

2019

COMPUTER SCIENCE

PAPER-I

Time Allowed—3 Hours

Full Marks—200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be given either in **English** or in **Bengali** but all answers must be in one and the same language.

Answer **any five** questions.

1. (a) Find the 10's-complement of 63918.  
(b) Convert  $(54.45)_{10}$  into its binary equivalent.  
(c) Explain the following types of numerical errors with an appropriate example of each:  
round-off error, chopping and truncation error.  
What do you understand by absolute error and relative error? Give examples.  
(d) What do you mean by SOP, POS and min-term in Boolean algebra? What are the different types of SOP? State with appropriate examples.  $2+4+(3 \times 4+4)+(3 \times 2+12)=40$

2. (a) Find whether each of the following is true or false (given reasons):

- |                       |                |
|-----------------------|----------------|
| (i) $f(n) = 1$        | $\in O(n)$     |
| (ii) $f(n) = \lg n$   | $\in O(n^2)$   |
| (iii) $f(n) = n^2$    | $\in O(n)$     |
| (iv) $f(n) = 3n + 10$ | $\in O(\lg n)$ |
| (v) $f(n) = n \lg n$  | $\in O(n^2)$   |
| (vi) $f(n) = n$       | $\in O(n^2)$   |

- (b) Show that  $1 + \sqrt{n} \in O(n)$

- (c) Express  $T(n)$  using big- $O$  notation (with brief explanation):

$$T(n) = 500n + \frac{n^5}{10} + 80 \log n$$



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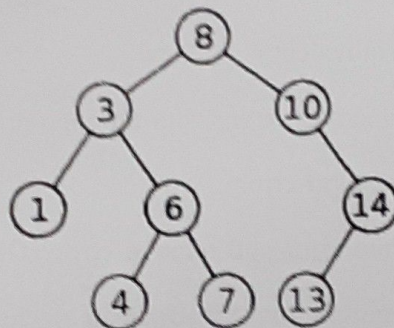
- (d) We have two algorithms A and B with  $n$  input values that solve one problem. Algorithm A takes time  $T_A(n) = n^3 + 5n^2 + 100n$  and algorithm B takes time  $T_B(n) = 1000n^2 + 1000n$ . When is B more efficient than A?  
 $(6 \times 2) + 10 + 4 + 14 = 40$

3. (a) Solve the recurrence:  $T(n) = 2T(n/2) + cn$ ;  $T(1) = 1$  [ $c$  is a constant].  
 (b) Snapshot of two separate recursive algorithms are given below. Let  $T(n)$  be the time to solve each problem. Represent  $T(n)$  recursively.

(i) function B1(n) {  
     for (i=1, i<=n, i++)  
         x = x + i  
     B1 (n/2)  
     B1 (n/2)  
 }

(ii) function B(n) {  
     x = x + i  
     B (n/2)  
 }

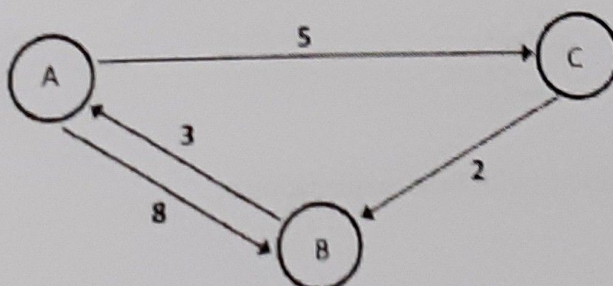
- (c) List the order of visiting vertices for in order, post order, preorder and level order traversal of the binary tree below.



- (d) Prove that the worst case behaviour of Quicksort is  $O(n^2)$ . What is the average case behaviour?  
 With what types of file it happens?  $8 + (4+4) + (4 \times 3) + (6+2+4) = 40$

4. (a) What is a complete graph? How many edges are there in  $K_n$  (where  $K_n$  is a complete graph of  $n$  nodes)?  
 (b) Describe Floyd's all-pair shortest path algorithm using pseudocode. Clarify the steps with appropriate comments.

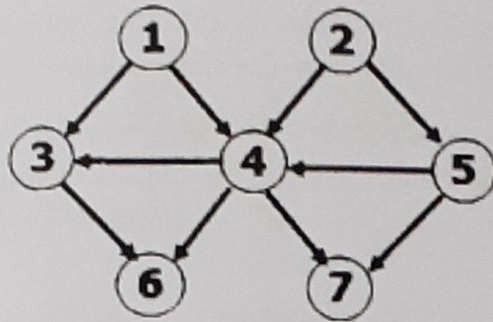
Apply Floyd's algorithm on the following graph:



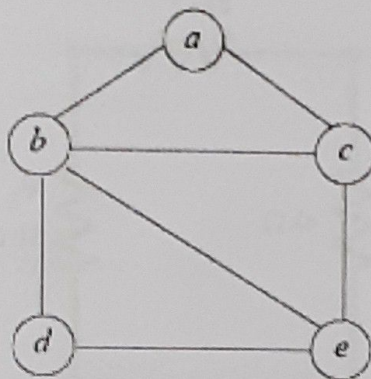
Enumerate the steps.



- (c) Find three topological ordering for the following graph:



- (d) Use backtracking to solve the 3-coloring problem with the following graph. Show the full state space search tree.  
 $(2+2)+(4+6)+6+20=40$



5. (a) Using the following tabular values for a function  $y = f(x)$ , obtain its second degree polynomial approximation using Lagrange's Interpolation formula:

$i$	0	1	2
$x_i$	0.10	0.16	0.20
$f(x_i)$	1.12	1.24	1.40

Also, find the approximate value of the function at  $x = 0.13$ .

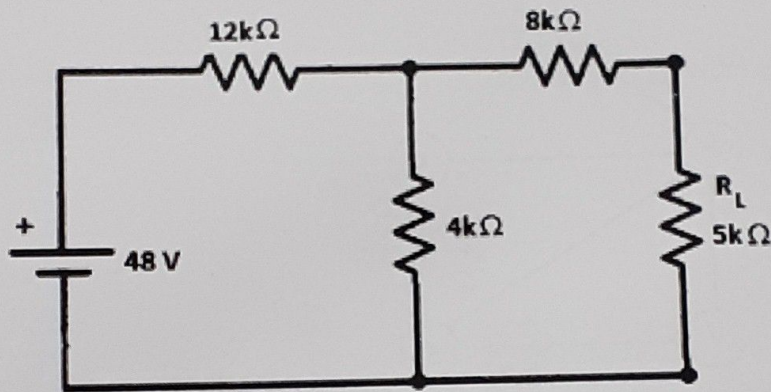
- (b) A company manufactures two products :  $X$  and  $Y$ . There are three machines (resources)  $M_1$ ,  $M_2$  and  $M_3$  and the available capacities are 50, 25 and 15 hours respectively. Product  $X$  requires 1 hour of machine  $M_2$  and 1 hour of machine  $M_3$ . Product  $Y$  requires 2 hours of machine  $M_1$ , 2 hours of machine  $M_2$  and 1 hour of machine  $M_3$ . The profit contribution of products  $X$  and  $Y$  are Rs. 5.00 and Rs. 4.00 respectively. Formulate a LP resource allocation model, along with the objective function and necessary constraints.
- (c) Compare and contrast: Transportation problem and Assignment problem.  $(12+6)+12+10=40$



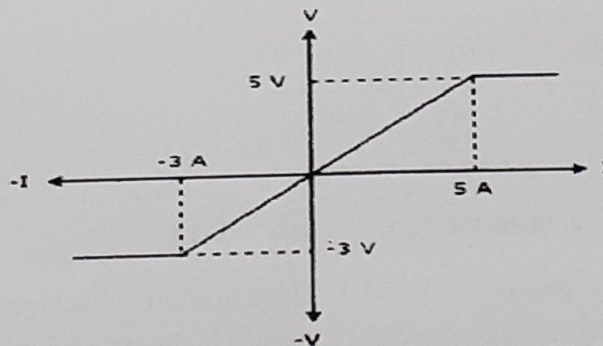
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(4)

6. (a) Give the truth table, output Boolean function and a gate level circuit diagram of  $4 \times 1$  multiplexer.
- (b) Implement an  $8 \times 1$  multiplexer using  $4 \times 1$  multiplexers and  $2 \times 1$  multiplexers. Show the block diagram and truth table. Briefly justify how the combination operates as an  $8 \times 1$  multiplexer.
- (c) Design a 3-bit asynchronous binary up counter using T flip-flops. Explain in brief how the counter works.  
(4+2+4)+(4+4+6)+(10+6)=40
7. (a) State Kirchhoff's current law and Kirchhoff's voltage law.
- (b) Find the Thevenin Voltage ( $V_{TH}$ ), Thevenin Resistance ( $R_{TH}$ ) in the following figure.



- (c) The V-I characteristics of a network element is shown below:



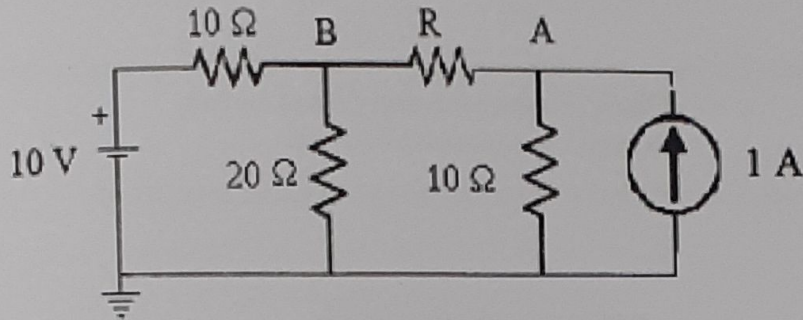
Find the following information for the network element.—Give proper justification:

- (i) type (linear or non-linear) and
- (ii) active or passive.



(d) Find the voltages  $U_A$  and  $U_B$  at points A and B, respectively, in the figure below ( $R = 10 \Omega$ )

$$(2+2)+(6+6)+(2 \times 2)+20=40$$



8. Write short notes on *any four*:

$$10 \times 4 = 40$$

- (a) Finite state machines
- (b) Asynchronous communication
- (c) TCP/IP protocol
- (d) AVL rotations
- (e) Linked list data structure
- (f) Modems

For guidance of WBCS Prelims , Main Exam and Interview by WBCS Gr A Officers/ Toppers, WBCS Prelims and Main Mock Test (Classroom & Online), Optional Subjects, Studymaterials, Correspondence Course etc. Call WBCSMadeEasy™ at 9674493673 or mail us at [mailus@wbcsmadeeasy.in](mailto:mailus@wbcsmadeeasy.in) Type your text