Answer Keys

1	C	**2**	B	**3**	8	**4**	10	**5**	C	**6**	D	**7**	3
8	D	**9**	D	**10**	A	**11**	A	**12**	C	**13**	D	**14**	D
15	2	**16**	C	**17**	C	**18**	A	**19**	36	**20**	B	**21**	936
22	B	**23**	A	**24**	B	**25**	C	**26**	D	**27**	A	**28**	2
29	C	**30**	A	**31**	C	**32**	5	**33**	A	**34**	C	**35**	32
36	31	**37**	D	**38**	C	**39**	29979	**40**	B	**41**	A	**42**	D
43	-1	**44**	A	**45**	D	**46**	A	**47**	B	**48**	B	**49**	B
50	4	**51**	280000	**52**	D	**53**	D	**54**	B	**55**	A	56	**B**
57	C	**58**	B	**59**	A	**60**	A	**61**	D	**62**	D	**63**	A
64	C	**65**	C										

Explanations:-

1. $^nC_0 \times 2^0 + {}^nC_1 \times 2^1 + {}^nC_2 \times 2^2 + \ldots + {}^nC_n \times 2^n = 3^n$

2. $\lim\limits_{x \to 0} \dfrac{1-\cos ax}{1-\cos bx}$; Using L'Hospital rule, we have

$$\lim_{x \to 0} \frac{-(-\sin ax)\cdot a}{-(-\sin bx)\cdot b} = \frac{a}{b} \lim_{x \to 0} \frac{\sin ax}{\sin bx} = \frac{a}{b} \times \frac{a}{b} = \frac{a^2}{b^2}$$

3. $f(x) = \alpha x + \beta$ and $f(1) = -2,\ f(2) = 1,\ f(3) = 4,\ f(4) = 7$
   $\alpha(1) + \beta = -2;\ \ 2\alpha + \beta = 1;\ \Rightarrow \alpha = 3$ and $\beta = -5 \Rightarrow \alpha - \beta = 8$

4. $\alpha = 7$ and $p = 23$
   Given that A selected $X_A=3$ so A calculates $Y_A = \alpha^{Xa}$ mod p and sends Y_A to B
   X_A is private and Y_A is public to A.
   So $Y_A = 7^3$ mod 23 = 21 => $(X_A, Y_A) = (3, 21)$
   B selected $X_B = 7$ and calculates $Y_B = \alpha^{Xb}$ mod p and sends Y_B to A.
   X_B is private and Y_B is public to B.
   So $Y_B = 7^7$ mod 23 = 5 => $(X_B, Y_B) = (7, 5)$

   Now the key is computed at A as $(Y_B)^{XA}$ mod p or at B as $(Y_A)^{XB}$ mod p
   Key calculated at A, $K_A = (Y_B)^{XA}$ mod p
   $= 5^3$ mod 23 = 10
   Key calculated at B, $K_B = (Y_A)^{XB}$ mod p
   $= 21^7$ mod 23 = 10

5. Number of switches required $\dfrac{r}{q} - 1 \therefore$ Time wasted on switches $= (\dfrac{r}{q} - 1) \times s$ units

7. Output

Centre_name	Sum (students_appeared)
Bangalore	300
Hyderabad	300
Pune	150

Having clause is used to filter the groups.

9. (Given Size of TCP segment = 1KB = 1024 Bytes
Header Length field is 6, so header size = 6*4 = 24 bytes
Total data size = size of Segment – Header size = 1024 – 24 = 1000bytes of data)
Starting Sequence no. is 3500
So the range of sequence no. of the data is 3500 to 4499
URG pointer = 45 so data from 0^{th} byte till 45^{th} byte are urgent so 46bytes are urgent data.
Therefore, the urgent data is 1000 to 1045 and its sequence no. range is 3500 – 3545.

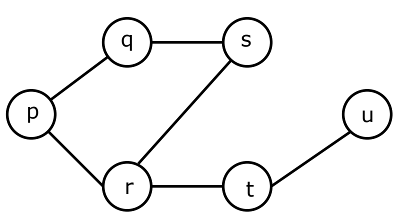
10. Given for every 2 secs, counter is incremented by 2,56,000
So for every 1 sec, counter is incremented by 2,56,000/2 = 1,28,000
The sequence number is 32 bit long and it can hold only $2^{32} - 1$ values.
So it takes $(2^{32} - 1)/(128000)$ = 33,554.431 seconds to wrap around.

11. Y may or may not be NP but it is NP hard $\therefore$ S_1 is false
'X' and 'Y' are NP complete hence, they are NP hard
All the NP complete problems are also NP hard but all NP hard need not to be NP complete
$\therefore$ S_4 is false.

12. Apply Floyd-Warshall's algorithm.

14. $(\lambda \cup \Sigma\Sigma\Sigma)(\lambda \cup \Sigma \cup \Sigma\Sigma)$
$(\Sigma\Sigma\Sigma\,\Sigma\Sigma)$
if $\Sigma = \{a\}$
then (aaaaa) will be produced whose length is greater then 4.

15.



Bridges are $\{r, t\}$ and $\{t, u\}$.

16. (A) aab is accepted
 (B) abbaa {Neither starts with aa or bb}
 (D) aab is generating but does not contain bb as a substring

17. (i) $wxw^R x \in (0,1)^*$

 We have to remember only one thing the strings generated should start and end with a same symbol.
 The whole part of w and w^R except the start and end symbol comes in x

 (ii) In these expression the FA has to remember where w ends x starts and again where x ends and x starts so it not possible.

 (iii) When x is fixed then
 wxw^R is not regular $w \in (0,1)^*$
 Because the whole string doesnot comes in x of w and w^R.

18. B-Tree of order k, every internal node must have $\left\lceil \frac{k}{2} \right\rceil$ to k children
 and number of keys will be one less than the children

19. Number of entries in the truth table $= 2^3 = 8$
 Number of functions containing 2-minterms out of 8 possible min terms= $8C_2$
 Similarly number of functions containing 7-minterms= $8C_7$
 So total number of functions $= 8C_2 + 8C_7 = 36$

21. Number of possible address using two letters=26×26
 Number of possible address using one letter followed by one numeral=26×10
 Total =26x26+26x10=936.

23. S1, S2 are tautology since S1, S2 are always true; S3 is contradiction since it is always false; S4 is contingency since it can be either true or false.

24. 1 sec – 20k bytes; $10^6 \mu\text{sec}$ - 20 k bytes; 1 byte $-\frac{10^6}{20 \times 10^3} = 50\mu\text{sec}$; Interrupt driven $= \frac{1}{10}\mu\text{sec}$
 Programmed I/O= $\frac{1}{50}$; Gain $= \frac{1}{10} \times \frac{50}{1} = 5$

25. Here keys are AB, CB
 $A \to C$, $C \to A$ voilate BCNF ;So the BCNF tables are (AC) (ABD) or (AC) (CBD)

26. Relative address mode; EA = PC + Address part
 $z = (y+1) + M[y]$; Since $y = w + 1$; Z is also equal to $(w+2) + M[y]$

28. A arrives and executes wait(mutex) ------------mutex=0
B arrives and executes wait(mutex) ------------mutex=-1
C arrives and executes wait(mutex) ------------mutex=-2
A arrives and executes signal(mutex) ----------mutex=-1
D arrives and executes wait(mutex) -----------mutex=-2
B arrives and executes signal(mutex) ---------mutex=-1
E arrives and executes wait(mutex)------------mutex=-2

So total processes blocked=mod(-2)=2

30. $p = \frac{1}{6}, q = \frac{5}{6}, n = 10$

Let $X =$ number of times getting 6 then X=0,1,2, …… and

$X \sim B(n, p)$

$\therefore$ Expected number of times 6 appears,

$E(x) = n.p = \frac{10}{6} = \frac{5}{3}$

31. Data item can be locked only if its parent is locked. In case II 'B' is not locked so it is invalid locking sequence.

32. LL and RR rotations are single rotation, LR and RL rotations are double rotations.
Step 1: Insert 80, 75. Give RL rotation to node 65.
Step 2: Insert 70 and give RL rotation to node 55.
Step 3: Insert 68 and give RR rotation to node 40.

34. In dynamic scoping an undeclared variable is searched in the scope where the function at hand is invoked.
In func_1() the value of b is the global value of b since it is declared outside of main().
In func_2() the value of b is the value declared in func_2() itself which is in the block enclosing 'return func_1()' statement.

35. Number of chips $= \frac{\text{size of memory}}{\text{size of chip}} = \frac{4M \times 8 \text{ bit}}{1M \times 1 \text{ bit}} = 32$ chips are required.

36. Given time = 30sec
B = 500 Mbps
1sec $\rightarrow$ 500 Mb
30 sec $\rightarrow$ 30 * 500 * 10^6/8 bytes = 1.875 * 10^9
No. of bits required to avoid wrap around = ceil($\log_2$ (1.875*10^9)) bits
= ceil(30.807) bits
= 31 bits

37. Given B = 250Mbps

RL = 120 μsec

L = 5000 bits

Number of hosts present is N

In early token reinsertion or multi token operation

$$\text{Efficiency} = \frac{N \times \text{Trans}}{N \times \text{Trans} + \text{RL}}$$

Trans delay = L/B = 5000bits/(250*10^6 bits/sec)= 20 μsec

Therefore efficiency = 20N/(N(20)+120) = N/(N + 6)

39. Given B = 48Mbps

Token Holding Time (THT) = 5ms

In token ring, minimum frame size can be anything since there are no collisions. In order to avoid monopolization, there is a limit on the time for which a station should hold a token, Token Holding Time (THT).

Therefore max frame size = B * T

= 48 Mbps * 5 ms = 240000bits

= 240000/8 bytes

= 30000bytes

Data size or payload = frame size – 21(Header length) = 29979 bytes

42. The problem can be stated as in how many ways 5 balls can be placed in 6 boxes where each box may contain more than one ball.

Possible solution: (1, 1, 0, 2, 0, 1) or (0, 1, 1, 2, 0, 1) etc.

i.e., $k_1 + k_2 + k_3 + k_4 + k_5 + k_6 = 5$ where K_i is non negative integer

Here $n = 6,\ r = 5;$ solution $= \binom{n+r-1}{r} = \binom{6+5-1}{5} = \binom{10}{5} = 252$

43. $N - 2^n = -1$

$N = FFFF = 65,535$

$n = 16$

$2^n = 65536$

44. T_1 is reading the value written by uncommitted transaction (T_2).

45. 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6

If free frame =1; No. of faults = 20 in all the algorithms.

If free frames = 7

FIFO

$$\begin{array}{ccccccc} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ & 2 & 2 & 2 & 2 & 2 & 2 \\ & & 3 & 3 & 3 & 3 & 3 \\ & & & 4 & 4 & 4 & 4 \\ & & & & 5 & 5 & 5 \\ & & & & & 6 & 6 \\ & & & & & & 7 \end{array} \rightarrow (7) \text{ faults}$$

LRU

$$\begin{array}{ccccccc} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ & 2 & 2 & 2 & 2 & 2 & 2 \\ & & 3 & 3 & 3 & 3 & 3 \\ & & & 4 & 4 & 4 & 4 \\ & & & & 5 & 5 & 5 \\ & & & & & 6 & 6 \\ & & & & & & 7 \end{array} \rightarrow (7)$$

Optimal

$$\begin{array}{ccccccc} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ & 2 & 2 & 2 & 2 & 2 & 2 \\ & & 3 & 3 & 3 & 3 & 3 \\ & & & 4 & 4 & 4 & 4 \\ & & & & 5 & 5 & 5 \\ & & & & & 6 & 6 \\ & & & & & & 7 \end{array} \rightarrow (7)$$

46. (i) b has 2 complements d, c

(iii) a has 2 complement b, e

(iv) b and d are not having complements.

So (ii) only is a distributed complemented lattice.

47. Using Bell's triangle.

$$\begin{array}{ccccc} 1 \\ 1 & 2 \\ 2 & 3 & 5 \\ 5 & 7 & 10 & 15 \\ 15 & 20 & 27 & 37 & 52 \end{array}$$

48. Let order of internal node be **n** → n-block pointers, (n-1) keys

$(n \times 8) + (n-1) \times 10 \le 1024$ → $n \le 57.44$ → $\underline{\mathbf{n}} \le \underline{\mathbf{57}}$

Let order of leaf node = **m** → m-keys, m-record pointers, 1-block pointer

$(m \times 10) + (m \times 10) + 8 \le 1024$ → $m \le 50.8$ → $\underline{\mathbf{m}} \le \underline{\mathbf{50}}$

49. Let order of B-Tree = **n** → n-block pointers, (n-1) keys, (n-1) record pointers

$(n \times 8) + (n-1) \times 10 + (n-1) \times 10 \le 1024$ → $n \le 37.2$ → $\underline{\mathbf{n}} \le \underline{\mathbf{37}}$

50. $\text{kLoc} = 22500 + 35000 + 12500 = 70000 \text{ Loc} (70 \text{ kLoc})$

$$\text{effort} = \frac{\text{Loc}}{\text{productivity}} = \frac{70000}{1250} = 56 \text{ months}$$

$$\text{Cost per line} = \frac{\text{Cost per month}}{\text{Productivity}} = \frac{5000}{1250} = 4 \text{ dollars.}$$

51. Cost $=$ effort $*$ Cost per month

$= 56 * 5000 = 280000$ dollars.

52. $0.97 \times 2 + 0.03 \times 102 = 5\text{ns}$

53. $\frac{40}{100} \times 5 = 2$, EMA $= 5 - 2 = 3$; $3 = \frac{x}{100} \times 2 + \frac{(100 - x)}{100} \times 102 \Rightarrow x = 99\%$

54 & 55.

$$\begin{aligned}\text{Number of chips} &= \frac{\text{memory desired}}{\text{chip size}} \\ &= \frac{16\text{kb}}{128 \times 8} \\ &= \frac{2^4 \times 2^{10} \times 8}{2^7 \times 8} \\ &= \frac{2^{14}}{2^7} = 2^7 = 128 \text{ chips}\end{aligned}$$

$\therefore$ Decoder size $= 7 \times 128$

56. (X is study of Y)

60. For the greatest chance of drawing a red ball the distribution has to be 1 red in the first bag and 4 red + 12 white balls in the second bag. This gives us

$$\frac{1}{2} \times 1 + \frac{1}{2} \times \frac{4}{16} = \frac{5}{8}$$

62. Let C be the capital in fixed amount

W be the weekly subsidy and 's' be the weekly wage for each man.

Then from given condition (first), $C + 52W = 42 \times 52s$...........(1)

From second condition $C + 13W = 13 \times 60s$...........(2)

Solving (1) and (2) we get

$39W = 1404\,s$

$W = 36\,s$

and $3C = 3120 - 2184 = 936s$ or $c = 3123$

For 13 weeks, $C + 13w = m \times 26s$

$312s + 468s = m \times 26s$

$m = 30$

63. Final ratio of water to total = Initial ratio of water to total $\times \left[\frac{v-x}{v}\right]^n$

As the process is repeated two more times.
So the number of times we do the same operation will be

$$\frac{27}{172} = \left[\frac{v-3}{v}\right]^3 \Rightarrow \frac{3}{12} = \frac{v-3}{v} \quad \Rightarrow \quad V = 4L$$

64. Let the total no. of apples be x.

1st customer $= \left(\frac{x}{2}+1\right)$

2nd customer $= \frac{1}{3}\left[x - \left(\frac{x}{2}+1\right)\right] + 1 = \left(\frac{x}{6}+\frac{2}{3}\right)$

3rd customer $= \frac{1}{5}\left[\left(\frac{x}{2}-1\right) - \left(\frac{x}{6}+\frac{2}{3}\right)\right] + 1 = \frac{x}{15}+\frac{2}{3}$

Remaining apples $= \left(\frac{x}{3}-\frac{5}{3}\right) - \left(\frac{x}{15}+\frac{2}{3}\right) = 7$

$\frac{4x-35}{15} = 7 \quad \Rightarrow \quad 4x-35 = 105 \quad \Rightarrow \quad 4x = 140 \quad \Rightarrow \quad x = 35$

Apples sold $= 35 - 7 = 28$

Total selling price $= 28 \times 12 = 336$

65. Required % $= \left[\frac{(288+98+3.00+23.4+83)}{(420+142+3.96+49.4+98)} \times 100\right]\%$

$\left[\frac{495.4}{713.36} \times 100\right]\% = 69.45\%$