
2. G produces all strings with equal number of a's and b's.
3. G can be accepted by a deterministic PDA.
Which combination below expresses all the true statements about G ?

2 Marks GATE-CSE/IT-2006( )

[A] 1 only
[B] 1 and 3 only
[C] 2 and 3 only
[D] 1, 2 and 3

19)S → aSa | bSb | a | b
The language generated by the above grammar over the alphabet {a,b} is the set of

1 Marks GATE-CSE/IT-2009(   )

[A] all palindromes
[B] all odd length palindromes
[C] strings that begin and end with the same symbol
[D] all even length palindromes

CFL & PDA

Key Paper

1.	C	2.	D	3.	B	4.	A	5.	B
6.	B	7.	A	8.	A	9.	B	10.	B
11.	C	12.	A	13.	C	14.	B	15.	B
16.	D	17.	D	18.	B	19.	B		

REL & TM

1) Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true?

1 Marks GATE-CSE/IT-2010( )

[A] L2 – L1 is recursively enumerable
[B] L1 – L3 is recursively enumerable
[C] L2 ∩L1 is recursively enumerable
[D] L2 ∪L1 is recursively enumerable

2) Nobody knows yet if P=NP. Consider the language L defined as follows

$$L = \begin{cases} (0+1)* & if\ P = NP \\ \phi & otherwise \end{cases}$$

Which of the following statements is true ?

1 Marks GATE-CSE/IT-2003( )

[A] L is recursive
[B] L is recursively enumerable but not recursive
[C] L is not recursively enumerable
[D] Whether L is recursive or not will be known after we find out if P= NP.

3) A single tape Turning Machine M has two states q0 and q1, of which q0 is the starting state, The tape alphabet of M is {0,1, B} and its input alphabet is {0,1}. The symbol B is the blank symbol used to indicate end of an input string. The transition function of M is described in the following table.

	0	1	B
q0	q1, 1, R	q1, 1, R	Halt
q1	q1,1,R	q0, 1, L	q0, B, L

The table is interpreted as illustrated below.
The entry (q1, 1, R) in row q0 and column 1 signifies that if M is in state q0 and reads 1 on the current tape square, then it writes 1 on the same tape square, moves its tape head one position to the right and transitions to state q1.
Which of the following statements is true about M ?

2 Marks GATE-CSE/IT-2003( )

[A] M does not halt on any string in $(0+1)^+$
[B] M does not halt on any string in (00 + 1)*
[C] M halts on all string ending in a 0
[D] M halts on all string ending in a 1

4) Define languages L0 and L1 as follows
L_0 = { | M halts on w }
L_1 = { | M does not halts on w }
Here <M, w, i> is a triplet, whose first component. M is an encoding of a Turing Machine, second component, w, is a string, and third component, t, is a bit.
Let $L = L_0 \cup L_1$. Which of the following is true ?

2 Marks GATE-CSE/IT-2003( )

[A] L is recursively enumerable, but L is not
[B] L is recursively enumerable, but L is not
[C] Both L and L are recursive
[D] Neither L nor L is recursively enumerable

5) If L and $\overline{L}$ are recursively enumerable then L is

1 Marks GATE-CSE/IT-2007( )

[A] regular
[B] context-free
[C] context-sensitive
[D] recursive

6) If the strings of a language L can be effectively enumerated in lexicographic (i.e., alphabetic) order, which of the following statements is true ?

1 Marks GATE-CSE/IT-2003( )

[A] L is necessarily finite
[B] L is regular but not necessarily finite
[C] L is context free but not necessarily regular
[D] L is recursive but not necessarily context free

REL & TM

7) L_1 is a recursively enumerable language over Σ. An algorithm A effectively enumerates its words as w_1, w_2, w_3,…Define another language L_2 over Σ U{ #} as {w_i # w_j: w_i, $w_j \in L_1$, i <j }. Here # is a new symbol. Consider the following assertions.
S_1 : L_1 is recursive implies L_2 is recursive
S_2: L_2 is recursive implies L_1 is recursive
Which of the following statements is true ?

2 Marks GATE-CSE/IT-2004( )

[A] Both S_1 and S_2 are true
[B] S_1 is true but S_2 is not necessarily true
[C] S_2 is true but S_1 is not necessarily true
[D] Neither is necessarily true

8) Let L_1 be a recursive language, and let L_2 be a recursively enumerable but not a recursive language. Which one of the following is TRUE ?

2 Marks GATE-CSE/IT-2005( )

[A] $\bar{L}_1$ is recursive and $\bar{L}_2$ is recursively enumerable
[B] $\bar{L}_1$ is recursive and $\bar{L}_2$ is not recursively enumerable
[C] $\bar{L}_1$ and $\bar{L}_2$ are recursively enumerable
[D] $\bar{L}_1$ is recursively enumerable and $\bar{L}_2$ is recursive

9) If L and $\bar{L}$ are recursively enumerable then L is

2 Marks GATE-CSE/IT-2007( )

[A] regular
[B] context-free
[C] context-sensitive
[D] recursive

REL & TM

Key Paper

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

Undecidability

1) Which of the following is/are undecidable?
1 G is a CFG. Is L (G) = Φ ?
2. G is a CFG. IS L (G) = Σ * ?
3. M is a Turning machine. Is L(M) regular?
4. A is a DFA and N is a NFA. Is L (A) = L (N) ?

2 Marks GATE-CSE/IT-2013( )

[A] 3 only
[B] 3 and 4 only
[C] 1, 2 and 3 only
[D] 2 and 3 only

2) Which of the following problems are decidable?
1) Does a given program ever produce an output?
2) If L is context-free language, then, is $\bar{L}$ also context-free?
3) If L is regular language, then, is $\bar{L}$ also regular?
4) If L is recursive language, then, is $\bar{L}$ also recursive?

1 Marks GATE-CSE/IT-2012( )

[A] 1, 2, 3, 4
[B] 1, 2
[C] 2, 3, 4
[D] 3, 4

3) Assuming P ≠ NP, which of the following is TRUE?

1 Marks GATE-CSE/IT-2012( )

[A] NP-complete = NP
[B] NP-complete ∩ P = ∅
[C] NP-hard = NP
[D] P = NP-complete

4) Consider the following problem X.
Given a Turing machine M over the input alphabet Σ, any state q of M And a word w ∈Σ*, does the computation of M on w visit the state q?
Which of the following statements about X is correct?

2 Marks GATE-CSE/IT-2001( )

[A] X is decidable
[B] X is undecidable but partially decidable
[C] X is undecidable and not even partially decidable
[D] X is not a decision problem

5) Which one of the following is not decidable?

2 Marks GATE-CSE/IT-1997( )

[A] Given a Turing machine M, a stings s and an integer k, M accepts s within k steps
[B] Equivalence of two given Turing machines
[C] Language accepted by a given finite state machine is not empty
[D] Language generated by a context free grammar is non empty

6) Ram and Shyam have been asked to show that a certain problem π is NP-complete. Ram shows a polynomial time reduction from the 3-SAT problem to π, and Shyam shows a polynomial time reduction from to 3-SAT. Which of the following can be inferred from these reduction ?

1 Marks GATE-CSE/IT-2003( )

[A] π is NP-hard but not NP-complete
[B] π is in NP, but is not NP-complete
[C] π is NP-complete
[D] π is neither Np-hard, nor in NP

7) The problems 3-SAT and 2-SAT are

1 Marks GATE-CSE/IT-2004( )

[A] both in P
[B] both NP- complete
[C] NP- complete and in P respectively
[D] undecidable and NP- complete respectively

8) The problems 3-SAT and 2-SAT are

1 Marks GATE-CSE/IT-2004( )

[A] both in P
[B] both NP- complete
[C] NP- complete and in P respectively
[D] undecidable and NP- complete respectively

9) Consider three decision problems P_1, P_2 and P_3. It is known that P_1 is decidable and P_2 is undecidable. Which one of the following is TRUE ?

2 Marks GATE-CSE/IT-2005( )

[A] P_3 is decidable if P_1 is reducible to P_3
[B] P_3 is undecidable if P_3 is reducible to P_2
[C] P_3 is undecidable if P_2 is reducible to P_3
[D] P_3 is decidable if P_3 is reducible to P_2's complement.

Undecidability

10)Consider the following two problems on undirected graphs

α : Given G(V,E), does G have an independent set of size |V| - 4 ?
β : Given G(V,E), does G have an independent set of size 5 ?
Which one of the following is TRUE ?

2 Marks GATE-CSE/IT-2005( )

[A] α is in the P and β is NP-complete
[B] α is NP-complete and β is in P
[C] Both α and β are NP-complete
[D] Both α and β are in P

11)Let S be an NP-complete problem Q and R be two other problems not known to be in NP. Q is polynomial-time reducible to S and S is polynomial-time reducible to R. Which one of the following statements is true ?

1 Marks GATE-CSE/IT-2006( )

[A] R is NP-complete
[B] R is NP-hard
[C] Q is NP-complete
[D] Q is NP-hard

12)Let $SHAM_3$ be the problem of finding a Hamiltonian cycle in a graph G=(V,E) with |V| divisible by 3 and $DHAM_3$ be the problem of determining if a Hamiltonian cycle exists in such graphs. Which one of the following is true ?

2 Marks GATE-CSE/IT-2006( )

[A] Both $DHAM_3$ and $SHAM_3$ are NP-hard
[B] $SHAM_3$ is NP-hard, but $DHAM_3$ is not
[C] $DHAM_3$ is NP-hard, but $SHAM_3$ is not
[D] Neither $DHAM_3$ nor $SHAM_3$ is NP-hard

13)Which of the following problems is undecidable ?

1 Marks GATE-CSE/IT-2007( )

[A] Membership problem for CFG's
[B] Ambiguity problem for CFGs
[C] Finiteness problem for FSAs
[D] equivalence problem for FSAs

14)Which of the following are decidable ?

1. Whether the intersection of two regular languages is infinite
2. Whether a given context-free language is regular
3. Whether two push-down automata accept the same language
4. Whether a given grammar is context-free

2 Marks GATE-CSE/IT-2007( )

[A] 1 and 2
[B] 1 and 4
[C] 2 and 3
[D] 2 and 4

Undecidability

Key Paper

1.	B	2.	D	3.	B	4.	B	5.	B
6.	A	7.	C	8.	C	9.	C	10.	C
11.	A	12.	A	13.	B	14.	B		

Chomskey Hierarchy

1) Consider the languages L1, L2 and L3 as given below
L1 = {0^p1^q | p, q ϵN}
L2 = {0p1q | p, q ϵN and p = q} and
L3 = {$0^p1^q0^r$ | p, q, r ϵN and p = q = r}
Which of the following statements is NOT TRUE?

2 Marks GATE-CSE/IT-2011( )

[A] Push Down Automata (PDA) can be used to recognize L1 and L2
[B] L1 is a regular language
[C] All the three languages are context free
[D] Turing machines can be used to recognize all the languages

2) Consider the following languages:
L1 = {ww | w ∈ {a, b} *}
L2 = {ww^R | w ∈ {a, b}*,w^R is the reverse of w}
L3 = {0^{2i} | i is an integer}
L3 = {0^{i^2} | i is an integer}
Which of the languages are regular?

2 Marks GATE-CSE/IT-2001( )

[A] Only L1 and L2
[B] Only L2, L3 and L4
[C] Only L3 and L4
[D] Only L3

3) Let L denotes the language generated by the grammar S →0S0 / 00.
Which of the following is true?

1 Marks GATE-CSE/IT-2000( )

[A] L = 0^+
[B] L is regular but not 0^+
[C] L is context free but not regular
[D] L is not context free

4) Consider the following decision problems:
(P1) Does a given finite state machine accept a given string
(P2) Does a given context free grammar generate an infinite number of stings Which of the following statements is true?

2 Marks GATE-CSE/IT-2000( )

[A] Both (P1) and (P2) are decidable
[B] Neither (P1) nor (P2) are decidable
[C] Only (P1) is decidable
[D] Only (P2) is decidable

5) If L is context free language and L_2 is a regular language which of the following is/are false?

2 Marks GATE-CSE/IT-1999( )

[A] $L_1 - L_2$ is not context free
[B] $L_1 \cap L_2$ is context free
[C] ~L_1 is context free
[D] ~L_2 is regular

6) Regarding the power of recognition of languages, which of the following statements is false?

1 Marks GATE-CSE/IT-1998( )

[A] The non-deterministic finite-state automata are equivalent to deterministic finite-state automata.
[B] Non-deterministic Push-down automata are equivalent to deterministic Push- down automata.
[C] Non-deterministic Turing machines are equivalent to deterministic Push-down automata.
[D] Non-deterministic Turing machines are equivalent to deterministic Turing machines.
[E] Multi-tape Turing machines are equivalent to Single-tape Turing machines.

7) Which of the following statements is false?

1 Marks GATE-CSE/IT-1996( )

[A] The Halting problem of Turing machines is undecidable.
[B] Determining whether a context-free grammar is ambiguous is undecidable.
[C] Given two arbitrary context-free grammars G_1 and G_2 it is undecidable whether L(G_1) = L(G_2).
[D] Given two regular grammars G_1 and G_2 it is undecidable whether L(G_1) = L(G_2).

8) Let Σ = {0, 1},L = Σ* and R = {0^n1^n such that n >0} then the languages L ∪ R and R respectively are

2 Marks GATE-CSE/IT-1995( )

[A] regular,regular
[B] notregular,regular
[C] regular,notregular
[D] notregular,noregular

9) The language $a^m b^n c^{m+n}$| m,n ≥1} is

2 Marks GATE-CSE/IT-2004( )

[A] regular
[B] context – free but not regular
[C] context sensitive but not context free
[D] type-0 but not context sensitive

10) Which of the following are decidable ?
1. Whether the intersection of two regular languages is infinite
2. Whether a given context-free language is regular
3. Whether two push-down automata accept the same language
4. Whether a given grammar is context-free

1 Marks GATE-CSE/IT-2007( )

[A] 1 and 2
[B] 1 and 4
[C] 2 and 3
[D] 2 and 4

11) Let $L = L_1 \cap L_2$, where L_1 and L_2 are languages as defined below:
$L_1 = \{a^m b^m c a^n b^n / m, n > 0\}$
$L_2 = \{a^i b^j c^k / i, j, k \geq 0\}$
Then L is

1 Marks GATE-CSE/IT-2009( )

[A] not recursive
[B] regular
[C] context-free but not regular
[D] recursively enumerable but not context-free

12) The language {$a^m b^n c^{m+n}$| m,n ≥1} is

2 Marks GATE-CSE/IT-2004( )

[A] regular
[B] context – free but not regular
[C] context sensitive but not context free
[D] type-0 but not context sensitive

13) Consider the following grammar C
S →bS | aA | b
A →bA | aB
B →bB | aS | a
Let Na(w) and Nb(w) denote the number of a's and b's in a string w respectively. The language L(G) {a,b}+ generated by G is

2 Marks GATE-CSE/IT-2004( )

[A] {w | N_a(w) >3N_b(w)}
[B] { w | N_b(w) >3N_a(w)}
[C] {w | N_a(w)= 3k, k∊{0,1,2,…}}
[D] {w | N_b(w) = 3k, k∊{0,1,2,…}}

14) Let N_f and N_P denote the classes of languages accepted by non-deterministic finite automata and non-deterministic push-down automata, respectively. Let D_f and D_P denote the classes of languages accepted by deterministic finite automata and deterministic push-down automata, respectively. Which one of the following is TRUE ?

2 Marks GATE-CSE/IT-2005( )

[A] $D_f \subset N_f$ and $D_P \subset N_P$
[B] $D_f \subset N_f$ and $D_P = N_P$
[C] $D_f = N_f$, and $D_P = N_P$
[D] $D_f = N_f$ and $D_P \subset N_P$

15) Consider the languages
$L_1 = \{a^n b^n c^m \mid n, m > 0\}$ and $L_2 = \{a^n b^m c^m \mid n, m > 0\}$
Which one of the following statements is FALSE?

2 Marks GATE-CSE/IT-2005( )

[A] $L_1 \cap L_2$ is a context-free language
[B] $L_1 \cup L_2$ is a context-free language
[C] L_1 and L_2 are context-free language
[D] $L_1 \cap L_2$ is a context sensitive language

16) Let L_1 be regular language, L_2 be a deterministic context-free language and L_3 a recursively enumerable, but not recursive, language. Which one of the following statements is false ?

2 Marks GATE-CSE/IT-2006( )

[A] $L_1 \cap L_2$ is deterministic CFL
[B] $L_3 \cap L_1$ is recursive
[C] $L_1 \cup L_2$ is context free
[D] $L_1 \cap L_2 \cap L_3$ is recursively enumerable

17) Which of the following languages is regular ?

2 Marks GATE-CSE/IT-2007( )

[A] $\{ww^R \mid w \epsilon \{0,1\}^+\}$
[B] $\{ww^R x \mid x, w \epsilon \{0,1\}^+\}$

[C] $\{wxw^R \mid x, w \in \{0,1\}^+\}$
[D] $\{xww^R \mid x, w \in \{0,1\}^+\}$

18)Which of the following is true for the language $\{a^p \mid p \text{ is a prime}\}$?

2 Marks GATE-CSE/IT-2007( )

[A] It is not accepted by a Turning Machine
[B] It is regular but not context-free
[C] It is context-free but not regular
[D] It is neither regular nor context-free, but accepted by a Turing machine

19)Which of the following statements is false ?

2 Marks GATE-CSE/IT-2008( )

[A] Every NFA can be converted to an equivalent DFA
[B] Every non-deterministic Turing machine can be converted to an equivalent deterministic Turing machine
[C] Every regular language is also a context-free language
[D] Every subset of a recursively enumerable set is recursive

20)Which of the following statements are true ?

1. Every left-recursive grammar can be converted to a right-recursive grammar and vice-versa
2. All ϵ - productions can be removed from any context-free grammar by suitable transformations.
3. The language generated by a context-free grammar all of whose productions are of the form X $\rightarrow$w or X $\rightarrow$ wY(where, w is a string of terminals and Y is a non-terminal), is always regular.
4. The derivation trees of strings generated by a context-free grammar in Chomsky Normal Form are always binary trees.

2 Marks GATE-CSE/IT-2008( )

[A] 1, 2, 3 and 4
[B] 2, 3 and 4 only
[C] 1 , 3 and 4 only
[D] 1, 2 and 4 only

21)Which one of the following is FALSE ?

1 Marks GATE-CSE/IT-2009( )

[A] There is a unique minimal DFA for every regular language
[B] Every NFA can be converted to an equivalent PDA
[C] Complement of every context-free language is recursive
[D] Every nondeterministic PDA can be converted to an equivalent deterministic PDA

Chomskey Hierarchy

Key Paper

1.	C	2.	D	3.	A	4.	A	5.	C
6.	B	7.	D	8.	C	9.	B	10.	B
11.	C	12.	B	13.	C	14.	D	15.	A
16.	B	17.	C	18.	D	19.	D	20.	C
21.	D								

Miscellaneous

1) How many sub strings of different lengths (non-zero) can be found formed from a character string of length n?

1 Marks GATE-CSE/IT-1998( )

[A] n
[B] n^2
[C] 2^n
[D] $\frac{n(n+1)}{2}$

2) Given Σ={a,b}, which one of the following sets is not countable?

1 Marks GATE-CSE/IT-1997( )

[A] Set of all strings over Σ
[B] Set of all languages over Σ
[C] Set of all regular languages over Σ
[D] Set of all languages over Σ accepted by Turing machines

3) Whichofthefollowingconversionsisnotpossible(algorithmically)?

1 Marks GATE-CSE/IT-1994( )

[A] Regulargrammartocontextfreegrammar
[B] Non-deterministicFSAtodeterministicFSA
[C] Non-deterministicPDAtodeterministicPDA
[D] Non-deterministicTuringmachinetodeterministicTuring machine

4) Match List-I with List-II and select the correct answer using the codes given below the lists :
List I .
A. Checking that identifiers are declared before their use
B. Number of formal parameters in the declaration of a function agrees with the number of actual parameters in a use of that function
C. Arithmetic expressions with matched pairs of parentheses
D. Palindromes

List –II
1. L = { $a^n b^m c^n d^m$ | n ≥ 1, m ≥ 1 }
2. X → X b X | X cX | d X f | g
3. L = [wcw | w ∈ (a | b)* }
4. X → b X b | c X c | ∈

Codes :

	A	B	C	D

2 Marks GATE-CSE/IT-2008( )

[A]	1	3	2	4
[B]	3	1	4	2
[C]	3	1	2	4
[D]	1	3	4	2

5) Match List-I with List-II and select the correct answer using the codes given below the lists :
List I .
A. Checking that identifiers are declared before their use
B. Number of formal parameters in the declaration of a function agrees with the number of actual parameters in a use of that function
C. Arithmetic expressions with matched pairs of parentheses
D. Palindromes

List –II
1. L = { $a^n b^m c^n d^m$ | n ≥ 1, m ≥1 }
2. X → X b X | X cX | d X f | g
3. L = [wcw | w ϵ (a | b)* }
4. X → b X b | c X c | ϵ

2 Marks GATE-CSE/IT-2008( )

[A] A- 1 B- 3 C-2 D-4
[B] A- 3 B- 1 C-4 D-2
[C] A-3 B-1 C- 2 D-4
[D] A-1 B- 3 C-4 D-2

Miscellaneous

Key Paper

1.	A	2.	B	3.	C	4.	C	5.	C

Old GATE Questions along with Key from 1991-2014
In CS & IT Department
(Questions of other Departments are also added for Combined Syllabus)

Index- Compiler Design

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Basics

1) What is the result of the following program?

```
program side-effect (input, output);
var x, result: integer:
function f (var x:integer):integer;
begin
x : x + 1; f := x;
end
begin
x := 5
result:=f(x)*f(x)
writeln(result)
end
```

2 Marks GATE-CSE/IT-1998( )

[A] 5 [B] 25
[C] 36 [D] 42

2) Faster access to non-local variables is achieved using an array of pointers to activation records called a

2 Marks GATE-CSE/IT-1998( )

[A] stack [B] heap
[C] display [D] activation tree

3) Given the following Pascal like program segment

```
Procedure A;
x,y:intger;
Procedure B;
x,z:real S1
end B;
Procedure C;
i:integer;
S2
end C;
end A;
```

The variables accessible in S1 and S2 are

2 Marks GATE-CSE/IT-1997( )

[A] x or A, y, x of B and z in S1 and x of B, y and i in S2
[B] x or B, y and z in S1 and x of B, i and z in S2
[C] x or B, z and y in S1 and x of A, i and y in S2
[D] None of the above

4) The pass numbers for each of the following activities
(i) object code generation
(ii) literals added to literal table
(iii) listing printed
(iv) address resolution of local symbols that occur in a two pass assembler respectively are

1 Marks GATE-CSE/IT-1996( )

[A] 1, 2, 1, 2 [B] 2, 1, 2, 1
[C] 2, 1, 1, 2 [D] 1, 2, 2, 2

5) The correct matching for the following pairs is

(A) Activation record	(1) Linking loader
(B) Location counter	(2) Garbage collection
(C) Reference counts	(3) Subroutine call
(D) Address relocation	(4) Assembler

2 Marks GATE-CSE/IT-1996( )

[A] A – 3 B – 4 C – 1 D - 2 [B] A – 4 B – 3 C – 1 D - 2
[C] A – 4 B – 3 C – 2 D - 1 [D] A – 3 B – 4 C – 2 D - 1

6) In the following Pascal program segment, what is the value of X after the execution of the program segment?

```
X:=-10; Y:=20;
If X >Y then if X <0 then X:=abs(X) else X:=2*X;
```

Basics

1 Marks GATE-CSE/IT-1995( )

[A] 10 [B] -20
[C] -10 [D] None

7) What are x and y in the following macro definition?

```
macro    Add x,y
          Load y
         Mul x
         Store y
end macro
```

1 Marks GATE-CSE/IT-1995( )

[A] Variables [B] Identifiers
[C] Actual parameters [D] Formal parameters

8) which of the following strings can definitely be said to be tokens without looking at the input character a pascal program?
I. begin II. program III. <>

1 Marks GATE-CSE/IT-1995( )

[A] I [B] II
[C] III [D] Alloftheabove

9) A shift reduce parser carries out the actions specified within braces immediately after reducing with the corresponding rule of grammar
_S _→ _x_xW {_print"1"}
_S _→ _y {_print"2"}
1_W _→ _Sz {_print"3"}
What is the translation of xxxxyzz using the syntax directed translation scheme described by the above rules?

2 Marks GATE-CSE/IT-1995( )

[A] 23131 [B] 11233
[C] 11231 [D] 33211

10) In which one of the following cases is it possible to obtain different results for call-by reference and call-by -name parameter passing methods?

1 Marks GATE-CSE/IT-1994( )

[A] Passingaconstantvalueasaparameter [B] Passingtheaddressofanarrayasaparameter
[C] Passinganarrayelementasaparameter [D] Passinganarrayfollowingstatementsistrue

Basics

Key Paper

1.	D	2.	C	3.	C	4.	B	5.	D
6.	B	7.	D	8.	B	9.	A	10.	B

Lexical Anal

1) Consider the grammar rule E --> E1 – E2 for arithmetic expressions. The Code generated is targeted to a CPU having a single user register. The subtraction operation required the first operand to be in the register. If E1 and E2 do not have any common sub expression, in order to get the shortest possible code

1 Marks GATE-CSE/IT-2004( )

[A] E1 should be evaluated first
[B] E2 should be evaluated first
[C] Evaluation of E1 and E2 should necessarily be interleaved
[D] Order of evaluation of E1 and E2 is of no consequence

2) In a simplified computer the instructions are :

OP Rj, Ri – Performs Rj OP Ri and stores the result in register Ri

OP m, Ri – Performs val OP Ri and stores the result in Ri. Val denotes the content of memory location m.

MCV m, Ri- Moves the content of memory location m to register Ri.

MCV m, Ri, m- Moves the content of register Ri to memory location m.

The computer has only two registers, and OP is either ADD or SUB. Consider the following basic block :

T1 = a + b

T2 = c + d

T3 = e – t2

T4 = t1 – t3

Assume that all operands are initially in memory. The final value of the computation should be in memory. What is the minimum number of MOV instructions in the code generated for this basic block ?

1 Marks GATE-CSE/IT-2007( )

[A] 2
[B] 3
[C] 5
[D] 7

3) Consider the grammar rule E $E_1 \rightarrow E_2$ for arithmetic expressions. The Code generated is targeted to a CPU having a single user register. The subtraction operation required the first operand to be in the register.If E_1 and E_2 do not have any common sub expression, in order to get the shortest possible code

1 Marks GATE-CSE/IT-2004( )

[A] Removing left recursion alone
[B] E_2 should be evaluated first
[C] Evaluation of E_1 and E_2 should necessarily be interleaved
[D] Order of evaluation of $E_1$and E_2 is of no consequence

Lexical Anal

Key Paper

1.	B	2.	D	3.	B

Parsing

Common Data for Q1 and Q2 is given below

Consider the CFG with {S,A,B} as the non-terminal alphabet, {a,b} as the terminal alphabet, S as the start symbol and the following set of production rules.

$S \rightarrow bA$ $\quad$ $S \rightarrow aB$

$A \rightarrow a$ $\quad$ $B \rightarrow b$

$A \rightarrow aS$ $\quad$ $B \rightarrow bS$

$A \rightarrow bAA$ $\quad$ $B \rightarrow aBB$

1) Which of the following strings is generated by the grammar ?

2 Marks GATE-CSE/IT-2008,GATE-CSE/IT-2007( )

[A] aaaabb [B] aabbbb
[C] aabbab [D] abbbba

2) For the correct answer string to Q.33 how many derivation trees are there ?

2 Marks GATE-CSE/IT-2007( )

[A] 1 [B] 2
[C] 3 [D] 4

Common Data for Q3 and Q4 is given below

Consider the following expression grammar. The semantic rules for expression calculation are stated next to each grammar production.

$E \rightarrow$ number	E.val= number.val
|E'+'E	$E^{(1)}$.val= $E^{(2)}$.val + $E^{(3)}$.val
|E'+' E	$E^{(1)}$.val=$E^{(2)}$.val x $E^{(3)}$.val

3) The above grammar and the semantic rules are fed to a yacc tool (which is an LALR(1) parser generator) for parsing and evaluating arithmetic expressions. Which one of the following is true about the action of yacc for the given grammar ?

2 Marks GATE-CSE/IT-2005( )

[A] It detects recursion and eliminates recursion
[B] It detects reduce-reduce conflict, and resolves
[C] It detects shift-reduce conflict, and resolves the conflict in favor of a shift over a reduce action
[D] It detects shift-reduce conflict, and resolves the conflict in favor of a reduce over a shift action

4) Assume the conflicts in Part (a) of this question are resolved and an LALR(1) parser is generated for parsing arithmetic expressions as per the given grammar. Consider an expression 3 x 2 + 1. What precedence and associativity properties does the generated parser realize ?

2 Marks GATE-CSE/IT-2005,GATE-CSE/IT-2006,GATE-CSE/IT-2005( )

[A] Equal precedence and left associativity; expression is evaluated to 7
[B] Equal precedence and right associativity; expression is evaluated to 9
[C] Precedence of ' x ' is higher than that of '+', and both operators are left associative; expression is evaluaterd to 7
[D] Precedence of '+' is higher than that of 'x', and both operators are left associative; expression is evaluaterd to 9

Common Data for Q5 and Q6 is given below

Consider the CFG with {S,A,B} as the non-terminal alphabet, {a,b} as the terminal alphabet, S as the start symbol and the following set of production rules.

S -->bA $\quad$ S --> aB

A -->a $\quad$ B --> b

A --> aS $\quad$ B --> bS

A --> bAA $\quad$ B --> aBB

5) Which of the following strings is generated by the grammar ?

1 Marks GATE-CSE/IT-2007( )

[A] aaaabb [B] aabbbb
[C] aabbab [D] abbbba

6) For the correct answer string to Q.33 how many derivation trees are there ?

2 Marks GATE-CSE/IT-2007( )

[A] 1 [B] 2
[C] 3 [D] 4

Common Data for Q7 and Q8 is given below

Consider the following expression grammar. The semantic rules for expression calculation are stated next to each grammar production

E number	E.val= number.val
|E '+' E	$E^{(1)}$.val= $E^{(2)}$.val + $E^{(3)}$.val
|E '+' E	$E^{(1)}$.val=$E^{(2)}$.val x $E^{(3)}$.val

7) The above grammar and the semantic rules are fed to a yacc tool (which is an LALR(1) parser generator) for parsing and evaluating arithmetic expressions. Which one of the following is true about the action of yacc for the given grammar ?

2 Marks GATE-CSE/IT-2005( )

[A] It detects recursion and eliminates recursion
[B] It detects reduce-reduce conflict, and resolves
[C] It detects shift-reduce conflict, and resolves the conflict in favor of a shift over a reduce action
[D] It detects shift-reduce conflict, and resolves the conflict in favor of a reduce over a shift action

8) Assume the conflicts in Part (a) of this question are resolved and an LALR(1) parser is generated for parsing arithmetic expressions as per the given grammar. Consider an expression 3 x 2 + 1. What precedence and associativity properties does the generated parser realize ?

2 Marks GATE-CSE/IT-2005( )

[A] Equal precedence and left associativity; expression is evaluated to 7
[B] Equal precedence and right associativity; expression is evaluated to 9
[C] Precedence of ' x ' is higher than that of '+', and both operators are left associative; expression is evaluated to 7
[D] Precedence of '+' is higher than that of 'x', and both operators are left associative; expression is evaluaterd to 9

9) Consider the following grammar.

S --> S*E

S --> E

E --> F + E

E --> F

F --> id

Consider the following LR(0) items corresponding to the grammar above.

(i) S --> S* .E

(ii) E --> F. + E

(iii) E --> F +.E

Given the items above, which two of them will appear in the same set in the canonical sets-of-items for the grammar ?

2 Marks GATE-CSE/IT-2005( )

[A] (i) and (ii) [B] (ii) and (iii)
[C] (i) and (iii) [D] None of these

Parsing

10)Consider the following grammar

S → FR
R → *S|ε
F → id

In the predictive parser table, M, of the grammar the entries M[S,id] and M[R,$] respectively

2 Marks GATE-CSE/IT-2006( )

[A]{ S --> FR} and { R --> ϵ }
[B]{S --> FR} and { }
[C]{ S --> FR} and { R --> *S}
[D]{F -->id}and {R --> ϵ}

11)Which one of the following grammars generates the language L=(ai bj | i #j} ?

2 Marks GATE-CSE/IT-2006( )

[A] S → AC | CB
C → aCb | a | b
A → aA | ε
B → Bb | ε

[B]S -->aS | Sb | a | b

[C] S → AC CB
C → aCb | ε
A → aA | ε
B → Bb | ε

[D] S → AC /CB
C → aCb | ε
A → aA | ε
B → Bb | ε

12)Which one of the following is a top – down parser ?

1 Marks GATE-CSE/IT-2007( )

[A]Recursive descent parser
[B]Operator precedence parser
[C]An LR(k) parser
[D]An LALR(k) parser

13)In the correct grammar above,what is the length of the derivation(number of steps starting from S) to generate the string a/ bmwith l # m ?

1 Marks GATE-CSE/IT-2007( )

[A]max (l,m) + 2
[B]l + m + 2
[C]l + m + 3
[D]max(l,m) +3

14)Consider the grammar with non-terminals N = {S, C,S}, terminals T= {a,b,i,t,e}, with S as the start symbol, and the following set of rules

S --> iCtSS1 | a

S1 --> eS | ϵ

C -->b

The grammar is NOT LL(1) because:

2 Marks GATE-CSE/IT-2007( )

[A]It is left recursive
[B]It is right recursive
[C]It is ambiguous
[D]It is not context-free

15)Consider the following two statements:

P: Every regular grammar is LL(1)

Q: Every regular set has LR (1) grammar

Which of the following is TRUE ?

1 Marks GATE-CSE/IT-2007( )

[A]Both P and ! are true
[B]P is true and Q is false
[C]P is false and Q is true
[D]Both P and Q are false

Parsing

16)Consider the following two sets of LR(1) items of an LR(1) grammar

X → c . X, c / d   X→ c . X, $

X → . cX, c / d   X → . cX, $

X → . d, c / d   X→ . d, $

Which of the following statements related to merging of the two sets in the corresponding LALR parser is/are FALSE?

1. Cannot be merged since look aheads are different
2. Can be merged but will result in S–R conflict
3. Can be merged but will result in R–R conflict
4. Cannot be merged since goto on c will lead to two different sets

2 Marks GATE-CSE/IT-2013( )

[A] 1 only   [B] 2 only

[C] 1 and 4 only   [D] 1, 2, 3 and 4 only

17)Assume that the SLR parser for a grammar G has n_1 states and the LALR parser for G has n_2 states.The relationship between $n_1$and $n_2$is

1 Marks GATE-CSE/IT-2003( )

[A] $n_1$is necessarily less than n_2 [B] n_1 is necessarily equal to n_2

[C] n_1 is necessarily greater than n_2 [D] None of the above

18)In a bottom-up evaluation of a syntax directed definition,inherited attributes can

1 Marks GATE-CSE/IT-2003( )

[A] always be evaluated   [B] be evaluated only if the definition is L-atributed

[C] be evaluated only if the definition has synthesized attributes   [D] never be evaluated

19)Consider the grammar shown below.

S --> C C

C --> c C | d

The grammar is

2 Marks GATE-CSE/IT-2003( )

[A] L L (1)   [B] SLR (1) but not LL (1)

[C] LALR (1) but not SLR (1)   [D] LR (1) but not LALR (1)

20)Which of the following grammar rules violate the requirements of an operator grammar ? P,Q, R are non terminals, and r,s, t are terminals.

(i) P --> Q R   (ii) P --> Q s R

(iii) P--> ϵ (iv) P --> Q t R r

1 Marks GATE-CSE/IT-2004( )

[A] (i) only   [B] (i) and (iii) only

[C] (ii) and (iii) only   [D] (III) and (iv) only

21)The grammar A AA|(A)| is not suitable for predictive-parsing because the grammar is

1 Marks GATE-CSE/IT-2005( )

[A] ambiguous   [B] Left-recursive

[C] right-recurisve   [D] n operator-grammar

22)Consider the grammar E E + n|E x n|n

For a sentence n+n x n, the handles in the right-sentential form of the reduction are

1 Marks GATE-CSE/IT-2005( )

[A] n, E + n and E + n x n   [B] n, E + n and E = E x n

[C] n, n + n and n + n x n   [D] n, E + n and E x n

23)Consider the grammar

S (S) | a

Let the number of states in SLR (1), LR(1) and LAKR(1) parsers for the grammar be n1 n2 and n3 respectively. The following relationship holds good

2 Marks GATE-CSE/IT-2005( )

[A] n1 <n2 <n3   [B] n1 = n3 <= n2

[C] n1 = n2 = n3   [D] n1 >= n3>= n2

Parsing

24)Which of the following describes a handle (as applicable to LR-parsing) appropriately ?

2 Marks GATE-CSE/IT-2008( )

[A] It is the position in a sentential form where the next shift or reduce operation will occur

[B] It is a non-terminal whose production will be used for reduction in the next step

[C] It is a production that may be used for reduction in a future step along with a position in the sentential form where the next shift or reduce operation will occur

[D] It is the production p that will be used for reduction in the next step along with a position in the sentential form where the right hand side of the production may be found

25)An LALR(1) parser for a grammar G can have shift-reduce (S-R) conflicts if and only if.

2 Marks GATE-CSE/IT-2008( )

[A] the SLR (1) parser for G has S-R conflicts

[B] the LR(1) parser for G has S-R conflicts

[C] the LR (0) parser for G has S-R conflicts

[D] the LALR(1) parser for G has reduce-reduce conflicts

26)The grammar $A \rightarrow AA|(A)|\epsilon$ is not suitable for predictive-parsing because the grammar is

2 Marks GATE-CSE/IT-2005( )

[A] ambiguous

[B] Left-recursive

[C] right-recurisve

[D] n operator-grammar

27)Consider the grammar $E \rightarrow E + n|E \times n|$

For a sentence n+n x n, the handles in the right-sentential form of the reduction are

2 Marks GATE-CSE/IT-2005( )

[A] n, E + n and E + n x n

[B] n, E + n and E = E x n

[C] n, n + n and n + n x n

[D] n, E + n and E x n

28)Consider the grammar

$S \rightarrow (S) \mid a$

Let the number of states in SLR (1), LR(1) and LALR(1) parsers for the grammar be n_1 $n_2$and n_3 respectively. The following relationship holds good

2 Marks GATE-CSE/IT-2005( )

[A] $n_1 < n_2 < n_3$

[B] $n_1 = n_3 < n_2$

[C] $n_1 = n_2 = n_3$

[D] $n_1 \geq n_3 \geq n_2$

29). Consider the following grammar.

$S \rightarrow S^*E$

$S \rightarrow E$

$E \rightarrow F + E$

$E \rightarrow F$

$F \rightarrow id$

Consider the following LR(0) items corresponding to the grammar above.

(i) $S \rightarrow S^* .E$

(ii) $E \rightarrow F. + E$

(iii) $E \rightarrow F +.E$

Given the items above, which two of them will appear in the same set in the canonical sets-of-items for the grammar ?

1 Marks GATE-CSE/IT-2006( )

[A] (i)and (ii)

[B] (ii) and (iii)

[C] (i) and (iii)

[D] None of these

30)Consider the following grammar

S $\rightarrow$ FR

R $\rightarrow$ *S|ϵ

F $\rightarrow$ id

In the predictive parser table, M, of the grammar the entries M[S,id] and M[R,$] respectively.

2 Marks GATE-CSE/IT-2006( )

[A]{ S$\rightarrow$FR} and { R $\rightarrow\epsilon$}
[B]{S $\rightarrow$ FR} and { }
[C]{ S $\rightarrow$ FR} and { R $\rightarrow$ *S}
[D]{F $\rightarrow$id} and {R $\rightarrow\epsilon$}

31)Which one of the following grammars generates the language

L=($a^i b^j$ | i $\neq$j} ?

2 Marks GATE-CSE/IT-2006( )

[A] S $\rightarrow$AC | CB

C $\rightarrow$aCb | a | b

A $\rightarrow$ aA |ϵ

B $\rightarrow$Bb | ϵ

[B] S $\rightarrow$aS | Sb | a | b

[C] S $\rightarrow$AC CB

C $\rightarrow$ aCb |ϵ

A $\rightarrow$ aA |ϵ

B $\rightarrow$ Bb |ϵ

[D] S $\rightarrow$AC | CB

C $\rightarrow$ aCb | ϵ

A $\rightarrow$ aA | a

B $\rightarrow$ bB | b

32)Which of the following describes a handle (as applicable to LR-parsing) appropriately ?

1 Marks GATE-CSE/IT-2008( )

[A] It is the position in a sentential form where the next shift or reduce operation will occur
[B] It is a non-terminal whose production will be used for reduction in the next step
[C] It is a production that may be used for reduction in a future step along with a position in the sentential form where the next shift or reduce operation will occur.
[D] It is the production p that will be used for reduction in the next step along with a position in the sentential form where the right hand side of the production may be found

33)An LALR(1) parser for a grammar G can have shift-reduce (S-R) conflicts if and only if.

2 Marks GATE-CSE/IT-2008( )

[A] the SLR (1) parser for G has S-R conflicts
[B] the LR(1) parser for G has S-R conflicts
[C] the LR (0) parser for G has S-R conflicts
[D] the LALR(1) parser for G has reduce-reduce conflicts

34)The grammar $S \rightarrow aSa \mid bS \mid c$ is

2 Marks GATE-CSE/IT-2010( )

[A] LL(1) but not LR(1)
[B] LR(1) but not LR(1)
[C] Both LL(1) and LR(1)
[D] Neither LL(1) nor LR(1)

35)Which of the following statements is false?

1 Marks GATE-CSE/IT-2001( )

[A] An unambiguous grammar has same leftmost and rightmost derivation
[B] An LL(1) parser is a top-down parser
[C] LALR is more powerful than SLR
[D] An ambiguous grammar can never be LR(k) for any k

36)A grammar that is both left and right recursive for a non-terminal, is

2 Marks GATE-CSE/IT-1999( )

[A] Ambiguous
[B] Unambiguous

[C] Information is not sufficient to decide whether it is ambiguous or unambiguous

[D] None of the above

37) Which of the following statements is true?

1 Marks GATE-CSE/IT-1998( )

[A] SLR parser is more powerful than LALR

[B] LALR parser is more powerful than Canonical LR parser

[C] Canonical LR parser is more powerful than LALR parser.

[D] The parsers SLR, Canonical CR, and LALR have the same power

Statement for Linked answer Q38 and Q39 is given below

38) For the grammar below, a partial LL(1) parsing table is also presented along with the grammar. Entries that need to be filled are indicated as E1, E2, and E3. ε is the empty string, $ indicates end of input, and | separates alternate right hand sides of productions.

S--> aAbB |bAaB |ε
A --> S
B --> S

	a	b	$
S	**E1**	**E2**	$S \to \varepsilon$
A	$A \to S$	$A \to S$	error
B	$B \to S$	$B \to S$	**E3**

Q.
The First and Follow sets for the non-terminals A and B are

2 Marks GATE-CSE/IT-2012,GATE-CSE/IT-2012( )

[A] FIR5T(A) = {a, b, ε } = FIR5T (B)
FOLLOW(A) = {a, b}
FOLLOW(B) = {a, b, $}

[B] FIR5T(A) = {a, b, $}
FIR5T(B) = {a, b, ε }
FOLLOW(A) = {a, b}
FOLLOW(B) ={$}

[C] FIR5T(A) = {a, b, ε } = FIR5T(B)
FIR5T(A) = {a, b}
FOLLOW(B) = ∅

[D] FIR5T(A) = {a, b,} = FIR5T(B)
FIR5T(A) = {a, b}
FOLLOW(B) ={a, b}

39) The appropriate entries for E1, E2, and E3 are

2 Marks GATE-CSE/IT-2012( )

[A] E1: $S \to aAbB$, $A \to S$
E2: $S \to bAaB$, $B \to S$
E3: $B \to S$

[B] E1: $S \to aAbB$, $S \to \varepsilon$
E2: $S \to bAaB$, $S \to \varepsilon$
E3: $S \to \varepsilon$

[C] E1: $S \to aAbB$, $S \to \varepsilon$
E2: $S \to bAaB$, $S \to \varepsilon$
E3: $B \to S$

[D] E1: $A \to S$, $S \to \varepsilon$
E2: $B \to S$, $S \to \varepsilon$
E3: $B \to S$

Parsing

Key Paper

1.	C	2.	B	3.	C	4.	B	5.	C
6.	B	7.	C	8.	C	9.	C	10.	A
11.	D	12.	A	13.	A	14.	A	15.	A
16.	D	17.	B	18.	D	19.	A	20.	B
21.	A	22.	D	23.	B	24.	D	25.	B
26.	A	27.	D	28.	B	29.	C	30.	A
31.	D	32.	D	33.	B	34.	C	35.	D
36.	A	37.	C	38.	B	39.	C		

SDT

1) Consider the translation scheme shown below

S --> TR

R --> T {print ('+');} R | ε

T --> num {print (num.val);}

Here num is a token that represents an integer and num, val represents the corresponding integer value. For an input string '9 + 5 + 2', this translation scheme will print

2 Marks GATE-CSE/IT-2003( )

[A] 9 + 5 + 2
[B] 9 5 + 2 +
[C] 9 5 2 + +
[D] + + 9 5 2

2) Consider the syntax directed definition shown below

S -->id : = E { gen (id.place = E.place;);}

E -->E1 + E2 {t = newtemp ( ) ;
Gen (t= E1. place + E2. place ;);
E. place = t}

E --> i {E. place=id. place;}Here, gen is a function that generates the output code, and newtemp is a function that returns the name of new temporary variable on every call. Assume that ti's are the temporary variable names generated by newtemp.For the statement 'X:=Y + Z', the 3-address code sequence generated by this definition is

2 Marks GATE-CSE/IT-2003( )

[A] X = Y + Z
[B] t_1= Y + Z ; X = t_1
[C] t_1= Y ; t_2= t_1+ Z ; X = t_2
[D] t_1= Y ; t_2= Z ; t_3= t_1+ t_2; X = t_3

3) Consider the grammar with the following translation rules and E as the start symbol.

E --> E1 # T {E.value=E1.value* T.value}
| T {E.value=T. value}

T --> T1 &F {T.value= T1.value + F.value}
| F {T.value= F.value}

F --> num {F.value = num.value}

Compute E. value for the root of the parse tree for the expression :
2 # 3 &5 # 6 &4.

1 Marks GATE-CSE/IT-2004( )

[A] 200
[B] 180
[C] 160
[D] 40

4) Consider the following translation scheme.

S -->ER

R -->*E {print('*'); R |

E -->F + E {print('+'); | F

F --> (S) | id {print (id.value);}

Here id is a taken that represents an integer and id. Value represents the corresponding integer value. For an input '2 * 3 + 4', this translation scheme prints

2 Marks GATE-CSE/IT-2006( )

[A] 2*3 + 4
[B] 2* + 3 4
[C] 2 3 * 4 +
[D] 2 3 4 + *

SDT

5) Consider the grammar with the following translation rules and E as the start symbol.

$E \to E_1 \# T$ {E.value=E_1.value* T.value}
| T {E.value=T. value}

$T \to T_1$ &F {T.value= T_1.value + F.value}
| F {T.value= F.value}

F →num {F.value = num.value}

Compute E. value for the root of the parse tree for the expression :
2 # 3 &5 # 6 &4.

2 Marks GATE-CSE/IT-2004( )

[A] 200 [B] 180
[C] 160 [D] 40

6) Consider the following translation scheme.

S →ER

R →*E {print('*'); R |ϵ

E →F + E {print('+'); | F

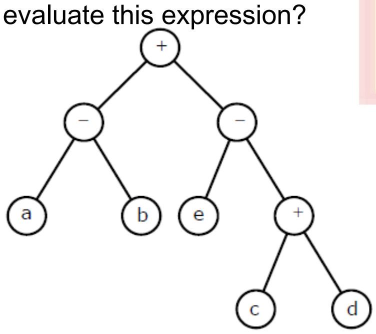
F →(S) | id {print (id.value);}

Here id is a taken that represents an integer and id. Value represents the corresponding integer value. For an input '2 * 3 + 4', this translation scheme prints

2 Marks GATE-CSE/IT-2006( )

[A] 2*3 + 4 [B] 2* + 3 4
[C] 2 3 * 4 + [D] 2 3 4 + *

7) Consider evaluating the following expression tree on a machine with load-store architecture in which memory can be accessed only through load and store instructions. The variables a, b, c, d and e are initially stored in memory. The binary operators used in this expression tree can be evaluated by the machine only when the operands are in registers. The instructions produce result only in a register. If no intermediate results can be stored in memory, what is the minimum number of registers needed to evaluate this expression?



2 Marks GATE-CSE/IT-2011( )

[A] 2 [B] 9
[C] 5 [D] 3

8) Type checking is normally done during

1 Marks GATE-CSE/IT-1998( )

[A] lexical analysis [B] syntax analysis
[C] syntax directed translation [D] code optimization

9) Generationofintermediatecodebasedonanabstractmachinemodelisusefulincompilersbecause

1 Marks GATE-CSE/IT-1994( )

[A] itmakesimplementationoflexicalanalysisandsyntax analysiseasier
[B] syntax-directed translationscanbewritten forintermediatecodegen eration
[C] itenhancesthe portabilityofthefrontendofthe compi ler
[D] itisnotpossibletogeneratecodeforrealmachinesdire ctlyfromhighlevellanguageprograms

SDT

Key Paper

1.	B	2.	B	3.	C	4.	D	5.	C
6.	D	7.	D	8.	C	9.	C		

ICG & TCG

1) Consider the grammar rule E --> E1 – E2 for arithmetic expressions. The Code generated is targeted to a CPU having a single user register. The subtraction operation required the first operand to be in the register. If E1 and E2 do not have any common sub expression, in order to get the shortest possible code

1 Marks GATE-CSE/IT-2004( )

[A] E1 should be evaluated first
[B] E2 should be evaluated first
[C] Evaluation of E1 and E2 should necessarily be interleaved
[D] Order of evaluation of E1 and E2 is of no consequence

2) In a simplified computer the instructions are :

OP Rj, Ri – Performs Rj OP Ri and stores the result in register Ri

OP m, Ri – Performs val OP Ri and stores the result in Ri. Val denotes the content of memory location m.

MCV m, Ri- Moves the content of memory location m to register Ri.

MCV m, Ri, m- Moves the content of register Ri to memory location m.

The computer has only two registers, and OP is either ADD or SUB. Consider the following basic block :

T1 = a + b

T2 = c + d

T3 = e – t2

T4 = t1 – t3

Assume that all operands are initially in memory. The final value of the computation should be in memory. What is the minimum number of MOV instructions in the code generated for this basic block ?

1 Marks GATE-CSE/IT-2007( )

[A] 2
[B] 3
[C] 5
[D] 7

3) Consider the grammar rule E $E_1 \rightarrow E_2$ for arithmetic expressions. The Code generated is targeted to a CPU having a single user register. The subtraction operation required the first operand to be in the register.If E_1 and E_2 do not have any common sub expression, in order to get the shortest possible code

1 Marks GATE-CSE/IT-2004( )

[A] Removing left recursion alone
[B] E_2 should be evaluated first
[C] Evaluation of E_1 and E_2 should necessarily be interleaved
[D] Order of evaluation of E_1 and E_2 is of no consequence

ICG & TCG

Key Paper

1.	B	2.	D	3.	B

Code Optim

1) Some code optimizations are carried out on the intermediate code because

1 Marks GATE-CSE/IT-2008( )

[A] They enhance the portability of the complier to other target processors

[B] Program analysis is more accurate on intermediate code than on machine code

[C] The information from data flow analysis cannot otherwise be used for optimization

[D] The information from the front end cannot otherwise be used for optimization

2) Some code optimizations are carried out on the intermediate code because

1 Marks GATE-CSE/IT-2008( )

[A] They enhance the portability of the complier to other target processors

[B] Program analysis is more accurate on intermediate code than on machine code

[C] The information from data flow analysis cannot otherwise be used for optimization

[D] The information from the front end cannot otherwise be used for optimization

3) What is the value of X printed by the following program?

```
program COMPUTE (input, output);
var
X:integer;
procedure FIND (X:real);
begin
X:=sqrt(X);
 end;

begin
X:=2
Find(X)
 Writeln(X)
end
```

2 Marks GATE-CSE/IT-1995( )

[A] 2

[B] $\sqrt{2}$

[C] Run time error

[D] None of the above

Code Optim

Key Paper

1.	**B**	**2.**	**B**	**3.**	**A**

Miscellaneous

1) Consider a program P that consists of two source modules M1 and M2 contained in two different files. If M1 contains a reference to a function defined in M2, the reference will e resolved at

1 Marks GATE-CSE/IT-2004( )

[A] Edit-time
[B] Compile-time
[C] Link-time
[D] Load-time

2) Which of the following suffices to convert an arbitrary CFG to an LL(1) grammar ?

1 Marks GATE-CSE/IT-2003( )

[A] Removing left recursion alone
[B] Factoring the grammar alone
[C] Removing left recursion and factoring the grammar
[D] None of this

3) Which of the following grammar rules violate the requirements of an operator grammar ? P,Q, R are noterminals, and r,s, t are terminals.

(i) $P \rightarrow \rightarrow$ Q R   (ii) $P \rightarrow$ Q s R

(iii) $P \rightarrow \epsilon$ (iv) $P \rightarrow$ Q t R r

1 Marks GATE-CSE/IT-2004( )

[A] (i) only
[B] (i) and (iii) only
[C] (ii) and (iii) only
[D] (III) and (iv) only

4) Consider a program P that consists of two source modules M_1 and M_2 contained in two different files.If M_1 contains a reference to a function defined in M_2, the reference will e resolved at

1 Marks GATE-CSE/IT-2004( )

[A] Edit-time
[B] Compile-time
[C] Link-time
[D] Load-time

5) The weight of a sequence a_0, $a_1,\ldots,a_{n-1}$ of real numbers is defined as a_0+ a_1/ 2 + ... + $a_{n-1}/2^{n-1}$. A subsequence of a sequence is obtained by deleting

some elements from the sequence, keeping the order of the remaining elements the same. Let X denote the maximum possible weight of a subsequence of a_0, a_1,..., a_{n-1}. Then X is equal to

2 Marks GATE-CSE/IT-2010( )

[A] max (Y, a_0 + Y)
[B] max(Y, a_0 + Y /2)
[C] max(Y, a_0 + 2Y)
[D] a_0 + Y / 2

6) A simple two-pass assembler does the following in the first pass:

2 Marks GATE-CSE/IT-1993( )

[A] It allocates space for the literals.
[B] It computes the total length of the program
[C] It builds the symbol table for the symbols and their values.
[D] It generates code for all the load and store register instructions.
[E] None of the above.

Miscellaneous

Key Paper

1.	C	2.	C	3.	B	4.	C	5.	D
6.	A								

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Analysis of Complexities

1) The cube root of a natural number n is defined as the largest natural number m such that m3 <n. The complexity of computing the cube root of n (n is represented in binary notation) is

2 Marks GATE-CSE/IT-2003( )

[A] O(n) but not O($n^{0.5}$)
[B] O ($n^{0.5}$) but not O($(logn)^k$) for any constant k >0
[C] O($(logn)^k$) for some constant k >0,but not O($(loglogn)^m$)for any constant m> 0
[D] O($(loglogn)^m$) for some constant k >0.5, but not O($(loglogn)^{0.5}$)

2) The tightest lower bound on the number of comparisons, in the worst case, for comparison-based sorting is of the order of

1 Marks GATE-CSE/IT-2004( )

[A] n
[B] n^2
[C] n logn
[D] $nlog^2n$

3) Two matrices M1 and M2 are to be stored in arrays A and B respectively. Each array can be stored either in row-major or column-major order in contiguous memory locations. The time complexity of an algorithm to compute M1 x M2 x will be

1 Marks GATE-CSE/IT-2004( )

[A] best if A is in row-major, and B is in column-major order
[B] best if both are in row-major order
[C] best if both are in column-major order
[D] independent of the storage scheme

4) Let A[1,…, n] be an array storing a bit (1 or 0) at each location, and f(m) is a function whose time complexity is θ(m). Consider the following program fragment written in a C like language :

```
Counter = 0 ;
For (i =  1 ; i
{ if      (A[i]= = 1) counter ++;
Else {f (counter); counter = 0;}
}
```

The complexity of this program fragment is

2 Marks GATE-CSE/IT-2004( )

[A] $\Omega(n^2)$
[B] Ω(n log n) and O(n^2)
[C] Θ(n)
[D] o (n)

5) The time complexity ofcomputing the transitive closure of a binary relation on a set of n elements isknown to be

1 Marks GATE-CSE/IT-2004( )

[A] O (n)
[B] O (n log n)
[C] O ($n^{\frac{3}{2}}$)
[D] O (n^3)

6) Suppose T(n) = 2T(n/2)+n,T(0) = T (1) =1 Which one of the following is FALSE ?

2 Marks GATE-CSE/IT-2005( )

[A] T(n)= O(n^2)
[B] T(n)= Θ(n log n)
[C] T(n) = Ω (n^2)
[D] T(n) = O (n log n)

7) Suppose there are log nsorted lists of n/log n elements each. The time complexity of producing a sorted list of all these elements is: (Hint : Use a heap data structure)

2 Marks GATE-CSE/IT-2005( )

[A] O (n log log n)
[B] θ(n log n)
[C] Ω(n log n
[D] Ω(n3/2)

8) Consider the polynominal $p(x)=a_0+a_1x+a_2x^2+a_3x^3$, where ai 0, i. The minimum number of multiplications needed to evaluate p on an input x is

1 Marks GATE-CSE/IT-2006( )

[A] 3
[B] 4
[C] 6
[D] 9

Analysis of Complexities

9). A set X can be represented by an array x [n] as follows

1 If i X
X[i]= 0 0 otherwise

Consider the following algorithm in which x,y, and z are Boolean arrays of size n :

```
Algorithm zzz(x[],z[]){
inti;
for (i=0; i
        z[i] = (x[i] ^ ~y[i] V (~x[i] ^ y [i])
}
```

The set Z computed by the algorithm is

2 Marks GATE-CSE/IT-2006( )

[A] (X Y)
[B] (X Y)
[C] (X-Y) (Y-X)
[D] (X-Y) (Y-X)

10)Consider the following is true ?

$T(n) = 2T([\sqrt{n}]) + 1, T(1) = 1$

Which one of the following is true ?

2 Marks GATE-CSE/IT-2006( )

[A] T(n) = θ(log log n)
[B] T(n)= θ (log n)
[C] T(n) = θ ($\sqrt{n}$)
[D] T(n) = θ (n)

11)Given two arrays of numbers $a_1 \ldots . a_n$ and $b_1 \ldots . b_n$ where each number is 0 or 1,the fastest algorithm to find the largest span (i,j) such that $a_i + a_{i+1} + \ldots + a_j = b_i + b_{i+1} + \ldots + b_j$, or report that there is no such span.

2 Marks GATE-CSE/IT-2006( )

[A] Takes O(3^n) and Ω (2^n) time if hashing is permitted
[B] takes O(3n) and W (2.5n) time in the key comparison model
[C] Takes Θ(n) time and space
[D] Takes O time only if the sum of the 2n elements is an even number

12)The median of n elements can be found in O (n) time. Which one of the following is correct about the complexity of quick sort, in which remains is selected as pivot ?

2 Marks GATE-CSE/IT-2006( )

[A] θ (n) (b) (c) (d)
[B] θ (n log n)
[C] θ(n^2)
[D] θ(n^3)

13)Which of the following sorting algorithms has the lowest worst-case complexity ?

1 Marks GATE-CSE/IT-2007( )

[A] Merge sort
[B] Bubble sort
[C] Quick sort
[D] Selection sort

14). What is the time complexity of the following recursive function:

```
int Do Something (int n) {
if        n <= 2)
             return 1 ;
else
return (Do Somethings(floor (sqrt (n))
) +                n);
   }
```

2 Marks GATE-CSE/IT-2007( )

[A] Θ(n^2)
[B] Θ($\log_2 n$)
[C] Θ($\log_2 n$)
[D] Θ($\log_2 \log_2 n$)

15)Consider the following C code segment :

```
int      IsPrime (n)
         {
                   int i, n;
                   for (i=2; I <=sqrt(n); I ++)
                        if (n &i = = 0)
                   printf("Not Prime\n"};
                             return 0 ;)
                   return 1 ;
                   }
```

Let T (n) denote the number of times the for loop is executed by the program on input n. Which of the following is TRUE ?

2 Marks GATE-CSE/IT-2007( )

[A] T(n) = O($\sqrt{n}$) and T(n)=$\Omega\sqrt{n}$ and T(n) = 0($\sqrt{n}$)

[B] T(n) = O $\Omega\sqrt{n}$

[C] T(n) =O($\sqrt{n}$) and T(n) = Ω(1)

[D] None of these

16)Consider the following functions:

f(n)=2^n
g(n)= n!
h(n)=n^{logn}
Which of the following statements about the asymptotic behavior
Of f(n), g(n), and h(n) is true ?

2 Marks GATE-CSE/IT-2008( )

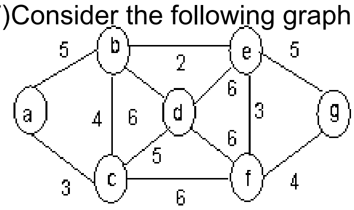
[A] f(n)=O(g(n)); f(n)=O(h)(n))

[B] f(n)= Ω(g(n)); g(n)= O(h(n))

[C] g(n)=O(f(n);h(n)= O (f(n))

[D] h(n)= O (f(n); g(n)= Ω(f(n))

17)Consider the following graph :



Which one of the following is NOT the sequence of edges added to the minimum spanning tree using Kruskal's algorithm ?

2 Marks GATE-CSE/IT-2009( )

[A] (b,e) (e,f) (a,c) (b,c) (f,g) (c,d)

[B] (b,e) (e,f) (a,c) (f,g) (b,c) (c,d)

[C] (b,e) (a,c) (e,f), (b,c) (f,g) (c,d)

[D] (b,e) (e,f) (b,c) (a,c) (f,g) (c,d)

Analysis of Complexities

Key Paper

1.	C	2.	C	3.	D	4.	C	5.	D
6.	B	7.	A	8.	A	9.	D	10.	A
11.	C	12.	C	13.	A	14.	D	15.	C
16.	D	17.	D						

Analysis of searching & sorting

1) Consider the process of inserting an element into a Max Heap, where the Max Heap is represented by an array. Suppose we perform a binary search on the path from the new leaf to the root to find the position for the newly inserted element, the number of comparisons performed is

2 Marks GATE-CSE/IT-2007( )

[A] θ (log2 n) [B] θ (log2 log2n)
[C] θn [D] θ (n log2n)

2) The minimum number of comparison required to determine if an integer appears more than n/2 times in a sorted array of n integers is

2 Marks GATE-CSE/IT-2008( )

[A] Θ(n) [B] Θ(log n)
[C] Θ(log*n) [D] Θ(1)

3). Consider the Quicksort algorithm. Suppose there is a procedure for finding a pivot element which splits the list into sub-lists each of which contains at least one –fifth of the elements. Let T(n) be the number of comparisons required to sort n elements. Then

2 Marks GATE-CSE/IT-2008( )

[A] T(n)   2T(n/5) +n [B] T(n) T (n/5) + T (4n/5) +n
[C] T(n)   2T (4n/5 + n [D] T(n) 2T (n/2) + n

4). What is the number of swaps required to sort n elements using selection sort, in the worst case ?

(a) (b) (n log n) (c) (n2) (d) (n2 log n)

2 Marks GATE-CSE/IT-2008( )

[A] Θ(n) [B] Θ(n log n)
[C] Θ(n2) [D] Θ(n2 log n)

5) Which of the following statement(s) is/are correct regarding Bellman-Ford shortest path algorithm ?
P. Always finds a negative weighted cycle, if one exists.
Q. Finds whether any negative weighted cycle is reachable from the Source

2 Marks GATE-CSE/IT-2008( )

[A] P only [B] Q only
[C] both P and Q [D] neither P nor Q

6) In quick sort, for sorting n elements, the (n/4)th smallest element is selected as pivot using an O(n) time algorithm. What is the worst case time complexity of the quick sort ?

2 Marks GATE-CSE/IT-2009( )

[A] Θ(n) [B] Θ(n log n)
[C] Θ(n^2) [D] Θ (n^2 log n)

Analysis of searching & sorting

Key Paper

1.	**A**	**2.**	**B**	**3.**	**B**	**4.**	**A**	**5.**	**C**
6.	**B**								

Asymptotic analysis

1) Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and the hash function x mod 10, which of the following statements are true ?
   1. 9679, 1989, 4199 hash to the same value
   2. 1471, 6171 hash to the same value
   3. All elements hash to the same value
   4. Each element hashes to a different value

1 Marks GATE-CSE/IT-2004( )

[A] 1 only
[B] 2 only
[C] 1 and 2 only
[D] 3 and 4 only

Asymptotic analysis

Key Paper

1.	**C**

Problem categories(P & NP

1) Let π_a be a problem that belongs to the class NP. Then which one of the following is TRUE ?

2 Marks GATE-CSE/IT-2008( )

[A] Thee is no polynomial time algorithm for π_a

[B] If π_a can be solved deterministically in polynomial time, then P=NP

[C] If π_a is NP-hard, then it is NP-complete

[D] π_a may be undecidable

Key Paper

1.	C

Algorithem Analysis

Common Data for Q1 and Q2 is given below

We are given 9 tasks T1, T2…T9. The execution of each task required one unit of time. We can execute one task at a time. Ti has a profit Pi and a deadline di profit pi earned if the task is completed before the end of the d_i^{th} unit of time.

Task	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

1) Are all tasks completed in the schedule that gives maximum profit ?

2 Marks GATE-CSE/IT-2005( )

[A] All tasks are completed
[B] T1 and T6 are left out
[C] T1 and T8 are left out
[D] T4 and T6 are left out

2) What is the maximum profit earned ?

2 Marks GATE-CSE/IT-2005( )

[A] 147
[B] 165
[C] 167
[D] 175

3) In a permutation $a_1 \ldots a_n$ of n distinct integers, an inversion is a pair $(a_1 \ldots a_n)$ such that i <j and $(a_i > a_j)$.
5. If all permutation are equally likely, what is the expected number of inversions in a randomly chosen permutation of 1…n ?

1 Marks GATE-CSE/IT-2003( )

[A] n(n-1)/2
[B] n(n-1)/4
[C] n(n+1)/4
[D] 2n[log2^n]

4) What would be the worst case time complexity of the insertion Sort algorithm, if the inputs are restricted to permutations of 1…n with at most n inversions ?

2 Marks GATE-CSE/IT-2003( )

[A] Θ(n^2)
[B] Θ(n log n)
[C] Θ($n^{1.5}$)
[D] Θ(n)

5) The following are the starting and ending times of cetivities A,B,C, D,E,F, G, and H respectively in chronological order: "$a_s b_s a_e d_s a_e e_s f_s b_e d_e g_s e_e f_e h_s g_e h_e$" Here, xs denotes the starting time and xe denotes the ending time of activity X.W need to schedule the activities in a set of rooms available to us. An activity can be scheduled in a room only if the room is reserved for the activity for its entire duration. What is the minimum number of rooms required ?

2 Marks GATE-CSE/IT-2003( )

[A] 3
[B] 4
[C] 5
[D] 6

6) Let G= (V,E) be a direction graph with n vertices. A path from vi to vj in G is sequence of vertices (v_i,v_i+1,.., v_j) such that (v_k, v_{k+1}) E for all k in I through j-1. A simple path is a path in which no vertex appears more than once.
Let A be an n x n array initialized as follow

_ 1 if (j,k) E
A[j,k]= 0 otherwise
Consider the following algorithm
For i = 1 to n
For j = 1 to n
For k = 1 to n
A[j,k] = max (A[j,k] (A[j,i] + A[i,k]);
Which of the following statements is necessarily true for all j and k after terminal of the above algorithm ?

2 Marks GATE-CSE/IT-2003( )

[A] A[j,k] n
[B] If A[j,j] n-1, then G has a Hamiltonian cycle
[C] If there exists a path from j to k, A[j,k] contains the longest path lens from j to k
[D] If there exists a path from j to k, every simple path from j to k contain most A[j,k] edges

7) Suppose each set is represented as a linked list with elements in arbitrary order. Which of the operations among union, intersection, membership, cardinality will be the slowest ?

2 Marks GATE-CSE/IT-2004( )

[A] union only
[B] intersection, membership
[C] membership, cardinality
[D] union, intersection

8) In a binary max heap containg n numbers, the smallest element can be found in time

1 Marks GATE-CSE/IT-2006( )

[A] θ(n)
[B] θ(log n)
[C] θ(log log n)
[D] θ(1)

9) Which one the following in place sorting algorithms needs the minimum number of swaps ?

1 Marks GATE-CSE/IT-2006( )

[A] Quick- sort
[B] Insertion sort
[C] Selection sort
[D] Heap sort

10) Consider the followingC-program fragment in which i,j, and n are integer variables.

```
for (i=n,j=0; i>0;i/=2,j+=i);
```

Let Val (j) = denote the valuestored in the variable j after termination of the for loop. Which one of the following is true ?

1 Marks GATE-CSE/IT-2006( )

[A] val(j) = θ (log n)
[B] val (j) = θ($\sqrt{n}$)
[C] val (j) =θ (n)
[D] val (j) = θ(n log n)

11) An element in anarray X is called a leader if it is greater than all elements to the right ofit in X. The best algorithm to find allleaders in an array.

1 Marks GATE-CSE/IT-2006,GATE-CSE/IT-2006( )

[A] Solves it in linear time using a left to right pass of the array
[B] Solves in linear time using a right to left pass
[C] Solves it is using divide and conquer in time θ(n log n)
[D] Solves it in time θ (n^2)

12) Consider the following code written in a pass-by-reference language like FORTAN and these statements about the code.

```
Subroutine swap  (ix, iy)
                 it = ix
L1 :             ix = iy
L2:              iy = it
  end
 ia = 3
 ib = 8
call swap (ia, ib + 5)
print*, ia, ib
end
```

S1: The compiler will generate code to allocate a temporary nameless cell, initialize it to 13, and pass the address of the cell to swap.
S2: On execution the code will generate a runtime error on line L1
S3: On execution the code will generate a runtime error on line L2
S4: The program will print 13 and 8
S: The program will print 13 and -2
Exactly the following set of statement (s) is correct :

2 Marks GATE-CSE/IT-2006( )

[A] S1 and S2
[B] S1 and S4
[C] S3
[D] S1 and S5

13) Consider the hash table of size seven, with starting index zero, and a has function (3x + 4) mod 7. Assuming the has table is initially empty, which of the following is the contents of the table when the sequence 1,3,8,10 is inserted into the table using closed hashing ? Note that –denotes an empty location in the table

2 Marks GATE-CSE/IT-2007( )

[A] 8-,-,-,-,-,10
[B] 1,8,10,-,-,-, 3
[C] 1,-,-,-,-,-, 3
[D] 1,10,8, -,-,-, 3

14)In the following C function let n≥ m.

```
int gcd (n,m)
{
        If(n &m= =0} return m:
        n= n &m;
        Return gcd (m,n);
}
```

How many recursive calls are made by this function ?

2 Marks GATE-CSE/IT-2007( )

[A] $\Theta(\log_2 n)$ [B] Ω (n)
[C] Θ(log2log2n) [D] $\Theta\sqrt{n}$

15). An array of n numbers is given where n is an even number. The maximum as well as the minimum of these n numbers needs to be determined. Which of the following is TRUE about the number of comparisons needed ?

2 Marks GATE-CSE/IT-2007( )

[A] At least 2n-c comparisons, for some constant c, are needed.
[B] At most 1.5n-2 comparisons are needed
[C] At least n, log2 n comparisons are needed
[D] None of the above

16)The subset- sum problem is defined as follows : Given a set S of n positive integers and positive integer W; determine whether there is a subset of S whose elements sum to W.
An algorithm Q solve this problem in O(nW) time. Which of the following statements is false. ?

2 Marks GATE-CSE/IT-2008( )

[A] Q solves the subset-sum problem polynomial time when the input is encoded in unary.
[B] Q solves the subset-sum – problem is polynomial time when .
[C] The subset sum problem belongs to the class NP
[D] The subset sum problem in NP-hard

Algorithem Analysis

Key Paper

1.	D	2.	A	3.	B	4.	A	5.	B
6.	D	7.	D	8.	A	9.	D	10.	C
11.	C	12.	A	13.	B	14.	A	15.	B
16.	D								

Tree and graph traversals

1) Let G= (V,E) be an undirected graph with a subgraph $G_1=(V_1, E_1)$, Weights are assigned to edges of G as follows

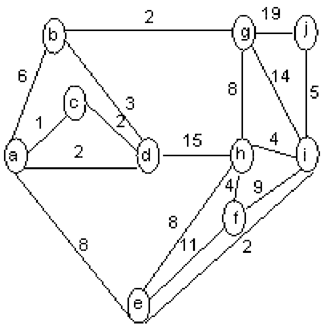
$W(e) = $ 0 if e E_1
1 otherwise

A single-source shortest path algorithm is executed on the weighted graph (V, E,w) with an arbitrary vertex v_1 of V_1 as the source. Which of the following can always be inferred from the path costs computed ?

2 Marks GATE-CSE/IT-2003( )

[A] The number of edges in the shortest paths from v_1 to all vertices of G
[B] G_1 is connected
[C] V_1 forms a clique in G
[D] G_1 is a tree

2) Let G= (V,E) be an undirected graph G_1= (V,E_1) such that E_1 E and V_1 V
Consider an example :



2 Marks GATE-CSE/IT-2003( )

[A] 29
[B] 31
[C] 38
[D] 41

3) Level order traversal of a rooted tree can be done by starting from the root and performing

1 Marks GATE-CSE/IT-2004( )

[A] preorder traversal
[B] inorder traversal
[C] depth first search
[D] breadth first search

4) Consider the label sequences obtained by the following pairs of traversals on a labeled binary tree. Which of these pairs identify a tree uniquely ?
1. preorder and postorder
2. inorder and postorder
3. preorder and inorder
4. level order and postorder

2 Marks GATE-CSE/IT-2004( )

[A] only
[B] 2 and 3
[C] 3 only
[D] 4 only

5) Suppose we run Dijkstra's single source shortest-path algorithm on the following edge-weighted directed graph with vertex P as the source.

In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized ?

2 Marks GATE-CSE/IT-2004( )

[A] P,Q,R,S,T,U
[B] P,Q,R,U,S,T
[C] P,Q,R,U,T,S
[D] P,Q,T,R,U,S,

6) A program takes as input a balanced binary search tree with n leaf nodes and computes the value of a function g(x) for each node x. If the cost of computing g(x) is min (number of leaf-nodes in leaf-subtree of x, number of leaf-nodes in right-subtree of x) then the worst case time complexity of the program is

2 Marks GATE-CSE/IT-2004( )

[A] $\Theta(n)$
[B] O (n log n)

[C] O (n^2)
[D] O (2^n)

7) A undirected graph G has n nodes. Its adjacency matrix is given by an n x n square matrix whose
1. diagonal elements are 0's and
2. Non-diagonal elements are 1's Which one of the following is TRUE ?

1 Marks GATE-CSE/IT-2004( )

[A] Graph G has no minimum spanning tree (MST)
[B] Graph G has a unique MST of cost n-1
[C] Graph G has multiple distinct MSTs, each of cost n-1
[D] Graph G has multiple spanning trees of different costs

8) A priority –Queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is given below :
10,8,5,3,2
Two new elements '1' and '7' are inserted in the heap in that order .The level order traversal of the heap after the insertion of the elements is

2 Marks GATE-CSE/IT-2005( )

[A] 10, 8, 7,5,3,2,1
[B] 10,8,7,2,3, 1,5
[C] 10, 8,7,1,2,3,5
[D] 10, 8,7,3,2, 1,5

9) How many distinct binary search trees can be created out of 4 distinct keys ?

2 Marks GATE-CSE/IT-2005( )

[A] 5
[B] 14
[C] 24
[D] 35

10) In a complete k-ary, every internal node has exactly k children. The number of leaves in such a tree with n internal nodes is

2 Marks GATE-CSE/IT-2005( )

[A] nk
[B] (n-1) k+1
[C] n(k-1) + 1
[D] n(k-1)

11) Consider a weighted complete graph G on the vertex set {v1, v2,….,vn} such that the weight of the edge (vi,vj) is 2|i-j|. The weight of a minimum spanning tree of G is

1 Marks GATE-CSE/IT-2006( )

[A] n – 1
[B] 2 n -2
[C] n /2
[D] n^2

12) To implement Dijkstra's shortest path algorithm on unweighted grphs so that it runs in linear time, then data structure to be used is

1 Marks GATE-CSE/IT-2006( )

[A] Queue
[B] Stack
[C] Heap
[D] B-Tree

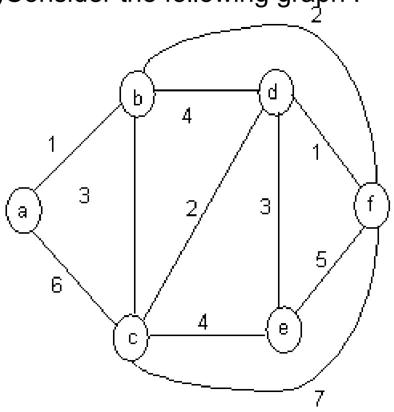
13) A scheme for storing binary trees in an array X is as follows.Indexing of X starts at 1 instead of 0.The roots is stored at X[1]. For a node stored at X[i], the left child, if any, is stored in X[2i] and the right child, if any, in X [2i + 1]. To be able to store any binary tree on n vertices, the minimum size of X should be

1 Marks GATE-CSE/IT-2006( )

[A] $\log_2 n$
[B] n
[C] 2n+1
[D] 2n

Tree and graph traversals

14)Consider the following graph :



Which one of the following cannot be the sequence of edges added, in that order, to a minimum spanning tree using Kruskal's algorithm ?

2 Marks GATE-CSE/IT-2006( )

[A](a-b), (d-f), (b-f), (d-c), (d-e)
[B](a-b), (d-f),(d-c), (b-f), (d-e)
[C](d-f),(a-b), (d-c) (b-f), (d-e)
[D](d-f), (a-b), (b-f), (d-e), (d-c)

15). Let T be a depth first search tree in a undirected graph G. Vertices u and v are leaves of this tree. T. The degrees of both u and v in G are at least 2. Which one of the following statements is true ?

2 Marks GATE-CSE/IT-2006( )

[A]There must exist a vertex w adjacent to both u and v in G
[B]There must exist a vertex w whose removal disconnects u and v in G
[C]There must be exist a cycle in G containing u and v
[D]There must exist a cycle in G containing u and all its neighbors in G

16)The height of a binary treeis the maximum number of edges in any root to leaf path. The maximum number of nodes is a binary treeof height h is

1 Marks GATE-CSE/IT-2007( )

[A]2^h
[B]2^{h-1}-1
[C]2^{h+1}-1
[D]2^{h+1}

17)The maximum number of binary trees that can be formed with three unlabeled nodes is

1 Marks GATE-CSE/IT-2007( )

[A]1
[B]5
[C]4
[D]3

18). The inorder and preorder traversal of a binary tree are d b e a f c g and a b d e c f g respectively. The postorder traversal of the binary tree is

2 Marks GATE-CSE/IT-2007( )

[A]d e b f g c a
[B]e d b g f c a
[C]e d b f g c a
[D]d e f g b c a

19)In an unweighted, undirected connected graph, the shortest path from a node S to every other node is computed most efficiently, in terms of time complexity, by

2 Marks GATE-CSE/IT-1997( )

[A]Dijkstra's algorithm starting from S.
[B]Warshall's algorithm
[C]performing a DFS starting from S
[D]performing a BFS starting from S

20)A complete n- ary tree is a tree in which eachnode has n children or no children. Let Ibe the number of internal nodes and L be the number of leaves in a completen-ary tree. If L=41, and I=10, what is the value of n

2 Marks GATE-CSE/IT-2007( )

[A]3
[B]4
[C]5
[D]6

Tree and graph traversals

21)Let w be the minimum weightamong all edge weights in an undirectedconnected graph. Let e be aspecific edge of weight w. which of thefollowing is FALSE ?

2 Marks GATE-CSE/IT-2007( )

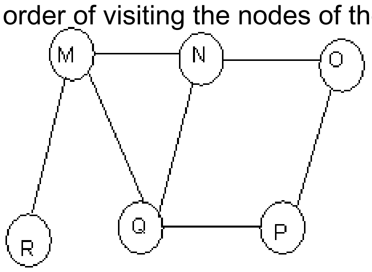
[A] There is a minimum spanning tree containing e.

[B] If e is not in a minimum spanning tree T, then in the cycle formed by adding e to T, all edges have the same weight.

[C] Every minimum spanning tree has an edge of weight w

[D] e is present in every minimum spanning tree

22) The Breadth First Search algorithm has been implemented using the queue data structure. One possible order of visiting the nodes of the following graph is



1 Marks GATE-CSE/IT-2008( )

[A] MNOPQR

[B] NQMPOR

[C] QMNPRO

[D] QMNPOR

23)A B-tree of order 4 is built from scratch by 10 successive insertions. What is the maximum number of node splitting operations that may take place ?

2 Marks GATE-CSE/IT-2008( )

[A] 3

[B] 4

[C] 5

[D] 6

24)G is a graph on n vertices and 2n-2 edges. The edges of G can be partitioned into two edge-disjoint spanning trees. Which of the following is NOT true for G ?

2 Marks GATE-CSE/IT-2008( )

[A] For every subset of k vertices, the induced sub graph has a most 2k-2 edges.

[B] The minimum cut in G has a least two edges.

[C] There are two edges-disjoint paths between every pair of vertices

[D] There are two vertex-disjoint paths between every pair of vertices.

25)

Dijkstra's single source shortest path algorithm when run from vertex a in the above graph, computes the corrects shortest path distance to

2 Marks GATE-CSE/IT-2008( )

[A] only vertex a (b) (c) (d)

[B] only vertices a,e,f,g.h

[C] only vertices a,b,c,d

[D] all the vertices

26). You are given the postorder traversal, P of a binary search tree on the n elements 1,2,…..,n. You have to determine the unique binary search tree that has P as its postorder traversal. What is the time complexity of the most efficient algorithm for doing this ?

2 Marks GATE-CSE/IT-2008( )

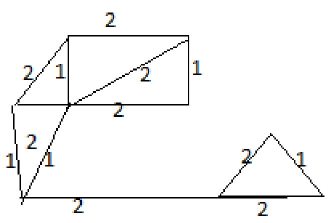
[A] Θ(log n)

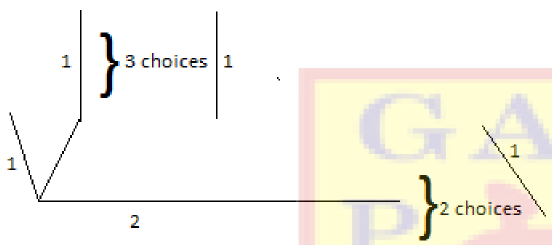
[B] Θ(n)

[C]Θ(n log n)

[D]None of the above, as the tree cannot be uniquely determined.

27)The number of distinct minimum spanning tree for weighted graph given below is ____





2 Marks GATE-CSE/IT-2014( )

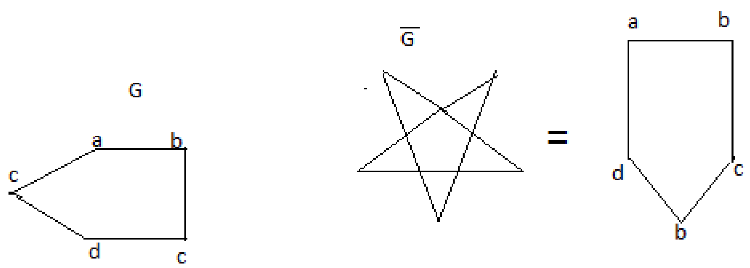
[A]6
[B]4
[C]8
[D]9

28)Maximum number of super keys for the relational schema (E , F , G , H) with E as key.

2 Marks GATE-CSE/IT-2014( )

[A]4
[B]8
[C]6
[D]9

29)A cycle of n vertices is isomorphic to its complement then value of n is ?



2 Marks GATE-CSE/IT-2014( )

[A]3
[B]6
[C]8
[D]5

Tree and graph traversals

Key Paper

1.	B	2.	B	3.	D	4.	B	5.	B
6.	A	7.	C	8.	D	9.	B	10.	C
11.	B	12.	C	13.	B	14.	D	15.	A
16.	C	17.	B	18.	A	19.	D	20.	C
21.	D	22.	C	23.	A	24.	D	25.	C
26.	C	27.	A	28.	B	29.	D		

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Index- Computer Networks

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ISO/OSI Layers

1) Which of the followingfunctionalities must be implemented by a transport protocol over and above thenetwork protocol?

1 Marks GATE-CSE/IT-2003( )

[A] Recovery from packet losses
[B] Detection of duplicate packets
[C] Packet delivery in the correct order
[D] End to end connectivity

2). Choose the best matching between Group 1 and Group 2.

Group – 1	Group -2
P. Data Link layer Q. Network layer R. Transport layer	1. Ensures reliable transport of data over a physical point-to-point link 2. Encodes/decodes data for physical transmission 3. Allow end-to-end communication between two processes 4. Routes data from one network node to the next

1 Marks GATE-CSE/IT-2004( )

[A] P-1, Q-4, R-3
[B] P-2, Q-4, R-1
[C] P-2, Q-3, R-1
[D] P-1, Q-3, R-2

3) Which of the following is NOT true with respect to a transparent bridge and a router?

1 Marks GATE-CSE/IT-2004( )

[A] Both bridge and router selectively forward data packets
[B] A bridge uses IP addresses while a router uses MAC addresses
[C] A bridge builds up it routing table by inspecting incoming packets
[D] A router can connect between a LAN and a WAN

4) Which one of the following uses UDP as thetransport protocol?

2 Marks GATE-CSE/IT-2007( )

[A] Telnet
[B] DNS
[C] SMTP
[D] HTTP

5) There are n stations in a slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot?

2 Marks GATE-CSE/IT-2007( )

[A] $np(1-p)^{n-1}$
[B] $(1 – p)^{n-1}$
[C] $p(1 –p)^{n-1}$
[D] $1 –(1 –p)^{n-1}$

6) While opening a TCP connection, the initial sequence number is to be derived using a time-of-day (ToD) clock that keeps running even when the host is down. The low order -32 bits of the counter of the To D clock is to be used for the initial sequence numbers. The clock counter increments once per millisecond. The maximum packet lifetime is given to be 64s.
Which one of the choices given below is closest to the minimum permissible rate at which sequence numbers used for packets of a connection can increase?

2 Marks GATE-CSE/IT-2008( )

[A] 0.015/s
[B] 0.064/s
[C] 0.135/s
[D] 0.327/s

7) Let G(x) be the generator polynomial used for CRC checking. What is the condition that should be satisfied by G(x) to detect odd number of bits in error?

2 Marks GATE-CSE/IT-2009( )

[A] G (x) contains more than two terms
[B] G(x) does not divide 1 + xk, for any k not exceeding the frame length
[C] 1 + x is a factor of G(x)
[D] G(x) has an odd number of terms

8) Packets of the same session may be routed through different paths in

1 Marks GATE-CSE/IT-2005( )

[A] TCP, but not UDP

[B] TCP and UDP

[C] UDP, but not TCP

[D] Neither TCP, nor UDP

9) One of the header fields in an IP datagram is the Time to Live (TTL) field. Which of the following statements best explains the need for this field?

1 Marks GATE-CSE/IT-2010( )

[A] It can be used to prioritize packets

[B] It can be used to reduce delays

[C] It can be used to optimize throughput

[D] It can be used to prevent packet looping

10) Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both use the same net mask N. Which of the values of N given below should not be used if A and B should belong to the same network?

2 Marks GATE-CSE/IT-2010( )

[A] 255.255.255.0

[B] 255.255.255.128

[C] 255.255.255.192

[D] 255.255.255.224

11) In serial data transmission, every byte of data is padded with a ‘0’ in the beginning and one or two ‘1’s at the end of byte because

1 Marks GATE-CSE/IT-2002( )

[A] Receiver is to be synchronized for byte reception

[B] Receiver recovers lost ‘0’s and ‘1’s from these padded bits

[C] Padded bits are useful in parity computation

[D] None of the above

12) A CPU has two modes-privileged and non-privileged. In order to change the mode from privileged to non-privileged

1 Marks GATE-CSE/IT-2001( )

[A] a hardware interrupt is needed

[B] a software interrupt is needed

[C] a privileged instruction (which does not generate an interrupt) is needed

[D] a non-privileged instruction (which does not generate an interrupt is needed

ISO/OSI Layers

Key Paper

1.	D	2.	A	3.	B	4.	B	5.	A
6.	B	7.	C	8.	B	9.	D	10.	D
11.	A	12.	B						

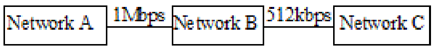
Network Topologies

Common Data for Q1 and Q2 is given below

Consider three IP networks A, B and C. Host H_a in network A sends messages each containing 180 bytes of application data to a host H_c- in network C. The TCP layer prefixes a 20 byte header to the message. This passes through an intermediate network B. The maximum packet size, including 20 bye IP header, In each network is

A	:	1000 bytes
B	:	100 bytes
C	:	1000 bytes

The network A and B are connected through a 1 Mbps link, while B and C are connected by a 512 Kbps link (bps = bits per second).



1) Assuming that the packets are correctly delivered, how many bytes, including headers, are delivered to the IPlayer at the destination for one application message, in the best case? Consider only data packets.

1 Marks GATE-CSE/IT-2004( )

[A] 200
[B] 220
[C] 240
[D] 260

2) What is the rate at which application data is transferred to host HC? Ignore errors, acknowledgements, and other overheads.

1 Marks GATE-CSE/IT-2004( )

[A] 325.5Kbps
[B] 354.5 Kbps
[C] 409.6Kbps
[D] 512.0 Kbps

3) Two computers C1 and C2 areconfigured as follows. C1 has IP address203. 197.2.53 and netmask 255.255.128.0 C2 has IP address 203.197.75.201 andnetmask 255.255.192.0. Which one of the following statements is true?

2 Marks GATE-CSE/IT-2006( )

[A] C1 and C2 both assume they are on the same network
[B] C2 assumes C1 is on same network, but C1 assumes C2 is on a different network
[C] C1 assumes C2 is on same network, but C2 assumes C1 is on a different network
[D] C1 and C2 both assume they are on different networks

4) In a token ring network the transmission speed is 10 bps and the propagation speed is 200 meters/ μs. The 1-bit delay in this network is equivalent to:

2 Marks GATE-CSE/IT-2007( )

[A] 500 meters of cable
[B] 200 meters of cable
[C] 20 meters of cable
[D] 50 meters of cable.

5) A computer on a 10Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2Mbps. It is initially filled to capacity with 16 Megabits. What is the maximum duration for which the computer can transmit at the full 10Mbps?

1 Marks GATE-CSE/IT-2008( )

[A] 1.6 seconds
[B] 2 seconds
[C] 5 seconds
[D] 8 seconds

Network Topologies

Key Paper

1.	D	2.	B	3.	C	4.	C	5.	B

Network Protocols

1) Which of the followingassertions is FALSE about the Internet Protocol (IP)?

1 Marks GATE-CSE/IT-2003( )

[A] It is possible for a computer to have multiple IP addresses
[B] IP packets from the same source to the same destination can take different routes in the network.
[C] IP ensures that a packet is forwarded if it is unable to reach its destination within a given number of hopes.
[D] The packet source cannot set the route of an outgoing packets; the route is determined only by the routing tables in the routers on the way.

2) The subnet mask for aparticular network is 225.255.31.0. Which of the following pairs of IPaddresses could belong to this network?

2 Marks GATE-CSE/IT-2003( )

[A] 172.57.88.62 and 172.56.87.23.2
[B] 10.3528.2 and 10.35.29.4
[C] 191.203.31.87 and 191.234.31.88
[D] 128.8 129.43 and 128.8.161.55

3) A 2 km long broadcast LAN has107 bpsbandwidth and uses CSMA/ CD. The signal travels along the wire at 2 x 108m/s. What is the minimum packet size that can be used on this network?

2 Marks GATE-CSE/IT-2003( )

[A] 50 bytes
[B] 100bytes
[C] 200bytes
[D] None of the above

4) A and B are the only two stations on an Ethernet. Each has a steady queue of frames to send. Both, A and B attempt to transmit a frame, collide, and a winds the first back off race. At the end of this successful transmission by A, both, A and B attempt to transmit and collide. The probability that A winds the second back off race is

1 Marks GATE-CSE/IT-2004( )

[A] 0.5
[B] 0.625
[C] 0.75
[D] 1.0

5) The routing table of a routeris shown below:

Destination	Subnet Mask	Interface
128.75.43.0	255.255.255.0	Eth0
128.75.43.0	255.255.255.128	Eth1
192.12.17.5	255.255.255.255	Eth3
deraulf		Eth2

On which interfaces will therouter forward packets addressed to destinations 128.75.43.16 and 192.12.17.10respectively?

1 Marks GATE-CSE/IT-2004( )

[A] Eth1 and Eth2
[B] Eth0 and Eth2
[C] Eth0 and Eth3
[D] Eth1 and Eth3

6) Suppose the round trippropagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 μs. Theminimum frame size is:

2 Marks GATE-CSE/IT-2005( )

[A] 94
[B] 416
[C] 464
[D] 512

7) For which one of the following reasons does Internet Protocol (IP) use the time-to-live (TTL) field in the IP diagram header?

2 Marks GATE-CSE/IT-2005( )

[A] Ensure packets reach destination within that time
[B] Discard packets that reach later than that time
[C] Prevent packets from looping indefinitely
[D] Limit the time for which a packet gets queued in intermediate routers

8) The address of a class B hostis to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and themaximum number of hosts in each subnet?

2 Marks GATE-CSE/IT-2007( )

[A] 62 subnets and 262142 hosts
[B] 64 subnets and 262142 hosts
[C] 62 subnets and 1022 hosts
[D] 64 subnets and 1024 hosts

9) What is the maximum size of data that the application layer can pass on to the TCP layer below

1 Marks GATE-CSE/IT-2008( )

[A] Any size
[B] 2^{16} bytes – size of TCP header
[C] 2^{16} bytes
[D] 1500 bytes

10) If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

1 Marks GATE-CSE/IT-2008( )

[A] 1022
[B] 1023
[C] 2046
[D] 2047

11) A client process P needs tomake a TCP connection to a server process S. Consider the following situation:the server process S executes a socket ( ), a bind ( ) and a listen ( ) systemcall in that order, following which it is preempted. Subsequently, the client process P executes asocket ( ) system call followed by connect ( ) system call to connect to theserver process S. The server process has not executed any accept ( ) systemcall. Which one of the following eventscould take place?

1 Marks GATE-CSE/IT-2008( )

[A] Connect ( ) system call returns successfully
[B] Connect ( ) system call blocks
[C] Connect ( ) system call returns an error.
[D] Connect ( ) system call results in a core dump

Network Protocols

Key Paper

1.	D	2.	D	3.	C	4.	B	5.	A
6.	D	7.	B	8.	C	9.	B	10.	C
11.	C								

Routing Algorithms

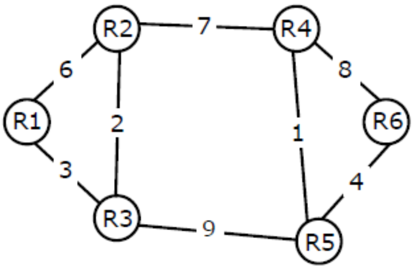
1) Station A uses 32 bytepackets to transmit messages to Station B using a sliding window protocol. Theround trip delay between A and B is 80 milliseconds and the bottleneckbandwidth on the path between A and B is 128 kbps. Hat is the optimal window size that a shoulduse?

2 Marks GATE-CSE/IT-2006( )

[A] 20 [B] 40
[C] 160 [D] 320

Statement for Linked answer Q2 and Q3 is given below

2) Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram



Q.
All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

2 Marks GATE-CSE/IT-2010,GATE-CSE/IT-2010( )

[A] 4 [B] 3
[C] 2 [D] 1

3) Suppose the weights of all unused links in the previous question are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

2 Marks GATE-CSE/IT-2010( )

[A] 0 [B] 1
[C] 2 [D] 3

Routing Algorithms

Key Paper

1.	B	2.	C	3.	D

Congestion control

1) The maximum window size fordata transmission using the selective reject protocol with n-bit frame sequencenumbers is

1 Marks GATE-CSE/IT-2005( )

[A] 2^n [B] 2^{n-1}
[C] $2^n -1$ [D] 2^{n-2}

2) Station A needs to send amessage consisting of 9 packets to station B using a siding window (window size3) and go-back-n error control strategy. All packets are ready and immediately available for transmission. If every 5th packet that Atransmits gets lost (but no acks from B ever get lost), then what is the numberof packets that A will transmit for sending the message to B?

2 Marks GATE-CSE/IT-2006( )

[A] 12 [B] 14
[C] 16 [D] 18

3) In the slow start phase of the TCP congesting control algorithm, the size of the congestion window

1 Marks GATE-CSE/IT-2007( )

[A] Does not increase [B] Increases linearly
[C] Increases quadratically [D] increases exponentially

Congestion control

Key Paper

1.	B	2.	C	3.	D

cryptography, digital signature

1) The message 11001001 is to be transmitted using the CRC polynomial $x^3 + 1$ to protect it from errors. The message that should be transmitted is:

2 Marks GATE-CSE/IT-2007( )

[A] 11001001000

[B] 11001001011

[C] 11001010

[D] 110010010011

cryptography, digital signature

Key Paper

1.	**B**

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Index- Discrete Mathematics

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Discrete Maths

Common Data for Q1 and Q2 is given below

Consider a complete undirected graph with vertex set {0, 1, 2, 3, 4}. Entry W_{ij} in the matrix W below is the weight of the edge {i, j}.

$$W = \begin{bmatrix} 0 & 1 & 8 & 1 & 4 \\ 1 & 0 & 12 & 4 & 9 \\ 8 & 12 & 0 & 7 & 3 \\ 1 & 4 & 7 & 0 & 2 \\ 4 & 9 & 3 & 2 & 0 \end{bmatrix}$$

1) What is the minimum possible weight of a spanning tree T in this graph such that vertex 0 is a leaf node in the tree T?

2 Marks GATE-CSE/IT-2010,GATE-CSE/IT-2010( )

[A] 7 [B] 8

[C] 9 [D] 10

2) What is the minimum possible weight of a path P from vertex 1 to vertex 2 in this graph such that P contains at most 3 edges?

2 Marks GATE-CSE/IT-2010( )

[A] 7 [B] 8

[C] 9 [D] 10

3) "If X then Y unless Z" is represented by which of the following formulas in prepositional logic? ("$\neg$", is negation, "$\wedge$" is conjunction, and "$\rightarrow$" is implication)

1 Marks GATE-CSE/IT-2002( )

[A] $(X \wedge \neg Z) \rightarrow Y$ [B] $(X \wedge Y) \rightarrow \neg Z$

[C] $X \rightarrow (Y \wedge \neg Z)$ [D] $(X \rightarrow Y) \wedge \neg Z$

4) How many undirected graphs (not necessarily connected) can be constructed out of a given set V = {V_1,V_2 ,..V_n} of n vertices?

2 Marks GATE-CSE/IT-2001( )

[A] $\frac{n(n-1)}{2}$ [B] 2^n

[C] n! [D] $2^{\frac{n(n-1)}{2}}$

5) The minimum number of cards to be dealt from an arbitrarily shuffled deck of 52 cards to guarantee that three cards are from some same suit is

1 Marks GATE-CSE/IT-2000( )

[A] 3 [B] 8

[C] 9 [D] 12

6) Given the relations
employee (name, salary, deptno), and
department (deptno, deptname, address)

Which of the following queries cannot be expressed using the basic relational algebra operations ($\sigma,\pi,\bowtie,\cup,\cap,-$)?

1 Marks GATE-CSE/IT-2000( )

[A] Department address of every employee [B] Employees whose name is the same as their department name

[C] The sum of all employees' salaries [D] All employees of a given department

7) E_1 and E_2 are events in a probability space satisfying the following constraints:

- $Pr(E_1) = Pr(E_2)$
- $Pr(E_1 \cup E_2) = 1$
- E_1 and E_2 are independent

The value of $Pr(E_1)$, the probability of the event E_1, is

2 Marks GATE-CSE/IT-2000( )

[A] 0 [B] 1/4

[C] 1/2 [D] 1

8) A relation R is defined on the set of integers as x Ry iff (x+y) is even. Which of the following statements is true?

2 Marks GATE-CSE/IT-2000( )

[A] R is not an equivalence relation [B] R is an equivalence relation having 1 equivalence class

[C] R is an equivalence relation having 2 equivalence classes
[D] R is an equivalence relation having 3 equivalence classes

9) Let P(S) denotes the powerset of set S. Which of the following is always true?

2 Marks GATE-CSE/IT-2000( )

[A] P(P(S))=P(S)
[B] P(S) ∩P(P(S)) = {φ}
[C] P(S) ∩S = P(S)
[D] S ∉P(S)

10) Let a, b, c, d be propositions. Assume that the equivalence a ↔ (b V-b) and b ↔ c hold. Then the truth-value of the formula (a ∧ b) → (a ∧ c) ∨ d is always

2 Marks GATE-CSE/IT-2000( )

[A] True
[B] False
[C] Same as the truth-value of b
[D] Same as the truth-value of d

11) The simultaneous equations on the Boolean variables x, y, z and w,
x + y + z = 1
xy = 0
xz + w = 1
xy + $\bar{z}\bar{w}$=0 have the following solution for x, y, z and w, respectively

2 Marks GATE-CSE/IT-2000( )

[A] 0 1 0 0
[B] 1 1 0 1
[C] 1 0 1 1
[D] 1 0 0 0

12) Let LASTPOST, LASTIN and LASTPRE denote the last vertex visited in a postorder, inorder and preorder traversal. Respectively, of a complete binary tree. Which of the following is always tree?

2 Marks GATE-CSE/IT-2000( )

[A] LASTIN = LASTPOST
[B] LASTIN = LASTPRE
[C] LASTPRE = LASTPOST
[D] None of the above

13) Let G be an undirected connected graph with distinct edge weight. Let e_{max} be the edge with maximum weight and the following statements is false? e_{min} the edge with minimum weight. Which of the following is false

2 Marks GATE-CSE/IT-2000( )

[A] Every minimum spanning tree of G must contain e_{min}
[B] If e_{max} is in a minimum spanning tree, then its removal must disconnect G
[C] No minimum spanning tree contains e_{max}
[D] G has a unique minimum spanning tree

14) Lt G be an undirected graph.Consider a depth-first traversal of G, and let T be the resulting depth-first search tree.Let u be a vertex in G and let v be the first new (unvisited)vertex visited after visiting u in the traversal. Which of the following statements is always true?

2 Marks GATE-CSE/IT-2000( )

[A] {u,v} must be an edge in G, and u is a descendant of v in T
[B] {u,v} must be an edge in G, and v is a descendant of u in T
[C] If {u,v} is not an edge in G then u is a leaf in T
[D] If {u,v} is not an edge in G then u and v must have the same parent in T

15) Suppose that the expectation of a random variable X is 5. Which of the following statements is true?

1 Marks GATE-CSE/IT-1999( )

[A] There is a sample point at which X has the value 5.
[B] There is a sample point at which X has value greater than 5.
[C] There is a sample point at which X has a value greater than or equal to 5.
[D] None of the above

16) The number of binary relations on a set with n elements is:

1 Marks GATE-CSE/IT-1999( )

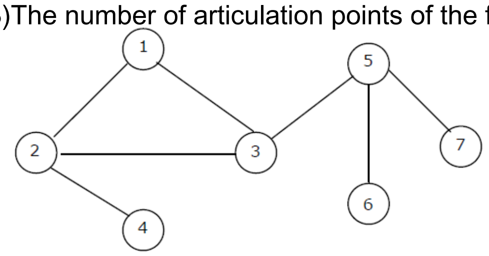
[A] n^2
[B] 2^n
[C] 2^{n^2}
[D] None of the above

17) The number of binary strings of n zeroes and k ones that no two ones are adjacent is

1 Marks GATE-CSE/IT-1999( )

[A] ${}^{n-1}C_k$
[B] ${}^{n}C_k$
[C] ${}^{n}C_{k+1}$
[D] None of the above

18)The number of articulation points of the following graph is



1 Marks GATE-CSE/IT-1999( )

[A] 0
[B] 1
[C] 2
[D] 3

19)Two girls have picked 10 roses, 15 sunflowers and 15 daffodils. What is the number of ways they can divide the flowers amongst themselves?

2 Marks GATE-CSE/IT-1999( )

[A] 1638
[B] 2100
[C] 2640
[D] None of the above

20) Let L be a set with a relation R which is transitive, anti-symmetric and reflexive and for any two elements a, b ∈ L let the least upper bound lub (a,b) and the greatest lower bound glb (a,b) exist. Which of the following is/are true?

2 Marks GATE-CSE/IT-1999( )

[A] L is a poset
[B] L is a Boolean algebra
[C] -L1 is context free
[D] -L2 is regular

21)A die is rolled three times. The probability that exactly one odd number turns up among the three outcomes is

1 Marks GATE-CSE/IT-1998( )

[A] 1/6
[B] 3/6
[C] 1/8
[D] 1/2

22)What is the converse of the following assertion?
I stay only if you go

1 Marks GATE-CSE/IT-1998( )

[A] I stay if you go
[B] If I stay then you go
[C] If you do not go then I do not stay
[D] If I do not stay then you go

23)Suppose A is a finite set with n elements. The number of elements in the largest equivalence relation of A is

1 Marks GATE-CSE/IT-1998( )

[A] n
[B] n^2
[C] 1
[D] n+1

24)Let R1 and R2 be two equivalence relations on a set. Consider the following assertions:
(i)R1 ∪ R2 is an equivalence relation
(ii)R1 ∩ R2 is an equivalence relation
Which of the following is correct?

1 Marks GATE-CSE/IT-1998( )

[A] Both assertions are true
[B] Assertion (i) is true but assertion (ii) is not true
[C] Assertion (ii) is true but assertion (i) is not true
[D] Neither (i) nor (ii) is true

25)The number of functions from an m element set to an n element set is

1 Marks GATE-CSE/IT-1998( )

[A] m + n
[B] m^n
[C] n^m
[D] m*n

26)Which of the following statements is false?

1 Marks GATE-CSE/IT-1998( )

[A] A tree with a n nodes has (n – 1) edges
[B] A labeled rooted binary tree can be uniquely constructed given its postorder and preorder traversal results.
[C] A complete binary tree with n internal nodes has (n + 1) leaves.
[D] The maximum number of nodes in a binary tree of height h is $(2^{h+1} - 1)$

27)The binary relation R = {(1,1)}, (2,1) , (2, 2) , (2, 3) , (2, 4) , (3,1) , (3, 2) , (3, 3) , (3, 4) on the set A = {1,2,3,4} is

2 Marks GATE-CSE/IT-1998( )

[A] reflexive, symmetric and transitive
[B] neither reflexive, nor irreflexive but transitive
[C] irreflexive, symmetric and transitive
[D] irreflexive and antisymmetric

28)A complete n-ary tree is one in which every node has O or n sons. If x is the number of internal nodes of a complete n-ary tree, the number of leaves in it is given by

2 Marks GATE-CSE/IT-1998( )

[A] x(n-1)+1
[B] xn-1
[C] xn+1
[D] x(n+1)

29)The probability that it will rain today is 0.5. The probability that it will rain tomorrow is 0.6. The probability that it will rain either today or tomorrow is 0.7. What is the probability that it will rain today and tomorrow?

1 Marks GATE-CSE/IT-1997( )

[A] 0.3
[B] 0.25
[C] 0.35
[D] 0.4

30)Let * be defined as x*y= $\bar{x}$ +y. Let z = x*y. value of z*x is

2 Marks GATE-CSE/IT-1997( )

[A] $\bar{x}$+y
[B] x
[C] 0
[D] 1

31)Let (Z,*) be an algebraic structure, where Z is the set of integers and the operation * is defined by n*m = maximum (n,m). which of the following statements is true for (Z,*)?

1 Marks GATE-CSE/IT-1997( )

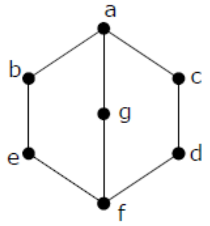
[A] (Z,*) is a monoid
[B] (Z,*) is an Abelian group
[C] (Z,*) is a group
[D] None of the above

32)Which of the following propositions is a tautology?

1 Marks GATE-CSE/IT-1997( )

[A] $(p \vee q) \rightarrow p$
[B] $p \vee (q \rightarrow p)$
[C] $p \vee (p \rightarrow q)$
[D] $p \rightarrow (p \rightarrow q)$

33)In the lattice defined by the Hasse diagram given in following figure, how many complements does the element 'e' have?



1 Marks GATE-CSE/IT-1997( )

[A] 2
[B] 3
[C] 0
[D] 1

34) A binary search tree contains the value 1, 2, 3, 4, 5, 6, 7, 8. The tree is traversed in pre-order and the values are printed out. Which of the following sequences is a valid output?

2 Marks GATE-CSE/IT-1997( )

[A] 5 3 1 2 4 7 8 6
[B] 5 3 1 2 6 4 8 7
[C] 5 3 2 4 1 6 7 8
[D] 5 3 1 2 4 7 6 8

35)A partial order ≤ is defined on the set S = {x, a_1, a_2,.... a_n, y} as x ≤ a_i for all i and a_1 ≤ y for all i, where n ≥1. The number of total orders on the set S which contain the partial order ≤ is

2 Marks GATE-CSE/IT-1997( )

[A] n!
[B] n+2
[C] n
[D] 1

36)Let G be a graph with 100 vertices numbered 1 to 100. Two vertices i and j are adjacent if $|i - j| = 8$ or $|i - j| = 12$. The number of connected components in G is

2 Marks GATE-CSE/IT-1997( )

[A] 8
[B] 4
[C] 12
[D] 25

37)The number of equivalence relations of the set {1,2,3,4} is

2 Marks GATE-CSE/IT-1997( )

[A] 15 [B] 16
[C] 24 [D] 4

38)Let A and B be sets and let A^c and B^c denote the complements of the sets A and B. the set (a – b) ∪(b-a) ∪(a∩b) is equal to.

1 Marks GATE-CSE/IT-1996( )

[A] A ∪ B [B] $A^c \cup B^c$
[C] A ∩ B [D] $A^c \cap B^c$

39)Let X = {2,3,6,12,24}, Let ≤ be the partial order defined by X ≤ Y if x divides y. Number of edge as in the Hasse diagram of (X,≤) is

1 Marks GATE-CSE/IT-1996( )

[A] 3 [B] 4
[C] 9 [D] None of the above

40)Suppose X and Y are sets and X and Y are their respective cardinalities. It is given that there are exactly 97 functions from X to Y. from this one can conclude that

1 Marks GATE-CSE/IT-1996( )

[A] |X| = 1 ,| Y |= 97 [B] |X| = 97 ,| Y |= 1
[C] |X| = 97 ,| Y |= 97 [D] None of the above

41)Which of the following statements is false?

1 Marks GATE-CSE/IT-1996( )

[A] The set of rational numbers is an abelian group under addition
[B] The set of integers in an abelian group under addition.
[C] The set of rational numbers form an abelian group under multiplication
[D] The set of real numbers excluding zero in an abelian group under multiplication.

42)Two dice are thrown simultaneously. The probability that at least one of them will have 6 facing up is

1 Marks GATE-CSE/IT-1996( )

[A] 1 /36 [B] 1 / 3
[C] 25 / 36 [D] 11 / 36

43)Let R denotes the set of real numbers. Let f:R×R →R×R be a bijective function defined by f(x,y)=(x+y,x-y). the inverse function of f is given by

2 Marks GATE-CSE/IT-1996( )

[A] f^{-1}(x,y) =(1/ x+y, 1/x-y) [B] f^{-1}(x,y)=(x-y, x+y)
[C] f^{-1}(x,y) = (x+y/2, x-y/2) [D] f^{-1}(x,y) = [2(x-y),2(x+y)]

44)Let R be a non-empty relation on a collection of sets defined by A R B if and only if A ∩ B = φ. Then, (pick the true statement)

2 Marks GATE-CSE/IT-1996( )

[A] R is reflexive and transitive [B] R is symmetric and not transitive
[C] R is an equivalence relation [D] R is not reflexive and not symmetric

45)Which one of the following is false?

2 Marks GATE-CSE/IT-1996( )

[A] The set of all bijective functions on a finite set forms a group under function composition.
[B] The set {1,2, ……., p –1} forms a group under multiplication mod p where p is a prime number.
[C] The set of all strings over a finite alphabet forms a group under concatenation.
[D] A subset s ≠ φ of G is a subgroup of the group if and only if for any pair of elements a, b ∈ s, a* b^{-1}∈ s.

46)The probability that top and bottom cards of a randomly shuffled deck are both aces in

2 Marks GATE-CSE/IT-1996( )

[A] $\frac{4}{52} \times \frac{4}{52}$ [B] $\frac{4}{52} \times \frac{3}{52}$
[C] $\frac{4}{52} \times \frac{3}{51}$ [D] $\frac{4}{52} \times \frac{4}{51}$

47)The probability that a number selected at random between 100 and 99 (both inclusive) will not contain the digit 7 is :

1 Marks GATE-CSE/IT-1995( )

[A] 16 /25 [B] $(\frac{9}{10})^3$
[C] 27 / 75 [D] 18 / 25

48)LetRbeasymmetricandtransitiverelationonasetA.Then

1 Marks GATE-CSE/IT-1995( )

[A] Risreflexiveandhenceanequivalencerelation
[B] Risreflexiveandhenceapartialorder
[C] Risreflexiveandhencenotanequivalencerelation
[D] None of the above

49)Thenumberofelementsinhepowerset _P (_S)_o_f the set S=_{_(φ_) ,1,_(2,3_)_} is

1 Marks GATE-CSE/IT-1995( )

[A] 2
[B] 4
[C] 8
[D] None of the above

50)Theminimumnumberofedgesinaconnectedcyclicgraphonnverticesis:

1 Marks GATE-CSE/IT-1995( )

[A] n-1
[B] n
[C] n+1
[D] None of the above

51)What values of A, B, C and D satisfy the following simultaneous Booleanequations?
__$\bar{A}$+ AB = 0, AB = AC, AB + A$\bar{C}$ + $\overline{CD}$= CD

2 Marks GATE-CSE/IT-1995( )

[A] A=1,B=0,C=0,D=1
[B] A=1,B=1,C=0,D=0
[C] A=1,B=0,C=1,D=1
[D] A=1,B=0,C=0,D=0

52)A bag contains 10 white balls and 15 black balls. Two balls are drawn insuccession.Theprobabilitythatone ofthemisblackandtheotheriswhiteis:

2 Marks GATE-CSE/IT-1995( )

[A] 2/3
[B] 4/5
[C] 1/2
[D] 2/1

53)LetAbethesetofallnon-singularmatricesoverrealnumberandlet*bethematrixmultiplicationoperation.Then

2 Marks GATE-CSE/IT-1995( )

[A] Aisclosedunder*but<A,*>isnotasemigroup
[B] <A,*>isasemigroupbutnotamonoid
[C] <A,*>isamonoidbutnotagroup
[D] <A,*>isagroupbutnotanabeliangroup

54)LetAandBbeanytwoarbitrary events,then,whichone of the followingistrue?

1 Marks GATE-CSE/IT-1994( )

[A] P (A ∩ B)= P (A)P (B)
[B] P (A ∪ B)= P (A)+ P (B)
[C] P(A|B) =P(A∩B) P(B)
[D] P (A ∪ B)≤ P (A)+ P (B)

55)The number of distinct simple graphs with upto three nodes is

1 Marks GATE-CSE/IT-1994( )

[A] 15
[B] 10
[C] 17
[D] 9

56)Some group (G,o) is known to be abelian. Then, which one of the following is true for G?

1 Marks GATE-CSE/IT-1994( )

[A] g = g_−_1 for every g ∈ G
[B] g = g_2 for every g ∈ G
[C] $(goh)^2 = g^2oh^2$ for every g, h∈ G
[D] G is of finite order

57)The line graph L(G) of a simple graph G is defined as follows:
• There is exactly one vertex v(e) in L(G) for each edge e in G.
• For any two edges e and e' in G, L(G) has an edge between v(e) and v(e'), if and only if e and e' are incident with the same vertex in G.
Which of the following statements is/are TRUE?
(P) The line graph of a cycle is a cycle.
(Q) The line graph of a clique is a clique.
(R) The line graph of a planar graph is planar.
(S) The line graph of a tree is a tree.

2 Marks GATE-CSE/IT-2013( )

[A] P only
[B] P and R only
[C] R only
[D] P, Q and S Only

58)What is the logical translation of the following statement?
"None of my friends are perfect."

2 Marks GATE-CSE/IT-2013( )

[A] ∃x (F (x) ∧ ¬P (x))
[B] ∃x (¬F (x) ∧ P (x))
[C] ∃x (¬F (x) ∧ ¬P (x))
[D] ¬∃x (F (x) ∧ P (x))

59)What is the correct translation of the following statement into mathematical logic?
"Some real numbers are rational"

1 Marks GATE-CSE/IT-2012( )

[A] ∃x (real (x) v rational (x))
[B] ∀x (real (x) → rational (x))
[C] ∃x (real (x) ∧ rational (x))
[D] ∃x (rational (x) → real (x))

60)Consider the following logical inferences.
I_1 : If it rains then the cricket match will not be played.
The cricket match was played.
Inference: There was no rain.
I_2 : If it rains then the cricket match will not be played.
It did not rain.
Inference: The cricket match was played.
Which of the following is TRUE?

1 Marks GATE-CSE/IT-2012( )

[A] Both I_1 and I_2 are correct inferences
[B] I_1 is correct but I_2 is not a correct inference
[C] I_1 is not correct but I_2 is a correct inference
[D] Both I_1 and I_2 are not correct inferences

61)Let G be a weighted graph with edge weights greater than one and G' be the graph constructed by squaring the weights of edges in G. Let T and T' be the minimum spanning trees of G and G' respectively, with total weights t and t'. Which of the following statements is TRUE?

2 Marks GATE-CSE/IT-2012( )

[A] T' = T with total weight t' = t^2
[B] T' = T with total weight t' < t^2
[C] T' ≠ T but total weight t' = t^2
[D] None of these

62)Let G be a complete undirected graph on 6 vertices. If vertices of G are labeled, then the number of distinct cycles of length 4 in G is equal to

2 Marks GATE-CSE/IT-2012( )

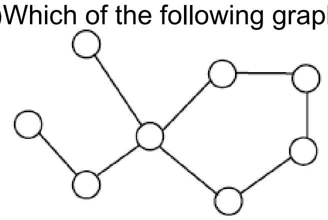
[A] 15
[B] 30
[C] 90
[D] 360

63)How many onto (or subjective) functions are there from an n-element (n ≥ 2) set to a 2-element set?

2 Marks GATE-CSE/IT-2012( )

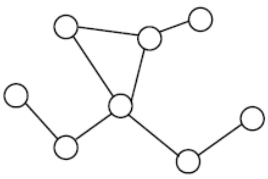
[A] 2^n
[B] 2^n-1
[C] 2^n-2
[D] 2(2^n-2)

64)Which of the following graph is isomorphic to

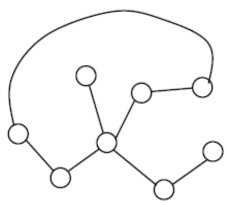


2 Marks GATE-CSE/IT-2012( )

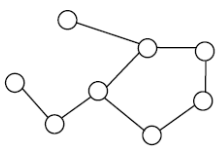
[A]



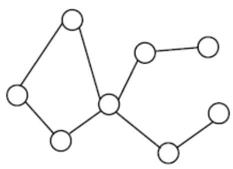
[B]



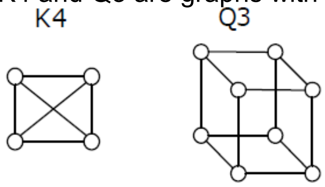
[C]



[D]



65)K4 and Q3 are graphs with the following structures



Which one of the following statements is TRUE in relation to these graphs?

1 Marks GATE-CSE/IT-2011( )

[A] K4 is planar while Q3 is not
[B] Both K4 and Q3 are planar
[C] Q3 is planar while K4 is not
[D] (D) Neither K4 not Q3 is planar

66)Consider the set S = {1, ω, ω^2}, where $\omega$and ω^2 are cube roots of unity. If * denotes the multiplication operation, the structure (S, *) forms

1 Marks GATE-CSE/IT-2010( )

[A] A group
[B] A ring
[C] An integral domain
[D] A field

67)The degree sequence of a simple graph is the sequence of the degrees of the nodes in the graph in decreasing order. Which of the following sequences can not be the degree sequence of any graph?

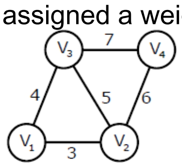
I. 7, 6, 5, 4, 4, 3, 2, 1
II. 6, 6, 6, 6, 3, 3, 2, 2
III. 7, 6, 6, 4, 4, 3, 2, 2
IV. 8, 7, 7, 6, 4, 2, 1, 1

2 Marks GATE-CSE/IT-2010( )

[A] I and II
[B] III and IV
[C] IV only
[D] II and IV

Statement for Linked answer Q68 and Q69 is given below

68)An undirected graph G(V,E) contains n (n >2) nodes named v_1,v_2,...v_n. Two nodes v_i, $v_j$are connected if and only if $0 < |i-j| \leq 2$. Each edge (v_i, v_j) is assigned a weight i + j. A sample graph with n = 4 is shown below



What will be the cost of the minimum spanning tree (MST) of such a graph with n nodes?

2 Marks GATE-CSE/IT-2011,GATE-CSE/IT-2011( )

[A] $\frac{1}{12}(11n^2 - 5n)$
[B] n^2- n +1
[C] 6n-11
[D] 2n+1

69)The length of the path from $v_5$to $v_6$in the MST of previous question with n = 10 is

2 Marks GATE-CSE/IT-2011( )

[A] 11
[B] 25
[C] 31
[D] 41

Discrete Maths

Key Paper

1.	A	2.	A	3.	C	4.	D	5.	C
6.	C	7.	C	8.	C	9.	B	10.	A
11.	C	12.	B	13.	C	14.	C	15.	A
16.	C	17.	D	18.	D	19.	D	20.	A
21.	C	22.	C	23.	B	24.	C	25.	C
26.	B	27.	B	28.	A	29.	D	30.	B
31.	D	32.	C	33.	B	34.	D	35.	A
36.	B	37.	A	38.	A	39.	B	40.	A
41.	C	42.	D	43.	C	44.	B	45.	C
46.	C	47.	D	48.	D	49.	C	50.	B
51.	D	52.	C	53.	D	54.	A	55.	C
56.	C	57.	A	58.	D	59.	C	60.	B
61.	D	62.	D	63.	C	64.	B	65.	B
66.	A	67.	D	68.	B	69.	C		

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Old GATE Questions along with Key from 1991-2014
In CS & IT Department
(Questions of other Departments are also added for Combined Syllabus)

Index- Information Systems and Software Engineering

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Requirement Analysis

1) Which of the following is NOT desired in a good Software Requirement Specifications (SRS) document?
1 Marks GATE-CSE/IT-2011( )

[A] Functional Requirements
[B] Non Functional Requirements
[C] Goals of Implementation
[D] Algorithms for Software Implementation

Requirement Analysis

Key Paper

1. **D**

Project Integration & maintenance

1) A company needs to develop digital signal processing software for one of its newest inventions. The software is expected to have 40000 lines of code. The company needs to determine the effort in person-months needed to develop this software using the basic COCOMO model. The multiplicative factor for this model is given as 2.8 for the software development on embedded systems, while the exponentiation factor is given as 1.20. What is the estimated effort in person- months?

1 Marks GATE-CSE/IT-2011( )

[A] 234.25 [B] 932.50
[C] 287.80 [D] 122.40

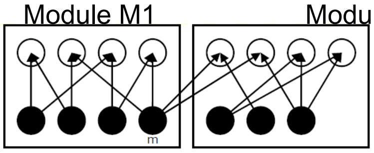
Project Integration & maintenance

Key Paper

1. **A**

software Engg

1) The following figure represents access graphs of two modules M1 and M2. The filled circles represent methods and the unfilled circles represent attributes. IF method m is moved to module M2 keeping the attributes where they are, what can we say about the average cohesion and coupling between modules in the system of two modules?



2 Marks GATE-CSE/IT-2013( )

[A] There is no change.
[B] Average cohesion goes up but coupling is reduced
[C] Average cohesion goes down and coupling also reduces
[D] Average cohesion and coupling increase

2) What is the appropriate pairing of items in the two columns listing various activities encountered in a software life cycle?

P.	Requirements Capture	1.	Module Development and Integration
Q.	Design	2.	Domain Analysis
R.	Implementation	3.	Structural and Behavioral Modeling
S.	Maintenance	4.	Performance Tuning

1 Marks GATE-CSE/IT-2010( )

[A] P-3, Q-2,R-4,S-1
[B] P-2, Q-3,R-1,S-4
[C] P-3, Q-2,R-1,S-4
[D] P-2, Q-3,R-4,S-1

3) The following is comment written for a C function /* This function computes the roots of a quadratic equation $ax^2 + bx + c$. The function stores two real roots in *root1 and *root2 and returns the status of validity of roots. It handles four different kinds of cases.
(i) When coefficient a is zero irrespective of discriminant
(ii) When discriminant is positive
(iii) When discriminant is zero
(iv) When discriminant is negative
Only in cases (ii) and (iii) , the stored roots are valid.
Otherwise 0 is stored in the roots. the function returns 0 when the roots are valid and -1 otherwise.
The function also ensures root1 >= root2.
int get_Quad Roots (float a, float b, float c, float *root1, float *root2) ;
A software test engineer is assigned the job of doing black box testing. He comes up with the following test cases, many of which are redundant

Test Case	Input set			Expected Output set		
	a	b	C	Root1	Root2	Return Value
T1	0.0	0.0	7.0	0.0	0.0	-1
T2	0.0	1.0	3.0	0.0	0.0	-1
T3	1.0	2.0	1.0	-1.0	-1.0	0
T4	4.0	-12.0	9.0	1.5	1.5	0
T5	1.0	-2.0	-3.0	3.0	-1.0	0
T6	1.0	1.0	4.0	0.0	0.0	-1

Which one of the following options provide the set of non-redundant tests using equivalence class partitioning approach from input perspective for black box testing?

2 Marks GATE-CSE/IT-2011( )

[A] T1, T2, T3, T6
[B] T1, T3, T4, T5
[C] T2, T4, T5, T6
[D] T2, T3, T4, T5

4) The following program is to be tested for statement coverage :

```
begin
if (a = = b) {S1; exit;}
else if (c = = d) {S2;}
else {S3; exit;}
S4;
end
```

The test cases T1, T2, T3 and T4 given below are expressed in terms of the properties satisfied by the values of variables a, b, c and d. The exact values are not given.

T1 : a, b, c and d are all equal
T2 : a, b, c and d are all distinct
T3 : a=b and c !=d
T4 : a !=b and c = d

Which of the test suites given below ensures coverage of statements S1, S2, S3 and S4?

2 Marks GATE-CSE/IT-2010( )

[A] T1, T2, T3
[B] T2, T4
[C] T3, T4
[D] T1, T2, T4

software Engg

Key Paper

1.	B	2.	B	3.	C	4.	D

Information Systems

1) A company needs to develop a strategy for software product development for which it has a choice of two programming languages L1 and L2. The number of lines of code (LOC) developed using L2 is estimated to be twice the LOC developed with L1. the product will have to be maintained for five years. Various parameters for the company are given in the table below.

Parameter	Language L1	Language L2
Man years needed for development	LOC / 10000	LOC / 10000
Development Cost per year	Rs. 10,00,000	Rs. 7,50,000
Maintenance time	5 years	5 years
Cost of maintenance per year	Rs. 1,00,000	Rs. 50,000

Total cost of the project includes cost of development and maintenance. What is the LOC for L1 for which the cost of the project using L1 is equal to the cost of the project using L2?

1 Marks GATE-CSE/IT-2011( )

[A] 4000 [B] 5000
[C] 4333 [D] 4667

Information Systems

Key Paper

1. B

Index- Web technologies

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HTML

1) HTML webpage contain an embedded pictuare within it. How many requests are needed to browse the webpage and embedded picture respectively?

2 Marks GATE-CSE/IT-2014( )

[A] 2 HTTP requests and 2 TCP requests
[B] 1 HTTP requests and 1TCP requests
[C] 1 HTTP requests and 2 TCP requests
[D] 2 HTTP requests and 1 TCP requests

HTML

Key Paper

1. **C**

client-server computing.

1) HTML (Hyper Text Markup Language) has language elements which permit certain actions other than describing the structure of the web document. Which one of the following actions is NOT supported by pure HTML (without any server or client side scripting) pages?

1 Marks GATE-CSE/IT-2011( )

[A] Embed web objects from different sites into the same page
[B] Refresh the page automatically after a specified interval
[C] Automatically redirect to another page upon download
[D] Display the client time as part of the page

2) Which one of the following is not a client server application?

1 Marks GATE-CSE/IT-2010( )

[A] Internet chat
[B] web browsing
[C] E - mail
[D] Ping

client-server computing.

Key Paper

1.	**D**	**2.**	**D**