

Sikkim Public Service Commission

Main Written Examination for the Post of Sub Inspector

PAPER - II COMPUTER SCIENCE & ENGINEERING

Time allowed: 3.00 Hrs

Maximum Marks: 250

INSTRUCTION TO CANDIDATES

Read the instructions carefully before answering the questions: -

1. **IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.**
2. **Use only Black Ball Point Pen to fill the OMR Sheet.**
3. **Do not write anything else on the OMR Answer Sheet except the required information.**
4. **This Test Booklet contains 50 questions in MCQ Mode in Part I to be marked in OMR Sheet. Part II and Part III are Subjective Questions which have to be written on separate answer sheet provided to you.**
5. **Before you proceed to mark in the Answer Sheet (OMR), you have to fill in some particulars in the Answer Sheet (OMR) as per given instructions.**
6. **After you have completed filling in all your responses on the Answer Sheet (OMR) and the examination has concluded, you should hand over the Answer Sheet (OMR) and separate answer sheet to the Invigilator only. You are permitted to take with you the Test Booklet.**
7. **Marking Scheme**

THERE WILL BE NEGATIVE MARKING FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTIONS

- i. **There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to the question will be deducted as penalty.**
- ii. **If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above to the question.**
- iii. **If a question is left blank. i.e., no answer is given by the candidate; there will be no penalty for that question.**

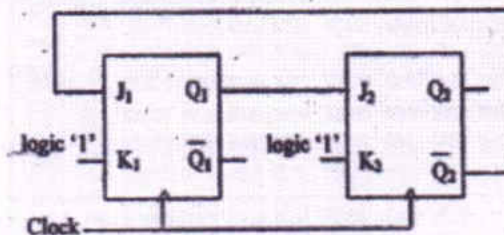
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PART - I

CHOOSE THE CORRECT ANSWER FOR THE FOLLOWING QUESTIONS:

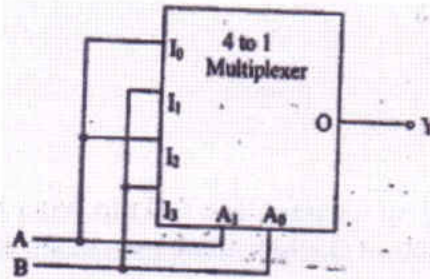
(3x50=150)

1. Which of the following instruction processing activity of the CPU can be pipelined?
 1. Instruction encoding
 2. Operand loading
 3. Operand Storing
 - A. 1 and 2 only
 - B. 2 and 3 only
 - C. 1 and 3 only
 - D. 1, 2 and 3
2. The speed mismatch between Processor and Memory in a computer is alleviated by using a small fast memory as an intermediate buffer between Memory and Processor. This buffer memory is known as
 - A. Volatile ROM
 - B. Non-Volatile ROM
 - C. Cache Memory
 - D. EPROM
3. The addressing mode that permits relocation without any changes whatsoever in the code, is
 - A. Indirect addressing
 - B. Base register addressing
 - C. Indexed addressing
 - D. PC relative addressing
4. What is an interrupt in which the external device supplies its address as well as the interrupt request known as?
 - A. Vectored interrupt
 - B. Maskable interrupt
 - C. Non Maskable interrupt
 - D. None of the above
5. The sequential circuit shown in the figure is



- A. Mod-1 Counter
- B. Mod-2 Counter
- C. Mod-3 Counter
- D. Mod-4 Counter

6. A gate having two inputs (A, B) and one output (Y) is implemented using 4-to-1 multiplexer as shown in Fig. A_1 (MSB) and A_0 are control bits and $I_0 - I_3$ are inputs to multiplexer. The gate is



- A. NAND
B. NOR
C. XOR
D. OR
7. The two numbers represented in signed 2's complement form is $P=11101101$ and $Q=11100110$. If Q is subtracted from P, the value obtained in signed 2's complement form is
A. 100000111
B. 00000111
C. 11111001
D. 111111001
8. The minimum decimal equivalent of the number $(11C)_x$ is
A. 183
B. 194
C. 268
D. 269
9. How many 1's are present in the binary representation of $(4 \times 4096) + (9 \times 256) + (7 \times 16) + 5$
A. 8
B. 9
C. 10
D. 11
10. Which one of the following statements is not correct?
A. A full adder can be constructed using two half-adders and an OR gate
B. Two four bit parallel adders can be cascaded to construct 8-bit parallel adder
C. Ripple carry adder has addition time independent of the number of bits
D. Carry lock ahead is used to speed up the parallel addition
11. Which one of the following statements is correct?
A. Static 1 hazard may occur in a 2-level AND-OR gate network.
B. Static 0 hazard may occur in a 2-level AND-OR gate network.
C. Dynamic hazards may occur in a 2-level OR-AND gate network.
D. Essential hazards may occur in a combinational logic circuit.

12. An eight-bit binary ripple UP counter with a modulus of 256 is holding the count 01111111. What will be the count after 135 pulses?

- A. 0000 0101
- B. 1111 1001
- C. 0000 0110
- D. 0000 0111

13. The output Q and \bar{Q} of master slave S-R flip-flops are connected to its R and S inputs respectively. The output Q when clock pulses are applied will be

- A. Permanently 0
- B. Permanently 1
- C. Fixed 0 or 1
- D. Complementing with every clock pulse

14. Which of these best describes an array?

- A. A data structure that shows a hierarchical behavior
- B. Container of objects of similar types
- C. Arrays are immutable once initialized
- D. Array is not a data structure

15. Which of the following concepts make extensive use of arrays?

- A. Binary trees
- B. Scheduling of processes
- C. Caching
- D. Spatial locality

16. Which of the following sorting algorithm is of divide and conquer type?

- A. Bubble sort
- B. Insertion sort
- C. Merge sort
- D. Selection sort

17. Which of the following is not the required condition for binary search algorithm?

- A. The list must be sorted
- B. There should be the direct access to the middle element in any sub list
- C. There must be mechanism to delete and/or insert elements in list.
- D. Number values should only be present

18. What is the overall term for creating, editing, formatting, storing, retrieving a text document?

- A. Word processing
- B. Spreadsheet design
- C. Web design
- D. Database management

19. Which of the following statements are not correct?
- A. The data is the collection of information.
 - B. Data isolation is one of the main advantages of DBMS
 - C. Concurrent access and Crash recovery are one of the advantages of DBMS.
 - D. Both B and C.
20. The database administrator's function in an organization is?
- A. to be responsible for the technical aspects of managing the information contained in organizational databases.
 - B. to be responsible for the executive level aspects of decision regarding the information management.
 - C. to show the relationship among entity classes in a data warehouse.
 - D. to define which data mining tools must be used to extract data.
21. The number of layers in ISO OSI reference model
- A. 5
 - B. 7
 - C. 6
 - D. None of the mentioned
22. In OSI model, when data is sent from device A to device B, the 5th layer to receive data at B is
- A. Application layer
 - B. Transport layer
 - C. Link layer
 - D. Session layer
23. Identify the statement which cannot be associated with OSI model
- A. A structured way to discuss and easier update system components
 - B. One layer may duplicate lower layer functionality
 - C. Functionality at one layer no way requires information from another layer
 - D. None of the mentioned
24. Which of the following input sequences for a cross-coupled R-S flip-flop realized with two NAND gates may lead to an oscillation?
- A. 11, 00
 - B. 01, 10
 - C. 10, 01
 - D. 00, 11
25. Consider the following logical inferences.
- I1: If it rains then the cricket match will not be played.
The cricket match was played.
Inference: There was no rain.
- I2: If it rains then the cricket match will not be played.
It did not rain.
Inference: The cricket match was played.
- Which of the following is TRUE?
- A. Both I1 and I2 are correct inferences
 - B. I1 is correct but I2 is not a correct inference
 - C. I1 is not correct but I2 is a correct inference
 - D. Both I1 and I2 are not correct inferences

26. The truth table

X	Y	f(X, Y)
0	0	0
0	1	0
1	0	1
1	1	1

represents the Boolean function

- A. X
- B. $X+Y$
- C. $X \text{ xor } Y$
- D. Y

27. Which one of the following is the tightest upper bound that represents the time complexity of inserting an object into a binary search tree of n nodes?

- A. $O(1)$
- B. $O(\log_n)$
- C. $O(n)$
- D. $O(n \log_n)$

28. Match the problem domains in GROUP I with the solution technologies in GROUP II

GROUP I

- (P) Service oriented computing
- (Q) Heterogeneous communicating systems
- (R) Information representation
- (S) Process description

GROUP II

- (1) Interoperability
- (2) BPMN
- (3) Publish-find-bind
- (4) XML

- A. P-1, Q-2, R-3, S-4
- B. P-3, Q-4, R-2, S-1
- C. P-3, Q-1, R-4, S-2
- D. P-4, Q-3, R-2, S-1

29. Routers forward a packet using forwarding table entries. The network address of incoming packet may match multiple entries. How routers resolve this?

- A. Forward it the router whose entry matches with the longest prefix of incoming packet
- B. Forward the packet to all routers whose network addresses match.
- D. Discard the packet.
- C. Forward it the router whose entry matches with the longest suffix of incoming packet

30. Which of the following is NOT true about User Datagram Protocol in transport layer?

- A. Works well in unidirectional communication, suitable for broadcast information.
- B. It does three-way handshake before sending datagrams
- C. It provides datagrams, suitable for modeling other protocols such as in IP tunneling or Remote Procedure Call and the Network File System
- D. The lack of retransmission delays makes it suitable for real-time applications

31. In a compiler, keywords of a language are recognized during
- parsing of the program
 - the code generation
 - the lexical analysis of the program
 - dataflow analysis
32. A layer-4 firewall (a device that can look at all protocol headers up to the transport layer) can not
- block entire HTTP traffic during 9:00PM and 5:00AM
 - block all ICMP traffic
 - stop incoming traffic from a specific IP address but allow outgoing traffic to the same IP address
 - block TCP traffic from a specific user on a multi-user system during 9:00PM and 5:00AM
33. Which one of the following is NOT desired in a good Software Requirement Specifications (SRS) document?
- Functional Requirements
 - Non-Functional Requirements
 - Goals of Implementation
 - Algorithms for Software Implementation
34. A main memory unit with a capacity of 4 megabytes is built using $1M \times 1$ -bit DRAM chips. Each DRAM chip has 1K rows of cells with 1K cells in each row. The time taken for a single refresh operation is 100 nanoseconds. The time required to perform one refresh operation on all the cells in the memory unit is
- 100 nanoseconds
 - 100×2^{10} nanoseconds
 - 100×2^{20} nanoseconds
 - 3200×2^{20} nanoseconds
35. A CPU generally handles an interrupt by executing an interrupt service routine
- As soon as an interrupt is raised
 - By checking the interrupt register at the end of fetch cycle.
 - By checking the interrupt register after finishing the execution of the current instruction.
 - By checking the interrupt register at fixed time intervals.
36. What is the minimum number of gates required to implement the Boolean function $(AB+C)$ if we have to use only 2-input NOR gates?
- 2
 - 3
 - 4
 - 5
37. Which of the following statements are not correct?
- The data is the collection of information.
 - Data isolation is one of the main advantages of DBMS
 - Concurrent access and Crash recovery are one of the advantages of DBMS.
 - Both b) and c).

38. Consider a 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. The number of bits in the TAG, LINE and WORD fields are respectively:

- A. 9, 6, 5
- B. 7, 7, 6
- C. 7, 5, 8
- D. 9, 5, 6

39. Which of the following are used to generate a message digest by the network security protocols?

- (P) RSA
- (Q) SHA-1
- (R) DES
- (S) MD5

- A. P and R only
- B. Q and R only
- C. Q and S only
- D. R and S only

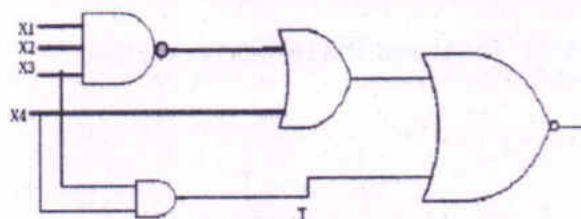
40. A sender is employing public key cryptography to send a secret message to a receiver. Which one of the following statements is TRUE?

- A. Sender encrypts using receiver's public key
- B. Sender encrypts using his own public key
- C. Receiver decrypts using sender's public key
- D. Receiver decrypts using his own public key

41. The minimum positive integer p such that $3^p \text{ modulo } 17 = 1$ is

- A. 5
- B. 8
- C. 12
- D. 16

42. The line T in the following figure is permanently connected to the ground.



Which of the following inputs (X1 X2 X3 X4) will detect the fault?

- A. 0000
- B. 0111
- C. 1111
- D. None of these

43. $(C012.25)_H - (10111001110.101)_B = ?$

- A. $(135103.412)_O$
- B. $(564411.412)_O$
- C. $(564411.205)_O$
- D. $(135103.205)_O$

44. Consider a weighted undirected graph with positive edge weights and let uv be an edge in the graph. It is known that the shortest path from the source vertex s to u has weight 53 and the shortest path from s to v has weight 65. Which one of the following statements is always true?

- A. $\text{weight}(u, v) < 12$
- B. $\text{weight}(u, v) \leq 12$
- C. $\text{weight}(u, v) > 12$
- D. $\text{weight}(u, v) \geq 12$

45. In the Spiral model of software development, the primary determinant in selecting activities in each iteration is

- A. Iteration size
- B. Cost
- C. Adopted process such as Rational Unified Process or Extreme Programming
- D. Risk

46. A processor takes 12 cycles to complete an instruction I . The corresponding pipelined processor uses 6 stages with the execution times of 3, 2, 5, 4, 6 and 2 cycles respectively. What is the asymptotic speedup assuming that a very large number of instructions are to be executed?

- A. 1.83
- B. 2
- C. 3
- D. 6

47. The following circuit implements a two-input AND gate using two 2-1 multiplexers. What are the values of X_1, X_2, X_3 ?

- A. $X_1=b, X_2=0, X_3=a$
- B. $X_1=b, X_2=1, X_3=b$
- C. $X_1=a, X_2=b, X_3=1$
- D. $X_1=a, X_2=0, X_3=b$

48. An ISP has a link of 100Mbps which is shared by its subscribers. Considering the fact that all of its subscribers are active 50% of the time and the probabilities of being active are independent, the ISP has promised 25 Mbps to its 6 subscribers. What is the probability that any subscriber gets degraded service (less than promised speed).

- A. $1/32$
- B. $5/16$
- C. $1/2$
- D. $7/64$

49. Which of the following changes to typical Quicksort improves its performance on average and are generally done in practice.

- 1) Randomly picking up to make worst case less likely to occur.
- 2) Calling insertion sort for small sized arrays to reduce recursive calls.
- 3) Quicksort is tail recursive, so tail call optimizations can be done.
- 4) A linear time median searching algorithm is used to pick the median, so that the worst case time reduces to $O(n \log n)$

- A. 1 and 2
- B. 2, 3, and 4
- C. 1, 2 and 3
- D. 2, 3 and 4

50. An examination paper has 150 multiple-choice questions of one mark each, with each question having four choices. Each incorrect answer fetches -0.25 mark. Suppose 1000 students choose all their answers randomly with uniform probability. The sum total of the expected marks obtained by all these students is:

- (a) 0
- (b) 2550
- (c) 7525
- (d) 9375

PART – II

Answer ANY TWO of the following:

(25x2=50)

1. Distinguish between Error and Failure? Which of the two is detected by testing, justify? Also tell the reason why it is practically impossible to exhaustively test a software product?
2. What do you mean by Risk Management? Explain the steps in Risk Management? Explain how to select the best risk reduction techniques when there are many?
3. A TCP session sends 10 packets per second over an Ethernet Local Area Network (LAN). Each packet has a total size of 1480 B (excluding the preamble and cyclic redundancy check (CRC)). Calculate the size of the headers, and hence the TCP payload data. What therefore is the TCP throughput of the session?
4. (a) Differentiate between Raster scan and Random Scan as used in computer graphics.
(b) What is meant by anti-aliasing?
5. A sequential circuit with two D flip-flops A and B, two input section by, and one output Z is specified by the following next state and output equation

$$A(t+1)=x'y+xA$$

$$B(t+1)=x'B+xA$$

$$Z=D$$

- A. Draw the logic diagram of the circuit
- B. Derive the state table
- C. Derive the state diagram

PART – III

Attempt ANY FIVE of the following questions:

(10x5=50)

1. Define Software Architecture? Compare Function Oriented Design and Object-Oriented Design.
 2. Contrast and compare Iterative enhancement Model and Spiral Model of software development.
 3. List four types of curve generations. Describe B-Spline method for curve generation.
 4. What are the different types of memory? Explain Difference between RAM and ROM.
 5. Describe the significance of addressing modes in a microprocessor. Explain various addressing modes of 8085 with suitable example.
 6. Compare the two functions n^2 and $2^n/4$ for various values of n . Determine when does the second become larger than the first.
 7. Explain the two types of links between a Bluetooth primary and a Bluetooth secondary?
 8. A hash algorithm creates a digest of N bits. How many different digests can be created from this algorithm?
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