Answer Keys

1	A	**2**	B	**3**	B	**4**	C	**5**	8192	**6**	C	**7**	D
8	3	**9**	55	**10**	D	**11**	B	**12**	D	**13**	C	**14**	130
15	D	**16**	A	**17**	B	**18**	D	**19**	A	**20**	A	**21**	B
22	32	**23**	A	**24**	A	**25**	A	**26**	A	**27**	B	**28**	B
29	C	**30**	D	**31**	D	**32**	D	**33**	D	**34**	C	**35**	B
36	1280	**37**	B	**38**	B	**39**	C	**40**	C	**41**	16	**42**	B
43	A	**44**	C	**45**	A	**46**	B	**47**	B	**48**	7	**49**	3
50	C	**51**	B	**52**	A	**53**	D	**54**	A	**55**	B	**56**	D
57	A	**58**	A	**59**	B	**60**	B	**61**	A	**62**	A	**63**	C
64	D	**65**	C										

Explanations:-

1. The sum of the degrees of the regions is equal to twice the number of edges. But each region must have degree ≥ 4 because all cycles have length ≥ 4. So we have $2e \geq 4r$

   By Euler's formula: $v - e + r = 2$, so combining these

   $$e - v + 2 \leq \frac{1}{2}e \Rightarrow \boxed{e \leq 2v - 4}$$

2. $$\int \frac{x^2}{x^2+4}\,dx = \int \frac{x^2+4-4}{x^2+4}\,dx = \int\left(1 - \frac{4}{x^2+4}\right)dx = \int dx - 4\int\frac{dx}{x^2+2^2}$$

   $$= x - 2\tan^{-1}\left(\frac{x}{2}\right) + c$$

3. Characteristic equation of 'A' is $|A - \lambda I| = 0 \Rightarrow \begin{vmatrix} 1-\lambda & 0 & 3 \\ 2 & 1-\lambda & -1 \\ 1 & -1 & 1-\lambda \end{vmatrix} = 0$

   (Or) Characteristics equation of 'A' is

   $\lambda^3 - (\text{trace } A)\lambda^2 + (A_{11} + A_{22} + A_{33})\lambda - |A| = 0$

   Where $A_{11} \rightarrow$ cofactor of a_{11}

   $A_{22} \rightarrow$ cofactor of a_{22}

   $A_{33} \rightarrow$ cofactor of a_{33}

   $\Rightarrow \lambda^3 - 3\lambda^2 + (0 - 2 + 1)\lambda - (-9) = 0 \Rightarrow \lambda^3 - 3\lambda^2 - \lambda + 9 = 0$

   By Cayley Hamilton theorem, every square matrix satisfies its own characteristic equation

   $\Rightarrow A^3 - 3A^2 - A + 9I = 0$

4. OSPF routing protocol uses link state routing algorithm which makes use of Dijkstra's shortest path first algorithm which has worst time complexity of $O(E + V \log V)$.

5. $$\text{No. of pages}(N) = \frac{\text{Logical address space}}{\text{page size}}$$
$$= \frac{32\text{ MB}}{4\text{ KB}} = \frac{2^{25}}{2^{12}} = 2^{13} = 8192$$

6. The relocation constant is calculated by starting address received after loading the module into memory.

7. Sparse index: one index record for one complete data block.
Secondary index can be built on both key field and non key field but they should be unordered.
Clustered index is sparse index not dense.

8. Candidate keys are AB, BDE and BC.

9. Prop time=15*100/(3x10^8)s=5 μs
Total delay=6*100 bit
So total latency= 600/(12*10^6) + 5 μs=55 μs

10. Probability of getting two tosses result tails is $\left(\frac{1}{2}\right)^7$
$$\text{Required probability} = \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{2}\right)^7 = \left(\frac{1}{2}\right)^9$$

11. It prints number of inputs what scanf is receiving. Here its reading two inputs.

12. Number of articulation points = Number of internal nodes (I)
In full 3-ary tree, number of leaves = 2I+1
$$n = 2I + 1 \Rightarrow I = \frac{n-1}{2}$$

13. In topological sort, whenever an edge $(a_i \to a_j)$ from a_i to a_j exists, a_i must appear before a_j in the sorting. This is fulfilled only in option (C)

14.

$$\underset{(SP+TLB)}{EMAT} = x(c+m) + (1-x)(c+2m)$$

Simple Paging

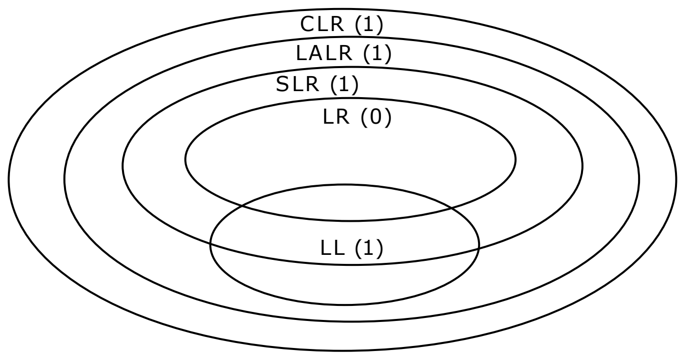
Translation Look aside buffer

$x \rightarrow$ hit ratio

$1 - x =$ miss ratio

$EMAT = 0.90(20+100) + 0.1(20+200) = 130$ ns

15. Every SLR(1) is unambiguous but not vice versa and relation among LL(1), LALR(1), SLR(1) and LR(0) is depicted in the following set diagram.



16. $L_1 \cup L_2$ is the language in which $n_a(w) = n_b(w)$ or $n_b(w) = n_c(w)$
L_1, L_2 are CFL and their union is also CFL but not DCFL because there are strings which can be generated by both L1 and L2.

17. In (II) 5 should be visited before 4.

18. We get maximum number of tuples when both R and S are disjoint and we get minimum number of tuples when one set is subset of other.

19. Maximum modulus possible with N-FFS in
(a) Ring counter = N only
(b) Johnson counter = 2N only

20. 463 belong to page address $\frac{463}{100} = 4$ and 63 is page off set.
$\therefore \{4,1,1,1,4,9,9,8,1,5,7,7,0,6,6\}$ is list of consecutive references.
If page number occurs successively, then it is considered only once
$\therefore$ ref. string is $= \{4,1,4,9,8,1,5,7,0,6\}$.

22. Number of multiplexer is equal to number of lines required in the bus system and number of lines required in the bus system is dependent on size of register.

24. S_1 : The system has no solution

S_2 : The system has one linearly independent solution

26. Address of instruction to be fetched is always present in program counter. So we put the content of PC in memory address register (MAR) to access memory. Then the content of that address accessed by memory are placed in memory buffer register (MBR) and finally placed in instruction register (IR).At the end program counter is incremented To Store The Next Instruction Address.

27. $A \Rightarrow aABC \Rightarrow aabCBC \Rightarrow aabBCC \Rightarrow aabbCC \Rightarrow aabbcC \Rightarrow aabbcc$

28. Total maximum size={10+64+2*64^2+3*64^3}*2048=1.63 GB

29.

	Need	Available
	A B C	A B C
P_0	743	332
P_1	122	543
P_2	600	
P_3	011	545 $\langle P_3, P_4, P_2, P_1, P_0 \rangle$
P_4	431	

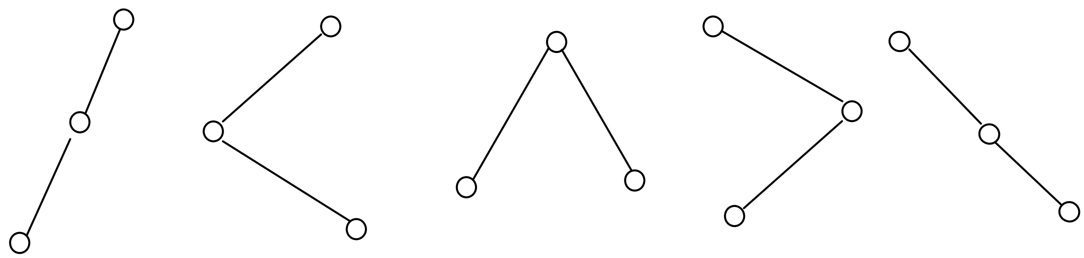
Here it is visible that with available <5,4,5> resources need of P_2 (<6,0,0>) can not be fulfilled and so $\langle P_3, P_4, P_2, P_1, P_0 \rangle$ is not a safe sequence.

30. $u = x^2 - y^2 - 2x;\ y = x^2 - \dfrac{1}{x}$

$$\frac{du}{dx} = \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} \cdot \frac{dy}{dx} = 2x - 2 + (-2y)\left(2x + \frac{1}{x^2}\right) = 2x - \frac{2y}{x^2} - 4xy - 2$$

32. $(S, \otimes_9)$ is a monoid

33. Possible structures of binary tree are as follows.



In all the above structures keys can be placed in 3! ways. Hence total binary trees are 5*3!.

35. Not allowed under any versions of timestamp based protocols (T1 is rolled back in all versions)

36. Bandwidth B = 512Mbps = $512*10^6$ bits/sec

Distance d = 2km

Speed of signal V = 2,00,000 kmps = $2 * 10^5$km/s

For CSMA – CD, to detect collision, Ttrans >= 2Tprop

Propagation delay T_{prop}=Distance/Speed of signal= 2km/($2X10^5$km/sec)= 10^{-5} sec

Transmission delay T_{trans} = Size of data/Bandwidth= L/ ($512*10^6$bits/sec)

Since Ttrans >= 2Tprop

$$L = 2 * 10^{-5}\text{sec} * 512 * 10^6\text{bits/sec}$$
$$= 10240 \text{ bits} = 1280 \text{ bytes}$$

37. J-K flip-flop will act as D flip-flop if we have inverter between J and K inputs.

38. $n = 2, h = \frac{\pi}{2}$ using Trapezoidal rule, the value of the given integral is

$$= \frac{h}{2}\left[f(0) + f(\pi) + 2f\left(\frac{\pi}{2}\right)\right] = 1.25$$

39. All features are for code optimization.

Redundancy elimination done by using DAG.

Loop Jamming by combing bodies of loops.

Frequency deduction by moving loop invariant code outside.

40. Regular expression for language of both the grammar is $L = \{a^*aabbbb^*\}$

41. Capacity of hard disk is= $32 \times 2k \times 512 \times 512$

$$= 2^5 \times 2^{11} \times 2^9 \times 2^9 = 2^{34} = 16GB$$

42. Given that P(A)=2P(B)=3P(C) and A,B,C are mutually exclusive

$\Rightarrow P(A)+P(B)+P(C)=1$

let $P(A)=2P(B)=3P(C)=k$

$\Rightarrow P(A)=k, P(B)=\frac{k}{2} \quad P(C)=\frac{k}{3}$

$\therefore k+\frac{k}{2}+\frac{k}{3}=1 \Rightarrow k=\frac{6}{11}$

$\therefore P(A)=k=\frac{6}{11} \Rightarrow P(\overline{A})=1-P(A)=1-\frac{6}{11}=\frac{5}{11}$

43.

	2's complement	Sign magnitude	$\overline{ABC}$
1100 0000	$-128\ 64\ 000000 = -64$	-64	
1000 0000	-128	-0	
1110 0000	-32	-94	

45. $C+5C^2+C^2+2C+2C=1$

$$6C^2+5C=1$$

$$6C^2+5C-1=0$$

$$\Rightarrow c=\frac{-5\pm\sqrt{25-4(-1)6}}{12}=\frac{-5\pm\sqrt{49}}{12}$$

$$c=\frac{-5-7}{12} \quad \text{or} \quad c=\frac{-5+7}{12}$$

$$\therefore c=\frac{1}{6}$$

46. $R=\{\langle 2,2\rangle,\langle 2,4\rangle,\langle 2,8\rangle\langle 2,16\rangle\langle 3,3\rangle\langle 3,6\rangle\langle 3,9\rangle,\langle 3,12\rangle\langle 3,18\rangle\langle 4,4\rangle$
$\langle 4,8\rangle\langle 4,2\rangle\langle 4,16\rangle\ldots\ldots\ldots\}$

So Equivalence classes of R are:

$E(2)=\{2,4,8,16\}$ $\quad E(7)=\{7,14\}$

$E(3)=\{3,6,9,12,18\}$ $\quad E(11)=\{11\}$ $\quad E(17)=\{17\}$

$E(5)=\{5,10,15,20\}$ $\quad E(13)=\{13\}$ $\quad E(19)=\{19\}$

$E(2)=E(4)=E(8)=E(16)$

$E(3)=E(6)=E(9),E(12)=E(18)$

$E(5)=E(10)=E(15)=E(20)$

$E(7)=E(14)$

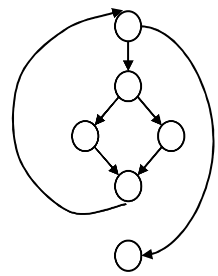
So total 8 classes

47. $\left(\underline{21}\ \ \underline{21}\ \ \underline{22}\ \ \underline{10}\ \ \underline{12}\ \ \underline{12}\right)_{3}① = (778355)_9 = (778355)_3②$

$$\downarrow$$

$$1\times 3^1 + 2\times 3^{\circ} = 5$$

48. Control flow graph for the given graph is as follows



Number of edges =7.

49. C=7-6+2=3

50 & 51. Given, $P(A)\cdot P(B) = \frac{2}{5}$ and $P(\overline{A})\cdot P(\overline{B}) = \frac{2}{15}$............(1)

From (1) an d (2), We have $P(A) = \frac{3}{5}$ or $\frac{2}{3}$; $P(B) = \frac{2}{3}$ or $\frac{3}{5}$

$P(A) = \frac{3}{5}$ or $\frac{2}{3}$ and $P(\overline{A}) = \frac{2}{5}$ or $\frac{1}{3}$

54. $a = \frac{t_p}{t_t}$ t_t : transmission delay

t_p : propagation delay

Efficiency, $S = \frac{1}{1+2a}$

or, $0.5 = \dfrac{1}{1 + 2\times \dfrac{d/v}{L/B}}$

or, $L = 2\times \frac{d}{v}\times B$

$= 2\times \frac{2000}{200}\times 10$ k bit

$= 200$ k bit

$= 25$ kB

55. Maximum data rate $= \dfrac{\text{Window size of sender}}{\text{RTT}}$

Sender window size $= 7$ frames as the protocol is Go $-$ Back $- 7$

$\therefore$ Window size $= 25 \times 7$ kB

$= 175$ kB

RTT $= 2 \times 10\,\text{s}$

$= 20\,\text{s}$

$\therefore$ Data rate $= \dfrac{175\text{ kB}}{20\text{ sec}} = 8.75\text{ kB / s}$

57. Bare infinitive is used after the conjunction "than"

58. Junior/ Senior/ prior are followed by "to"

60. Total no. of balls = 8 + 7 + 6 = 21

Let E = Event that balls drawn is neither red nor green

$\therefore n(E) = 7$

$\therefore P(E) = \dfrac{7}{21} = \dfrac{1}{3}$

62. $x = \dfrac{90}{360} \times 45{,}000 = 11{,}250\,\text{rs}$

$y = \dfrac{120}{360} \times 45{,}000 = 15{,}000\,\text{rs}$

$z = \dfrac{150}{360} \times 45{,}000 = 18{,}750\,\text{rs}$

Hence in 1997 the costs are:

$x = 11{,}250 \times 1.1 = \text{Rs. } 12375$

$y = 15{,}000 \times 1.3 = \text{Rs. } 19500$

$z = 18{,}750 \times 1.2 = \text{Rs. } 22500$

Total cost $= 12375 + 19500 + 22500 = 54375$

63. Speed of 1st train $= \dfrac{600}{15}$ m/s $= 40\,\text{m/s}$

Speed of 2nd train $= \dfrac{600}{20}$ m/s $= 30\,\text{m/s}$

When they move in opposite direction Relative speed $= 40 + 30 = 70\,\text{m/s}$

$\dfrac{600 + 600}{70} = \dfrac{1200}{70} = 17.14\,\text{sec}$

64. Increase of 30% and 50%

$= 30 + 50 + \frac{30 \times 50}{100} = 80 + \frac{150}{100}$

$= 80 + \frac{3}{2} = 160 + \frac{3}{2} = \frac{163}{2}$

$\text{Price of bus} = P + P \times \frac{163}{2}\% = 72600$

$\frac{363P}{200} = 72600 \Rightarrow P = 40,000.$

65. Cyclicity of 3 is 4.

$\frac{57}{4}$ Gives the remainder 1.

So, 3^{57} will have $3' = 3$ on its unit place

$\frac{59}{4}$ gives the remainder 3.

So, 3^{59} will have $3^3 = 27 \Rightarrow 7$ on its unit place

$3^{57} + 13^{59}$ will have $3 + 7 = 0$ on its units place.

It means the number is divisible by 5 & 10.