Answer Keys

1	C	**2**	B	**3**	C	**4**	511	**5**	B	**6**	5	**7**	43
8	C	**9**	C	**10**	B	**11**	B	**12**	A	**13**	C	**14**	C
15	B	**16**	B	**17**	D	**18**	B	**19**	256	**20**	A	**21**	99
22	B	**23**	B	**24**	B	**25**	B	**26**	**C**	**27**	2048	**28**	0
29	A	**30**	8	**31**	7	**32**	C	**33**	B	**34**	B	**35**	D
36	B	**37**	40	**38**	D	**39**	9	**40**	A	**41**	A	**42**	B
43	A	**44**	D	**45**	D	**46**	B	**47**	C	**48**	0.138	**49**	0.143
50	48	**51**	A	**52**	D	**53**	A	**54**	A	**55**	B	**56**	A
57	C	**58**	A	**59**	D	**60**	A	**61**	B	**62**	C	**63**	C
64	B	**65**	A										

Explanation:

1. Probability that P_5 is among the 6 winners =

$P(P_5 \text{ being in a pair}) \times P(P_5 \text{ winning in group})$

$= 1 \times \frac{1}{2} \left[\because P_5 \text{ is definately in a group}\right] = \frac{1}{2}$

2. $P\left(B / A \cup B^C\right) = \dfrac{P\left(B \cap \left(A \cup B^C\right)\right)}{P\left(A \cup B^C\right)}$; Now

$P\left(B \cap \left(A \cup B^C\right)\right) = P\left[(B \cap A) \cup \left(B \cap B^C\right)\right] = P\left[(B \cap A) \cup \phi\right] = P(B \cap A)$

$P(B \cap A) = P(A) - P\left(A \cap B^C\right) = 0.6 - 0.5 = 0.1$

$P\left(A \cup B^C\right) = P(A) + P\left(B^C\right) - P\left(A \cap B^C\right) = 0.8; \quad \therefore \ P\left(B/A \cup B^C\right) = \dfrac{0.1}{0.8} = \dfrac{1}{8}$

3. The zeroes of cos x are the odd multiples of $\frac{\pi}{2}$ at the points it crosses x-axis, also $-1 \le \cos x \le 1$. Therefore, in the interval $\left[\frac{\pi}{5}, \frac{11\pi}{5}\right]$, it has only one local maximum at $x = 2\pi$.

4. Here fork is called 9 times, hence number of child process created is $2^9 - 1 = 511$

6. $4n < n + 18 \Rightarrow n < 6$

7. $n\ 6\ +\ n-1\ 18 \le 1024 \Rightarrow 6n + 18n - 18 \le 1024$

$24n \le 1042 \Rightarrow n \le \frac{1042}{24} \Rightarrow n \le\ 43.41$

9. 194.43.75.128, 194.65.73.64 are subnetwork addresses,
since the host part
last 6 bits are all 0's .
194.25.64.68 and 194.75.74.131 are ip-addresses under subnet id .64 and .128 respectivly.

10. TCP connections are end to end(port to port) and full duplex but not link to link. Link to link connections are maintained at data link layer.

11. By case(i) of master's theorem

12. Post order is "visit left subtree in post order, visit right subtree in post order and then visit node.

13 If Y $\le_p$ X that implies: given a problem X is solvable in polynomial time,Y can also be solved in polynomial time. Contrapositive of the above statement: If Y cannot be solved in polynomial time then X also cannot be solved in polynomial time. So S1 is true. To prove a problem (P) to be NP – complete one needs to reduce a known NP –Complete problem to P in polynomial time, so S2 is false.

16. (A) If L_1 is regular, then L_2 will also be regular , it need not to be true necessarily as wehave contradicting example where $L_1 = a^n\ b^m \mid m, n \geq 0$ and $L_2 = a^n\ b^n \mid n \geq 0$,here L_1 is regular and L_2 is non-regular but their union is regular which is L_1 itself.

(B) If L_1 is regular & finite, then L_2 will be regular, it needs to be true necessarily as if we take $L_1 = ab$ and $L_2 = a^n\ b^n \mid n \geq 0$, here L_1 is regular & finite and L_2 is non-regular and their union is non-regular.

(C) If L_1 is regular & finite, then L_2 will be regular & finite , it need not to be true necessarily because if we take $L_1 = ab$ and $L_2 = a^n\ b^m \mid m, n \geq 0$, here L_1 is regular & finite and L_2 is infinitely regular but their union is regular.

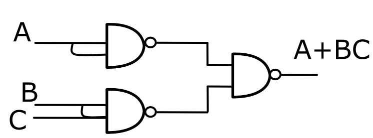
So, for L_2 to be regular L_1 should be finite & regular, but we cannot comment over finiteness of L_2 , from given information.

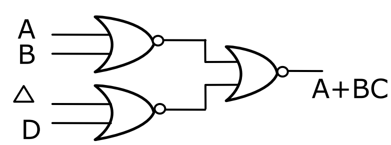
18. n instructions for addition and 1 instruction for storing

19. With n- boolean variables, number of self-dual functions = $2^{2^{n-1}}$

With n=4, number of self-dual functions = $2^{2^3} = 2^8 = 256$

20. <u>NAND</u> <u>NOR</u> $A + BC = A + B \quad A + C$





21 Availability = MTTF/(MTTF + MTTR) and MTBF = MTTF + MTTR

23. Since rank = 2

$$\Rightarrow |A| = 0$$

$$\Rightarrow \begin{vmatrix} k & -1 & 0 \\ 0 & k & -1 \\ -1 & 0 & k \end{vmatrix} = 0 \Rightarrow k = 1$$

24. We have $\int_a^b \frac{f\ x}{f\ x\ + f\ a+b-x}\, dx = \frac{b-a}{2}$

$$\therefore \int_2^4 \frac{\sqrt{x}}{\sqrt{x}+\sqrt{6-x}}\, dx = \frac{4-2}{2} = 1$$

25. Characteristic equation of 'A' is $|A-\lambda I| = 0$

$$\Rightarrow \begin{vmatrix} 1-\lambda & 2 \\ -1 & 3-\lambda \end{vmatrix} = 0$$

$$\Rightarrow \lambda^2 - 4\lambda + 5 = 0$$

By Hamliton theorem $\Rightarrow A^2 - 4A + 5I = 0$

$$\Rightarrow A^2 = 4A - 5I \qquad ....(1)$$

$$\Rightarrow A(A^2) = A(4A-5I)$$

$$\Rightarrow A^3 = 4A^2 - 5A \qquad ....(2)$$

$$\Rightarrow A^4 = 4A^3 - 5A^2 \qquad ....(3)$$

$$\Rightarrow A^5 = 4A^4 - 5A^3 \qquad ....(4)$$

$$\Rightarrow A^6 = 4A^5 - 5A^4 \qquad ....(5)$$

Now $A^6 - 4A^5 + 8A^4 - 12A^3 + 14A^2$

$= 4A^5 - 5A^4 - 4(4A^4 - 5A^3) + 8(4A^3 - 5A^2) - 12(4A^2 - 5A) + 14(14A - 5I)$

$= -4A + 5I$ $\quad$ ($\because$ by applying equations (1), (2), (3), (4) & (5))

Q. No. 26 – 55 Carry Two Marks Each

26.

Number of lines in direct mapped = 512
Block size = 32 bytes

FBFC = 1111 1011 1111 1100

	Tag	Lines	word
D/M =	2	9	5

Line $= \underbrace{\quad}_{1}\ \underbrace{1\ 1}_{D}\ 1\ \underbrace{0\ 1\ 1}_{F}\ 1\ 1\ 1$

	Tag	set	word
8 way set associate =	5	6	5

Line / set $= \underbrace{0\ 1}_{1}\ \underbrace{1\ 1\ 1\ 1}_{F}$

27.

$\longleftarrow 30 \longrightarrow$

Tag	10	4
16	Lines	words

so total tag size $=$ Number of Lines $\times$ tag bits

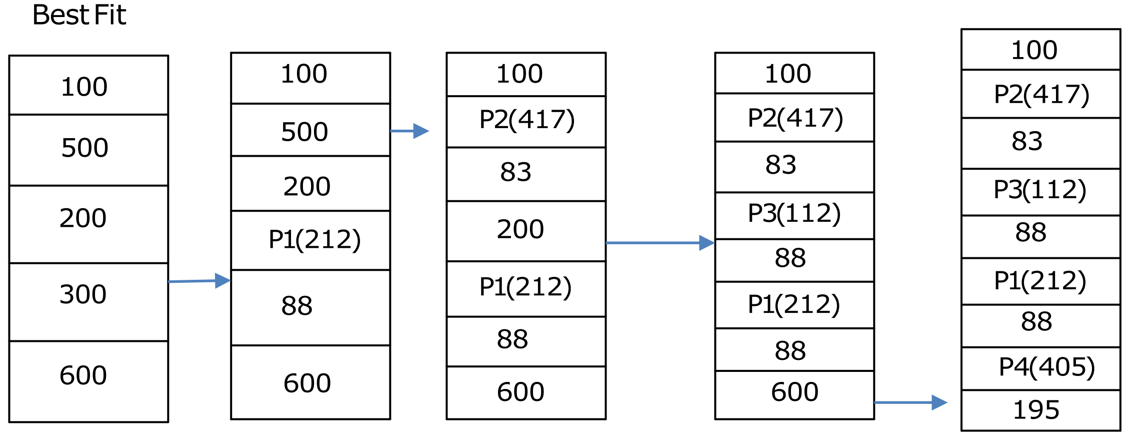
$$= 2^{10} \times 16\text{Bits} = 2^{10} \times 2\text{Byte} = 2^{11}\text{Byte} = 2048 \text{ Bytes}$$

28. If we denote output by $WXYZ$, $W = C$, $X = D$, $Y = A$ and $Z = B$

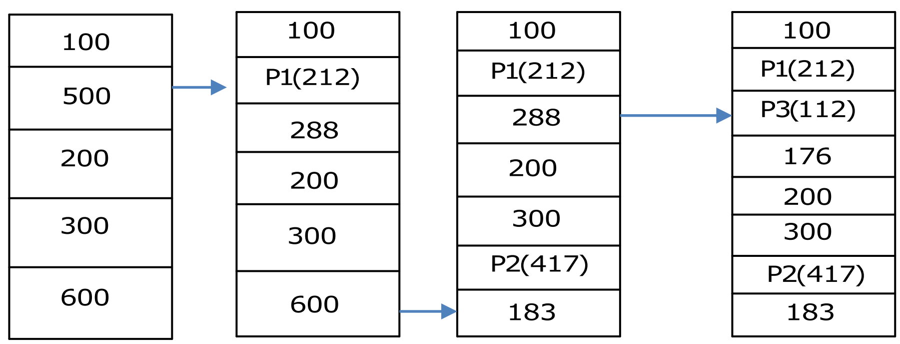
So this can be implemented by directly connecting input wires with output pin using zero gates.

29.

Best Fit

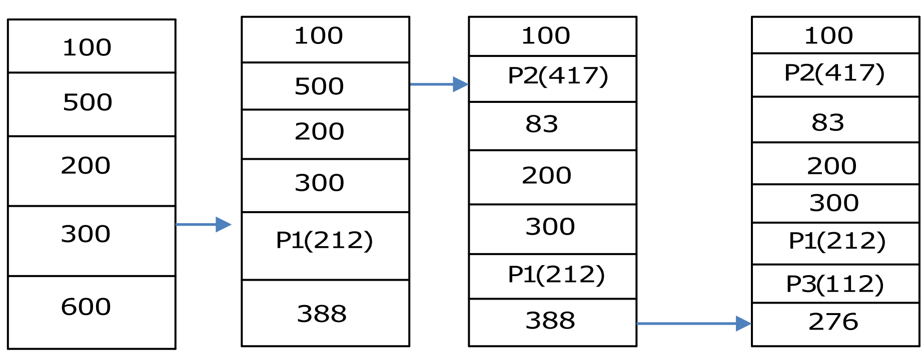


First Fit



No space for P4

Worst Fit



No space for P4

30.

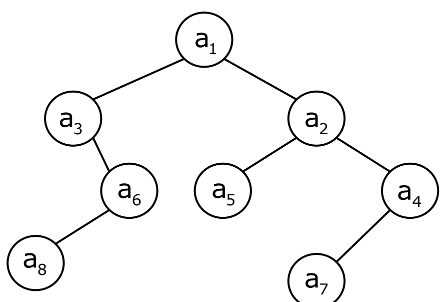
String	1	2	4	2	3	5	3	4	3	1	6	3	2	1	2	1	2	3	5	4
Frame1	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Frame2		**2**	2	2	2	**5**	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Frame3			**4**	4	4	4	4	4	4	4	**6**	6	**2**	2	2	2	2	2	2	2
Frame4					**3**	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**4**

Bold represents page miss. So total 8 misses.

31. From P_1 to P_{15} at most 5 processes can be in critical section now P_{16} can go to critical section by performing V (signal) operation and increments X by 1 allowing one more process from P_1 to P_{15} into critical section. This makes count 7.

32. Each component can be complete graph in itself. After that no edges can be added in G, maximum number of edges possible $= \sum_{i=1}^{k} {}^{n_i}C_2$

33. After swap tree is



Post order traversal: $a_8\ a_6\ a_3\ a_5\ a_7\ a_4\ a_2\ a_1$

34. Given $f\ n = \sum_{i=0}^{m} a_i n^i = a_m n^m + a_{m-1} n^{m-1} + ... + a_1 n + a_0$ where $a_m > 0$ then $f\ n = O\ n^m$

Each of the terms in summation is of the form $a_i n^i$. Since, 'n' is non-negative, a particular term will be negative only if $a_i < 0$. Hence for each term the summation $a_i n \le |a_i| n^i$

35. If not mentioned, it starts with 0 & once mentioned, it's get updated with the mentioned value & next one if not explicitly mentioned will have value of previous one +1;

37. The HLEN value is 15, which means the total number of bytes in the header is 15*4 = 60 bytes (this is the maximum possible header length). Given the total length is 0X0064 in hexadecimal = 100bytes including header size. So, the data carried by this packet = total length – header length = 100 – 60 = 40 bytes

38. 0 $\boxed{1111111111}$ 0

→ Block of consecutive 1's

Starting position of block represents subtraction and ending position of block represents addition operation.

So number of operations required in each multiplier pattern is as follows:-

(a) 1 addition, 1 subtraction required

(b) 1 addition, 2 subtractions required

(c) 2 additions, 2 subtractions required

(d) 0 additions, 1 subtraction required

→ Because it requires minimum number of additions and subtractions, so this multiplier gives the better performance.

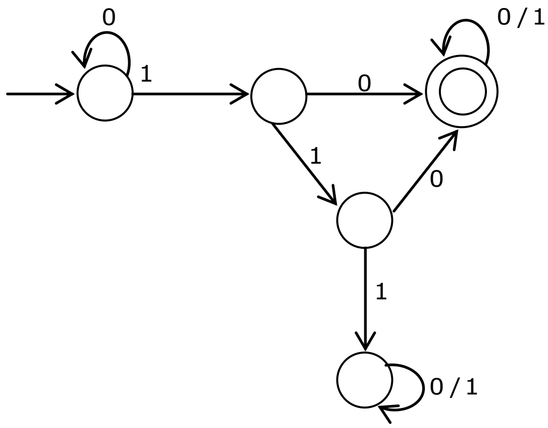
39. Total number of productions is 9 and the grammar after removing unit productions is as follows:-

$S \to b|bb|a$

$A \to b|bb|a$

$B \to b|bb|a$

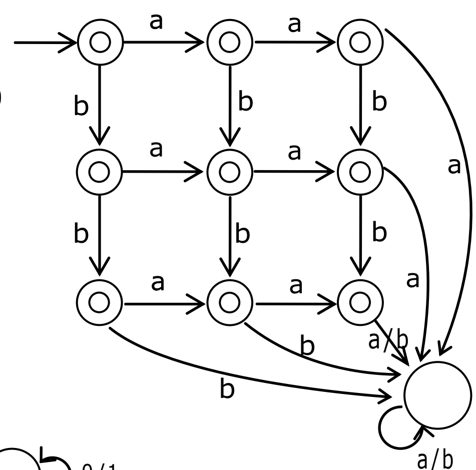
41. Minimized DFA possible:



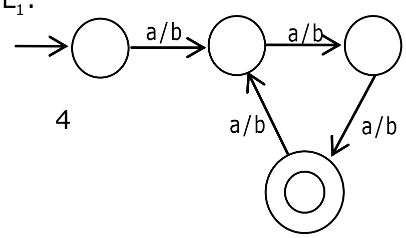
42.

L_2:

10

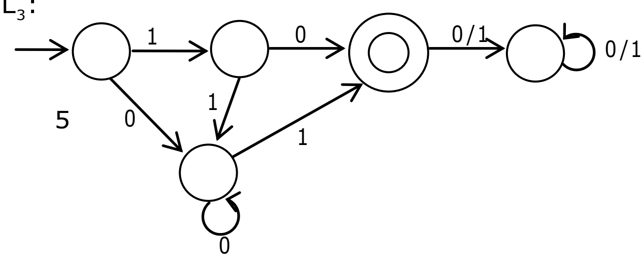


L_1:



4

L_3:



5

43. Option A

Explanation:
Given routing vectors coming into router C are:
From B: (3, 0, 6, 5, 3, 8, 3);
From D: (1, 5, 3, 0, 8, 6, 3);
From E: (4, 3, 1, 1, 0, 4, 6);
From F: (3, 8, 3, 6, 4, 0, 9);
Given that the distance metric (delay) from C to B is 2; C to D is 3; C to E is 1 and C to F is 6
So the distance vector at C if going via B is = Distance from C to B + Distance from B to other routers

- ⇨ Going via B gives (2+3, 2+0, 2+6, 2+5, 2+ 3, 2+8, 2+3) = (5, 2, 8, 7, 5, 10, 5)
- ⇨ Going via D gives (3+1, 3+5, 3+3, 3+0, 3+8, 3+6, 3+3) = (4, 8, 6, 3, 11, 9, 6)
- ⇨ Going via E gives (1+4, 1+3, 1+1, 1+1, 1+0, 1+4, 1+6) = (5, 4, 2, 2, 1, 5, 7)
- ⇨ Going via F gives (6+3, 6+8, 6+3, 6+6, 6+4, 6+0, 6+9) = (9, 14, 9, 12, 10, 6, 15)

So, taking minimum for each destination except C from the above calculations, we get the distance vector at C as (4, 2, 0, 2, 1, 5, 5)

44. Relation is in 2NF.
Redundancy is existing because of FD: BC → D, where BC is not a key.
Redundancy will be eliminated completely by decomposing the relation into BCNF. BCNF decomposition of R(ABCD) is R1(ABC) and R2(BCD)

45. We have $(\text{adj}A).\ \text{adj}\ \text{adj}A = |\text{adj}A|\,I$

$$\Rightarrow |A|.I.\text{adj}(\text{adj}A) = |A|^3\ I = |A|^3\ I.A$$
$$\Rightarrow \text{adj}(\text{adj}A) = 16A$$

46. (B) P Not appearing same number $= 1 - P$ appearing same number

P Not appearing same number $= 1 - \left(\frac{1}{6} \times \frac{1}{6} \times \frac{1}{6}\right) = \frac{215}{216}$

48. If births randomly occur at a rate of 1.8 births/hour, then births randomly occur at a rate of 3.6 births/2 hours

Let X = Number of births in 2 hour period

We use a poisson distribution here

$$Y = P_0\left(3.6\right), \text{ so } P\left(y = 5\right) = e^{-3.6}\frac{\left(3.6\right)^5}{5!} = 0.13768$$

49. $X = P_0\left(\lambda_1\right) \qquad \lambda_1 = 1.8 \quad A$

$Y = P_0\left(\lambda_2\right) \qquad \lambda_2 = 3.1 \quad B$

$X + Y = P_0\left(\lambda_1 + \lambda_2\right) = P_0\left(4.9\right)$

$$P\left(6\right) = e^{-4.9}\frac{\left(4.9\right)^6}{6!} = 0.143$$

50. Let, $a = \dfrac{\text{transmission delay}}{\text{propagation delay}} = \dfrac{10\,\text{ms}}{2\,\text{ms}} = 5$

$$\text{Efficiency} = \frac{1}{1 + 5.4 / a} \times 100\%$$

$$= \frac{1}{1 + 1.08} \times 100\% = 48\%$$

51. $L \geq R_{TT} \times B$

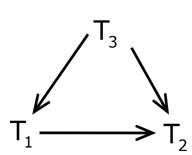
$RTT = 4\,\text{ms}$

$B = 5\,\text{kbps}$

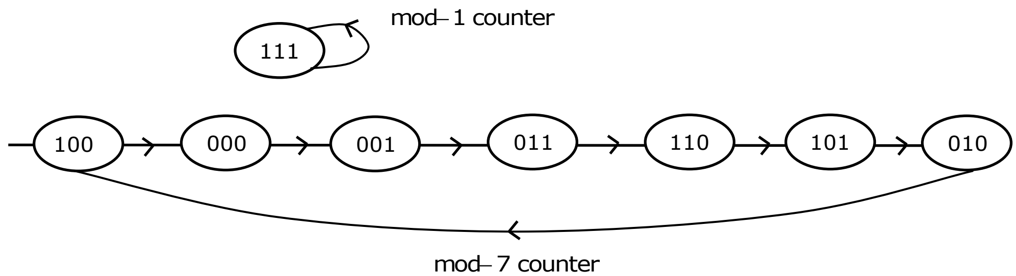
$\therefore L \geq 20\,\text{bit}$

52 & 53.

If you construct precedence graphs for first three schedules we will get cycle, hence they are not conflict serializable. Precedence graph for schedule 4 is shown below



54. The counting sequence of above circuit is



55. Apply 6 clock pulses (76% 7 = 6) to state 001, it will take us to state 000.

60. P#Q $\Rightarrow$ P<Q; R ^S $\Rightarrow$ R>S; Q$R $\Rightarrow$ Q=R; P<Q=R
Hence P#R = P<R is true.

62. $A \cup B = 40$

$A \cup B = A + B - A \cap B$

$40 = A + 22 - 12$

A=30 enrolled for English & included both subjects
Number of students enrolled for English only = 30-12=18.

63. 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.

64. The question requires you to find no. of outcomes in which at most 3 coins turn up as heads.
I.e, 0 coin turn head or 1 coin turns head or 2 coins turns head or 3 coin turns head.

The no. of outcomes in which 0 coins turn head is $6_{c0} = 1$ outcome

The no. of outcomes in which 1 coins turn head is $6_{c1} = 6$ outcome

The no. of outcomes in which 2 coins turn head is $6_{c2} = 15$ outcome

The no. of outcomes in which 3 coins turn head is $6_{c3} = 20$ outcome

$\text{Total} = 1 + 6 + 15 + 20 = 42$

65. Clearly marked price of Book = 120% of CP
Also, Cost of paper = 25% of CP
Let, cost of paper for a single book be Rs. n
Then 125 : 25 = 180 : n

$$n = \frac{180 \times 25}{125} = \text{Rs.}37.50$$