049/2025

PART – II

Total Number of Questions : 40	Maximum Marks : 200	Time : 3 Hours

INSTRUCTIONS (നിർദ്ദേശങ്ങൾ)

1. Question cum Answer Booklets are processed by electronic means. The following instructions are to be strictly followed to avoid invalidation of answer scripts.
(ചോദ്യവും ഉത്തരവും അടങ്ങുന്ന ഈ ബുക്ക് ലെറ്റുകൾ ഇലക്ട്രോണിക് സാങ്കേതിക വിദ്യയുടെ സഹായത്തോടുകൂടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനാൽ ഇവ അസാധുവാകാതിരിക്കുവാൻ താഴെപ്പറയുന്ന നിർദ്ദേശങ്ങൾ പൂർണ്ണമായും പാലിക്കുക.)

2. The first page of this question cum Answer Booklet is an OMR data Sheet (Part I). All entries in the OMR sheet are to be made with blue or black ball point pen only.
(ഈ പുസ്തകത്തിന്റെ ഒന്നാമത്തെ പേജ് ഒരു ഒ.എം.ആർ. ഡാറ്റാ ഷീറ്റാണ് (പാർട്ട് I). ഇത് നീലയോ, കറുപ്പോ നിറത്തിലെ ബോൾ പോയിന്റ് പേന ഉപയോഗിച്ച് മാത്രമേ പൂരിപ്പിക്കാവൂ.)

3. Make sure that register number is bubbled correctly and completely; no correction is permitted.
(രജിസ്റ്റർ നമ്പർ രേഖപ്പെടുത്തുന്നതിനുള്ള കുമിളകൾ കൃത്യമായും പൂർണ്ണമായും കറുപ്പിച്ചിട്ടുണ്ടെന്ന് ഉറപ്പു വരുത്തുക. തിരുത്തലുകൾ അനുവദനീയമല്ല.)

4. Do not tamper the bar code printed on the OMR sheet and subsequent pages. Tampering of bar code will result in the invalidation of this booklet.
(ഈ പുസ്തകത്തിൽ എവിടെയും പ്രിന്റ് ചെയ്തിരിക്കുന്ന ബാർ കോഡിൽ ഒരു കാരണവശാലും തിരുത്തലുകളോ, മാർക്കുകളോ പാടില്ല. ഇതിനു വിരുദ്ധമായി ചെയ്യുന്ന പക്ഷം ഈ പുസ്തകം അസാധുവാകുന്നതാണ്.)

5. Answers should be written with blue or black ball point pen only.
(ഉത്തരങ്ങൾ നീലയോ, കറുപ്പോ നിറത്തിലെ ബോൾ പോയിന്റ് പേന ഉപയോഗിച്ച് മാത്രമേ എഴുതാവൂ.)

6. Do not write anything outside the margin of space provided for writing the answer and write only one line of answer between two lines.
(പുസ്തകത്തിൽ ഉത്തരം എഴുതുവാൻ നൽകിയിരിക്കുന്ന സ്ഥലത്തിനു വെളിയിൽ യാതൊന്നും തന്നെ എഴുതുവാൻ പാടില്ല. രണ്ടു വരകൾക്കിടയിൽ ഒരു വരി ഉത്തരം മാത്രമേ എഴുതുവാൻ പാടുള്ളൂ.)

7. Rough work should be done only in the specific page provided with.
(റഫ് വർക്കുകൾ ഇതിനായി നൽകിയിരിക്കുന്ന പേജിൽ മാത്രമേ ചെയ്യുവാൻ പാടുള്ളൂ.)

1. If X and Y are iid random variables uniformly distributed in $(0, 4)$ find $P(X > Y / X < 2Y)$ (5 Marks)

2. Given that $G\left\{\begin{bmatrix} a & b \\ 0 & d \end{bmatrix}; a,b,d \in R;\ ad = 1\right\}$ is a group under matrix multiplication and $H = \left\{\begin{bmatrix} 1 & b \\ 0 & 1 \end{bmatrix}; b \in R\right\}$ is a subgroup of G show that G/H is isomorphic to the group of all 2×2 diagonal matrices over R of determinant 1. (5 Marks)

3. What is the minimum number of students required in a mathematics class to be sure that atleast five will receive the same grade if there are six possible grades A, B, C, D, E and F. (5 Marks)

4. How distributed bus arbitration is different from centralized bus arbitration in direct memory access? What advantages does distributed bus arbitration have over centralized bus arbitration? Explain distributed bus arbitration with scheme diagram. (5 Marks)

5. What are the three modes of operation of content addressable memory (CAM)? Explain its working with simple cell diagram. How its potentials is used in computer networks? (5 Marks)

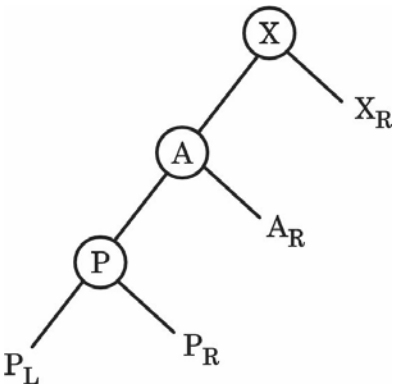
6. How an organization of micro-programmed control unit can be modified to allow micro-program branching? State the conditions which override the auto incrementing of the micro-program counter. (5 Marks)

7. Write the pseudo-code for generating minimum spanning tree using disjoint sets. (5 Marks)

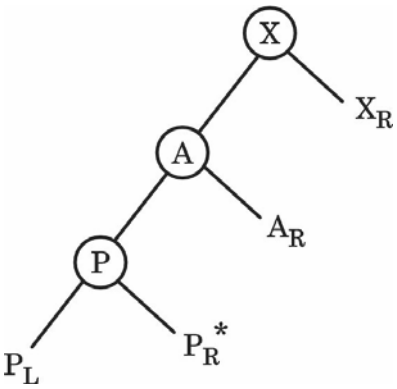
8. Device an algorithm to transform a given binary search tree in such a way that smaller values are on the right sub-tree and larger values are on the left sub-tree of each node. Discuss the time complexity of the algorithm. (5 Marks)

9. Start with the following AVL tree where X, A and P are nodes and the other represent sub-trees, assume that an insertion in P_R creates a sub-tree P_R * which makes the tree out of balance (No longer an AVL tree) and assume that X is chosen as the lowest out of balance node

Before insertion



After insertion



(a) Show how to restructure the tree so that it is once again an AVL tree.

(b) If we define h to be the height of A_R, what is the height of P_R *? Justify your answer. (5 Marks)

10. Prove that $\log n \in O(\sqrt{n})$ but $\sqrt{n} \notin O(\log n)$. (5 Marks)

11. Illustrate the concept of parameterized and non parameterized constructors with suitable examples. (5 Marks)

12. Explain the concept of dynamic binding. State its benefits. Illustrate with example program. (5 Marks)

13. Design a OR gate using universal NAND gate. (5 Marks)

14. Derive a sequential circuit to convert a JK flip flop into a D flip flop. It will have a D flip flop and 2 inputs J and K. Also show the conversion table, the K-map for D in terms of J, K and Qp. (5 Marks)

15. Differentiate direct and indirect addressing modes used in 8086 with an example. What is the addressing mode of MOV AX, 55H (BX) (SI)? (5 Marks)

16. For the production rules $S->ACB|Cbb|Ba$, $A->da|BC, B->\ g|\in$, $C->h|\in$, compute the first set of all non terminals. (5 Marks)

17. What are the main data structures used by two pass assembler? How does it handles forward references? (5 Marks)

18. Describe the actions taken by the operating system during a page fault. (5 Marks)

19. Consider a system with 100 cylinders numbered from 0 to 99. The request to access the cylinders occur in the following sequence 4, 34, 10, 7, 19, 73, 2, 15, 6, 20. Assuming that the head is currently at cylinder 50, compute the time taken to satisfy all request if shortest seek time first policy is used (Time taken to move from one cylinder to adjacent cylinder is 1 ms). (5 Marks)

20. What are Armstrong's axioms in DBMS? Discuss the different types. (5 Marks)

21. Consider the following relations and dependencies. Determine the candidate keys and if the relation is not in BCNF then decompose it into a collection of BCNF relations. $R1(A, C, B, D, E), A \rightarrow B, C \rightarrow D$ (5 Marks)

22. How does 2 phase locking protocols preserve data base consistency? Explain. (5 Marks)

23. Find the bit rate of a channel having a bandwidth of 1 MHz with 8 signal levels. How will the rate improve theoretically and practically, if we double the bandwidth? If we double the SNR, what will be the change in the capacity of the channel? (5 Marks)

24. Consider a 12 bit hamming code with 8 data bits and 4 check bits $d_8, d_7, d_6, d_5, c_8, d_4, d_3, c_4, d_2, d_1, c_2, c_1$. Let the data bits are : (5 Marks)

d8	d7	d6	d5	d4	d3	d2	d1
1	1	0	0	0	y	0	z

and the check bits are :

c8	c4	c2	c1
x	0	1	0

Find the bits x, y, z.

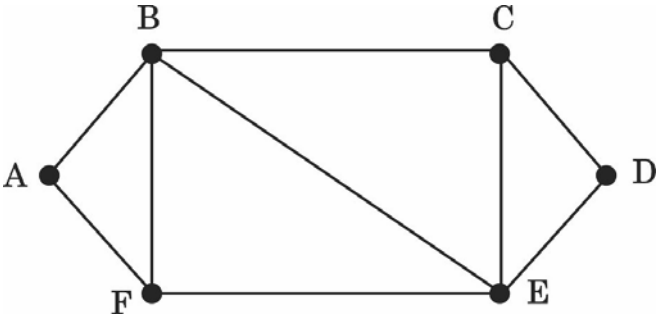
25. Compare GSM,4G,5G mobile communication technologies in terms of bandwidth, switching types, applications and challenges. (5 Marks)

26. (a) Consider a CSMA/CD network running at 100 Mbps over 2 km cable with no repeaters. Find the frame size when signal speed is 100,000 km/sec. (3 Marks)

(b) Name the version of CSMA protocol applicable to wireless networks and its basic working principle. (2 Marks)

27. Consider an instance of TCP congestion control protocol with slow start and congestion avoidance (addictive increase). The window size and threshold at the beginning of the cold start is 1 MSS and 16 MSS, respectively. Assume that a time out occurs at 8^{th} transmission. Find the congestion window size at the end 15^{th} transmission. (5 Marks)

28. Consider the following network which employs distance vector routing: (5 Marks)



The following vectors are just received to router B. From A : (0, 5, 11, 15, 8, 1) from C: (11, 8, 0, 4, 3, 10), from E (8, 4, 3, 10, 0, 7) and from F (1, 5, 10, 14, 7, 0). The current delays to A, C, E and F are 5, 8, 4 and 5 respectively. Find the new routing table (expected delay, outgoing line) of node B. What will be the chances of count to infinity problem, if the link between nodes B and E is failed.

29. (a) Can you devise a finite automata which recognize a" b"? Justify your answer. (1.5 Marks)

(b) Develop a DFA which accepts all strings over $\{a, b\}$ such that numbers of b's is multiple of 3 and number of a's multiple of 2. (3.5 Marks)

30. Write the context free grammar for language accepting the strings, $L(G)=\{WCW^R \mid W \in \{a, b\}^*\}$. Check whether the grammar is in Chomsky normal form, if not, convert to Chomsky normal form. (5 Marks)

31. With appropriate code snippet, demonstrate how JSON is used to exchange data between a client and server in JavaScript? Is XML better than JSON in the above example? Justify. (5 Marks)

32. What is the difference between ReactJS with Node.js with respect their purpose? How does the non-blocking I/O model of Node.js improve performance for web servers? Provide a simple example of creating an HTTP server in Node.js. (5 Marks)

33. How does virtualization enable cloud computing? Explain the role of hypervisors. Differentiate between Type -1 and Type -2 hypervisors. (5 Marks)

34. Compare and contrast IaaS, PaaS, and SaaS in terms of user control, provider responsibilities, and typical use cases. How does XaaS extend these models? (5 Marks)

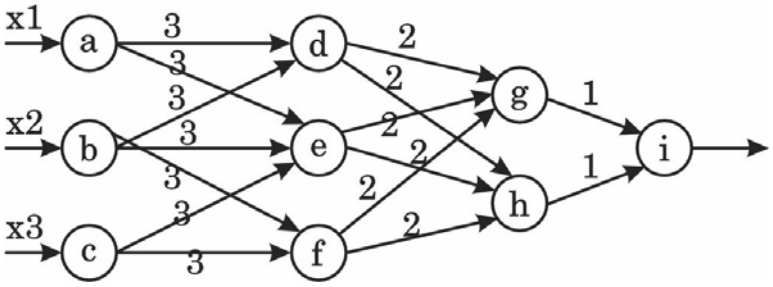
35. (a) A Tennis organization has decided to develop a decision tree based model to predict future chances of players winning a game. The factors considered are *court types (hard(H), clay(C), grass (G)), skills (Good in serves(S), Good in footwork(F)) and weather (rainy(R), windy(W))*. Calculate the gain of the attribute *court type* either using entropy or Gini index. (3 Marks)

Match No	Court type	Skill	Weather	Winner
1	H	F	R	Boris
2	G	S	R	Boris
3	G	S	W	Boris
4	H	F	W	Andre
5	G	F	R	Boris
6	H	S	W	Andre
7	C	F	R	Boris
8	C	S	W	Andre
9	C	F	W	Boris
10	H	S	R	Andre

(b) Information gain based algorithm is biased towards attribute with more number splits. How does gain ratio resolves this issue? (2 Marks)

36. A disease prediction model is developed, trained and tested. The number of positive and negative samples available were 1000 and 9000 respectively. 90% of both positive and negative samples were classified correctly and remaining 10% were incorrect predictions. Compute accuracy, precision and recall of the model. In this case, among the measures, which of them are more reliable? Does ROC or precision-recall curve give more meaningful insight, in this context? (5 Marks)

37. (a) Consider a neural network shown in Figure. ReLU is the activation function in all the nodes ($\text{Re}\,LU(z)=\max(0,z)$, for all z in R) . Connections between the nodes and their weights are marked in the Figure and biases of all nodes set to zero. For a given input of x values as $(1,1,1)$, find the output from node i. (3 Marks)



(b) Write the derivatives of sigmoid and ReLU function. State the reason why ReLU is preferred over sigmoid in deep neural networks. (2 Marks)

38. Two persons A and B want to share a secret key using Diffie-Hellman Key Exchange protocol. An impersonator I intercepts the communication with man-in-the-middle attack. The following shows the credentials chosen by A, B and I.

Prime number, p = 11

Generator, g = 3

Private key of A = 4

Private key of B = 5

Private key of I for communication with A = 5

Private key of I for communication with B = 7

Calculate the public key and secret key generated at A in this scenario. (5 Marks)

39. In a RSA cryptosystem, a participant A uses two prime numbers p = 7 and q = 13 to generate public and private keys. If the private key of A is 5, what will be the public key of A? (5 Marks)

40. What is meet-in-the-middle attack? Identify a scenario where the SHA-512 algorithm is vulnerable to this attack. Give the reasoning for it. (5 Marks)