SEAL

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Invigilator's signature

Question Booklet No.

400060

J/EE/R EXAM

2020

COMPUTER SCIENCE AND ENGINEERING

Time : 2 Hours **Maximum Marks : 200**

ROLL NO. | | | | | | |

INSTRUCTIONS FOR CANDIDATES

1. This Test Booklet consists of two parts—PART–I (Objective) contains 50 multiple choice questions carrying *2* marks each and PART–II (Subjective) is of 100 marks.
2. In PART–I (Objective), each question contains four responses. Choose only one correct answer for each question and darken the bubble on the OMR RESPONSE SHEET. In PART–II (Subjective), answer all questions as directed in full sentences. The marks in the right-hand margin indicate full marks for the questions.
3. DO NOT write your Name or anything else except Roll No. and the actual answer to the question, anywhere on the OMR RESPONSE SHEET.
4. DO NOT handle your OMR RESPONSE SHEET in such a manner as to mutilate, fold, etc.
5. Entry into the examination venue shall be closed **10 minutes** before the scheduled commencement of the Examination, i.e. 8:50 AM for Forenoon session and 12:50 PM for the Afternoon session.
6. No candidate shall have in his/her possession, inside the Examination Hall, any book, notebook or loose paper, calculator, mobile phone etc., except his/her Admit Card and other things permitted by the Commission.
7. Immediately after the final bell indicating the closure of the Examination, stop bubbling. Be seated till the OMR RESPONSE SHEET is collected by the Invigilator. Thereafter you may leave the Examination Hall.
8. Violation of any of the above rules will render the candidate liable to expulsion from the examination and disqualification from the examination, and according to the nature and gravity of his/her offence, he/she may be debarred from future examinations and interviews to be conducted by the Commission and other such organizations (i.e. UPSC, SSC and SPSCs).

NB: CANDIDATES ARE ALLOWED TO TAKE THIS QUESTION BOOKLET ONLY AFTER COMPLETION OF 2 (TWO) HOURS EXAMINATION TIME

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PART—I
(Objective)

1. The energy gap between conduction and valence bands of silicon is

[A] 0·11 V

[B] 1·1 V

[C] 1·1 eV

[D] None of the above

2. The Boolean expression $A \cdot B$ can be represented by

[A] $[A' \cdot B']'$

[B] $[A' + B']'$

[C] $[A' + B']$

[D] $[A + B]'$

3. The decimal number 277·375 has the binary value

[A] 100010101·101

[B] 10010011·101

[C] 10010011·010

[D] 100010101·011

4. Consider the characteristic equation of a flip-flop given below :

$$Q(t+1) = X + Y'Q$$

where Q and $Q(t+1)$ are the present and next outputs of the flip-flop respectively. Then the inputs X and Y are

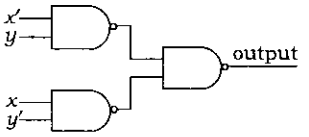
[A] R, S

[B] S, R

[C] J, K

[D] K, J

5. In the following diagram



the output wire has the value :

[A] $x \cdot y$

[B] $x + y$

[C] $x \oplus y$

[D] $x \odot y$

6. Assume that X is stored in a shift register. After the register is shifted right, the contents of the register is

[A] $X \div 2$

[B] $X \times 2$

[C] $X + 2$

[D] $X - 2$

7. If a function needs to change the actual parameter passed to it, then the parameter needs to be passed

[A] by value

[B] by reference

[C] by activation record

[D] None of the above

8. To allocate dynamic memory in Pascal or C++, the construct used is

[A] malloc

[B] calloc

[C] memory

[D] new

9. The FORTRAN arithmetic expression $A**B$ can be expressed in C language by

[A] $A*B$

[B] $A\%B$

[C] $A**B$

[D] pow(A, B)

10. Consider the following Pascal code fragment :

```
WHILE i >0 DO
BEGIN
    x = y + z;
        GOTO  1;
END
1:
```

The GOTO 1 statement above is equivalent to the C construct

[A] continue

[B] return

[C] exit

[D] break

11. Consider the following statements about Pascal case or C switch statement :

[P] It performs equality and other logical comparisons

[Q] It evaluates for character, enum and integer values only

[R] It is equivalent to if-else statement

Choose the correct option below :

[A] P only

[B] Q only

[C] R only

[D] P and R only

12. If * and & are the content-of operator and address-of-operator respectively, the array element A[i] can be found by

[A] *(&A[0]+i)

[B] (&A[0]+i)

[C] *(A[0]+i)

[D] &(a[0]+i)

13. The minimum height of a binary tree of n nodes is

[A] $n-1$

[B] $2n-1$

[C] $n \div 2$

[D] $\lfloor \log_2 n \rfloor$

14. Consider the following traversal of a binary search tree :

Inorder : 4 5 6 7 8 9 10

Preorder : 7 5 4 6 9 8 10

When element 7 is deleted, what is the post-order traversal of the modified tree?

[A] 8 5 4 6 9 10

[B] 5 4 8 6 9 10

[C] 4 8 5 6 9 10

[D] 8 5 4 9 6 10

15. Consider the following Pascal program foo that uses Push() and Pop() stack operations; assuming a StackLibrary called StackLib.

```
PROGRAM foo;
USES StackLib;
VAR Stack :          StackType;
i,   j: integer;
BEGIN
    Create(Stack);
    Read(i);
    WHILE  i >0  DO BEGIN
            Push(Stack, i MOD 2);
            i  := i DIV 2;
    END;
    WHILE  NOT  Empty(Stack)  DO
                                BEGIN
            Pop(Stack, j);
            Write (j);
    END;
    END.
```

What does foo print?

[A] $(i)^{32}$

[B] i left-shifted i % 2 times

[C] binary equivalent of i

[D] $(i)^8$

16. Consider a database system that has to manage index pages for large files. Which of the following data structures is the most suitable?

[A] AVL Tree

[B] Binary Search Tree

[C] Queue

[D] B Tree

17. The time required to insert an element at any position in a doubly-linked list containing n elements is

[A] proportional to n

[B] proportional to log$n$

[C] proportional to n^2

[D] constant

18. For an 8-bit microprocessor, consider the following statements :

[P] Only 8-bit operations can be performed on registers.

[Q] ALU can handle 8 bits only.

[R] Memory is limited to 2^8 bytes only.

Choose the correct option below :

[A] P, Q, R are true

[B] only Q is true

[C] only P and Q are true

[D] only P and R are true

19. Consider the following statements about a DMA controller device :

[P] Enables direct data transfer between memory and I/O.

[Q] Enables direct data transfer between memory and CPU.

[R] Enables direct data transfer between CPU and I/O.

Choose the correct option below :

[A] P and Q only

[B] Q and R only

[C] P only

[D] Q only

20. When an Intel x86 processor operates in real mode, the maximum physical memory it can access is about

[A] 4 GB

[B] 2 GB

[C] 1 KB

[D] 1 MB

21. Which addressing mode is used by the 8085 microprocessor instruction LDA?

[A] Absolute addressing mode

[B] Register addressing mode

[C] Immediate addressing mode

[D] Indirect addressing mode

22. The daisy chaining mechanism is used in

[A] master-slave flip-flop configuration

[B] hash table open chaining

[C] doubly linked list chain

[D] I/O device connection

23. A RAID device is used as

[A] logical disk drive

[B] extended RAM

[C] processor cache

[D] None of the above

24. In 8085, a keyboard can be connected to the microprocessor in

[A] polled mode only

[B] interrupt mode only

[C] both polled and interrupt mode

[D] interactive mode

25. On an old PC, which of the following measures is likely to improve performance?

[A] Replace hard drive with higher capacity

[B] Increase RAM capacity

[C] Replace L1 cache

[D] Replace BIOS chip

26. When a computer is booted up, it runs a diagnostic procedure called POST. What does POST stand for?

[A] Power on Self Test

[B] Processor on Self Test

[C] Processor on Start Test

[D] None of the above

27. A typical hard disk platter can spin at the maximum speed range of

[A] 1–100 rpm

[B] 101–999 rpm

[C] 1000–20000 rpm

[D] None of the above

28. A modern graphics card is usually connected to the computer using

[A] PCIe

[B] SCSI

[C] ISA

[D] SATA

29. To connect a 3-phase UPS in India, the input phase-to-phase voltage required is usually

[A] 230 V

[B] 120 V

[C] 440 V

[D] 660 V

30. The earthing wire is connected to a stabilizer to

[A] prevent voltage surge

[B] provide electrical safety

[C] provide additional current

[D] prevent power overload

31. Suppose the diagnostic command ipconfig shows that your Windows computer is connected to a network with netmask 255.255.252.0. Maximum how many number of computers can be connected to this network?

[A] 256

[B] 512

[C] 1024

[D] 64

32. What is the use of the diagnostic command 'ping 127.0.0.1' in a computer?

[A] To check Network Interface card

[B] To check default gateway

[C] To check the default router

[D] None of the above

33. What is diagnostic command to identify listening TCP/UDP ports in your computer running Windows?

[A] ipconfig

[B] scanport

[C] tracert

[D] netstat

34. In a Windows 10 computer, a user can change the paging file size. How does Windows 10 use this paging file?

[A] As virtual memory

[B] For pager service

[C] As recycle bin

[D] None of the above

35. Consider the following statements about standard RAM modules of a computer :

[P] Requires periodic refresh cycles

[Q] Bit stored as charge

[R] Made of flip-flops

Choose the correct option below :

[A] P only

[B] P and Q only

[C] P and R only

[D] P, Q and R

36. Logic block addressing is a mechanism for

[A] pointer arithmetic

[B] I/O device addressing

[C] RAM addressing

[D] disk addresing

37. The space required for merge sort algorithm running on n elements is proportional to

[A] n

[B] constant

[C] $\log n$

[D] n^2

38. If a sorted list has 512 elements, maximum how many comparisons are required using binary search to locate the element?

[A] 12

[B] 10

[C] 9

[D] 8

39. The worst case time complexity of merge sort of n elements is proportional to

[A] n^2

[B] $\log n$

[C] $n \log n$

[D] n

40. Consider the following algorithms which can be used to compute minimum spanning tree of a graph :

[P] Kruskal's algorithm

[Q] Prim's algorithm

[R] Dijkstra's algorithm

Choose the correct option below :

[A] Q only

[B] P and Q only

[C] P and R only

[D] Q and R only

41. The system software that creates an executable from a PASCAL or C program is called

[A] interpreter

[B] assembler

[C] loader

[D] compiler

42. What does the sector 0 of a computer hard drive contain?

[A] BIOS code

[B] MBR

[C] Partition table

[D] Drive C:

43. Which of the file systems is based on file journaling mechanism?

[A] FAT-16

[B] FAT-32

[C] NTFS

[D] None of the above

44. You have a computer that has 32-bit Intel CPU. The maximum amount of RAM usable is

[A] 2 GB

[B] 4 GB

[C] 8 GB

[D] 16 GB

45. Function calls are typically implemented in operating systems by using

[A] hash table

[B] doubly linked list

[C] priority queue

[D] stack

46. In a spreadsheet program like LOTUS or Microsoft Excel, the smallest unit of data is stored in a

[A] cell

[B] record

[C] tuple

[D] None of the above

47. In a database, if every non-key attribute is fuctionally dependent on the primary key, then the relation will be in

[A] first normal form

[B] second normal form

[C] third normal form

[D] None of the above

48. The cells of a worksheet B5, B6, C1 and C2 contain 10, 15, 20, 25 respectively. Let cell D1 contain the formula @AVG(B5..B6, C1..C2). What will be the value displayed in cell C1?

[A] 20

[B] 17.5

[C] 17

[D] None of the above

49. A non-linear data structure where a node's descendent can never be its ancestor is called

[A] graph

[B] skip-list

[C] chain

[D] tree

50. A data stucture which exhibits FIFO characteristic is called

[A] queue

[B] array

[C] priority queue

[D] undirected graph

PART—II

(Subjective)

1. Convert the number $(345)_{10}$ to *(a)* octal *(b)* hexadecimal. Find 2's complement of binary equivalent of $(345)_{10}$. 3+3+4=10

2. *(a)* Design a full adder circuit that can add 3 bits. 5

(b) Use Karnaugh map to simplify the function F

$$F(A,B,C) = \sum(0,3,5,6)$$ 5

3. Using FORTRAN or C, write a function factorial (n) which computes the factorial of the whole number n. Also, write a function that computes factorial (n) without using recursion. Which version of factorial (n) is likely to be more efficient and why? 4+4+2=10

4. Explain how to implement the singly-linked list data structure and its common operations. Explain why insertion operation is efficient in case of a singly-linked list compared to an array. 8+2=10

5. Write an 8085 assembly language program that adds two numbers 0×E7 and 0×45 and stores the sum 0×36 at memory location 3000 and the carry 0×1 at memory location 3001. Explain the significance of 8085 flag register. 7+3=10

6. A friend brings you her computer which has stopped working suddenly. Using suitable diagram(s), explain the various troubleshooting steps you will follow with clear reasoning of each step. 10

7. Using suitable diagram(s), explain the working principle of a hard drive. Explain the cylinder/head/sector addressing scheme for disk sectors. Assuming 512 bytes per sector, what is the maximum capacity of a hard drive that uses the cylinder/head/sector scheme? 6+2+2=10

8. *(a)* Explain any sorting algorithm of your choice with suitable example and find its worst case time complexity. 4+2=6

(b) Explain the adjacency matrix representation of a graph with a suitable example. 4

9. Using a microprocessor of your own choice, explain how interrupts are used to perform various operations. Differentiate between maskable and non-maskable interrupts with suitable examples. 6+4=10

10. Consider the STUDENT and DEPARTMENT database tables with the following information :

- STUDENT (RollNo, Name, Age, DeptNo, Course)
- DEPARTMENT (DeptNo, DeptName, DeptLocation)

Using the above tables, use either dBase or SQL commands to store the detailed information of each student in another table STUDENTINFO. State your assumptions clearly. 10