



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION - 2016
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT
COMPUTER SCIENCE, PAPER-I

Roll Number

TIME ALLOWED: THREE HOURS	PART-I (MCQS)	MAXIMUM MARKS = 20
PART-I(MCQS): MAXIMUM 30 MINUTES	PART-II	MAXIMUM MARKS = 80
NOTE: (i) Part-II is to be attempted on the separate Answer Book.		
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PART-II
SECTION-I

- Q. 2. (a)** Write a program to input choice from user for temperature conversion from Fahrenheit to Celsius or Celsius to Fahrenheit. After the choice, input temperature from user and display the converted answer. Sample execution of the program is given below; (6)
1. Fahrenheit to Celsius
2. Celsius to Fahrenheit
Enter your choice: 1
Enter Temperature in Fahrenheit: 98
Same Temperature in Celsius: 36.7
Press Any Key to Continue....
- (b)** Which type of computer (supercomputers, mainframe computers, minicomputers, microcomputers) will suit an individual? Justify your answer. (6)
- (c)** Suppose you are trying to build a Student Registration System using object oriented approach. Objective of the system is to store information of course registration of students and their course results. In C++ syntax define following classes with suitable attributes each having getdata() and showdata() member functions along with suitable constructor functions; (8)
- Person, Teacher, Student, Course, Section, Allocation (containing information about allocation of a course to a teacher in a semester), Registration (containing information about registration of a student in course, this class will also save course result information of the student). You can add more classes which you think suitable for the system.
- Q. 3. (a)** Define a function named monthly-profit which will calculate the monthly profit on the given investment amount. Function will take two float arguments, percent profit rate and investment amount and return the monthly profit (float). Write function prototype, function definition and a main program to demonstrate the functionality. Sample execution of the program is given below. Note that monthly profit 4000 has been calculated by the function by doing $(8/100) * 50000$. User can enter any values therefore write generalized function (user variables, not given values). (6)
- Enter percent profit rate: 8
Enter investment amount: 50000
Monthly profit: 4000
Press Any Key to Continue....
- (b)** Explain and differentiate between volatile and non-volatile memory, giving examples. (6)
- (c)** Suppose you are trying to build a Library Information System using object oriented approach. System should be able to keep track of books issued and returned. It should be able to calculate fine if a book is late. Currently you are required to design classes i.e. not to write C++ code but describe which class you will define, which data members you will add, which member functions you will include in those classes. Define only suitable classes and suitable attributes (data members) in C++ syntax. Names of some classes are like, Student, Teacher, Book, Issue Book etc. You can (but not required to) extend this list of four classes if you think of some other suitable classes. (8)

COMPUTER SCIENCE, PAPER-I

- Q. 4. (a)** Define a structure to store records of Persons. We want to store only Name, age and address of Person. Write main program to input record of one person and display 'Young' if its age is less than 20 or 'Old' if the age is greater than 50 and 'Middle' if the age of person is between 21 and 49. Sample execution of the main program is given below: (6)
- Enter Name = Kashif
Enter Age = 19
Enter Address = H 120, St: 08, KAR.
Person is YOUNG
Press Any Key to Continue
- (b)** Convert given binary numbers to Decimal, Octal and Hexadecimal. (6)
- (i) $100_{(2)}$ (ii) $10100_{(2)}$ (iii) $100101_{(2)}$
- (c)** Suppose you are designing software for a Medical Store, using object oriented techniques. Decide and define classes (like 'Person', 'Customer', 'Salesman', 'Purchase' etc.) and their attributes in C++ or Java syntax. You are not required to write any member functions and main programme. You must use inheritance where suitable. (8)

SECTION-II

- Q. 5. (a)** Describe the followings (no description with more than three lines); (8)
- i. Sibling Nodes ii. Degree of a tree iii. Leaf Node
iv. Height/ Depth of a tree v. Binary Tree vi. Full Binary Tree
vii. Complete Binary Tree viii. Maximum number of nodes in a Binary Tree at level L. (6)
- (b)** Find the time complexity of Binary search by resolving the recurrence (given below) using iterative substitution method. (6)
- $T(1) = 2$ if $n \leq 1$
 $T(n) = 4 + T(n/2)$ if $n > 1$
- (c)** Draw the given array in the form of binary tree. Then apply 'Build-Heap' Algorithm to convert the given tree in the form of Max-Heap (i.e. draw final Max-heap in the form of tree and array). Finally show execution of 'Heap-sort' algorithm by rewriting the Heap array after each iteration of the algorithm. (6)
- $A = \{8, 14, 2, 26, 10, 12, 16, 28, 20, 7\}$
- Q. 6. (a)** Write Abstract Data Types (ADT) of Stack and Queue. Include the specifications of Add, Delete, IsEmpty, IsFull functions along with their respective functions. (8)
- (b)** For step count expressions $n^2 + 10$ and $2^n / 4$ find breakeven point i.e. for which value of n (starting from 1,2,...) second expression will become greater than value of first expression. (6)
- (c)** In AVL tree balance factor of every node is -1 or 0 or +1. We can calculate the balance factor as $\text{Height}_{\text{left-sub-tree}} - \text{Height}_{\text{right-sub-tree}}$. Construct AVL tree from the given data; (6)
- $A = \{8, 14, 2, 26, 10, 12, 16, 28, 20, 7\}$
- Q. 7. (a)** Draw a diagram that illustrates the process of translating a C++ source file into an executable file. Give example of each phase depicted in your diagram of compilation process. (5)
- (b)** Compare and contrast among compiler, interpreter and assembler. (5)
- (c)** Describe Software Development Life Cycle (SDLC). Explain your answer with the help of depicting and describing different phases of pure water fall software life cycle. (5)
- (d)** What is the difference between SRS document and design document? What are the contents we should contain in the SRS document and design document. (5)
- Q. 8. (a)** What are the purposes of Data Flow diagrams, Entity-Relationship diagrams? Give an example diagram of each. (5)
- (b)** Explain five properties of language using the example of English. Explain why a software language like MiniJava meets these properties as well. (5)
- (c)** Lexical analysis: Consider the following regular expression (5)
- $$r_1 = (A \mid \dots \mid Z)^* (0 \mid \dots \mid 9)^*$$

Describe the language defined by r_1 in English. Turn r_1 into an equivalent finite automaton. Remove ϵ -moves from the finite automaton.
- (d)** What do you mean by Context Free Grammar (CFG)? Illustrate your answer with examples. (5)



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PART-II
SECTION-A

- Q. 2. (a)** Suppose you add two new devices to an existing five-device network. If you have a fully connected mesh topology, how many new cable lines are needed? If, however, the devices are arranged in a ring, how many new cable lines are needed? **(6)**
- (b)** Transmission media are not perfect because of imperfections and impairments in the signal sent through the medium. Signals at the beginning and at the end of the medium are not the same. Discuss in detail the impairments in the transmission medium. **(7)**
- (c)** Whenever multiple devices are used in a network, the problem arises that how to connect them to make one-on-one communication possible. Switching is the best solution for this kind of problem. A switched network consists of a series of inter-linked nodes called switches. Explain briefly the methods of switching used by computer networks. **(7)**
- Q. 3. (a)** RAID is a physical disk drives viewed by the operating system as a single logical drive, where data are distributed across the physical drives of an array. Explain different levels of RAID? Elaborate your answer with suitable diagrams. **(8)**
- (b)** The basic function performed by a computer is execution of a program, which consists of set of instructions stored in memory. The processor required for a single instruction is called an instruction cycle. Elaborate basic instruction cycle used by modern computer systems. Also add diagrams for explanation. **(6)**
- (c)** Differentiate between Reduced Instruction Set Computers (RISC) and Complex Instruction Set Computers (CISC) architectures. **(6)**
- Q. 4. (a)** Deadlock prevention algorithms prevents deadlock by restraining how requests can be made, the restrain ensure that at least one of the necessary conditions for deadlock cannot occur and hence, that deadlock cannot hold. Explain the Banker's Algorithm for deadlock avoidance. **(8)**
- (b)** Central Processing Unit (CPU) scheduling deal with the problem of deciding which of the processes in the ready queue is to be allocated to the CPU. What are the pros and cons of *Multilevel Queue Scheduling* and *Multilevel Feedback Queue Scheduling*? **(6)**
- (c)** What do you know about Process Control Block? Discuss its components in detail. **(6)**

SECTION-B

- Q. 5. (a)** A complete SELECT statement embedded within another SELECT statement. The results of this inner SELECT statement (or subselect) are used in the outer statement to help determine the contents of the final result. Differentiate among following nested sub-queries operators "IN", "ANY" and "ALL". **(8)**
- (b)** Explain how Pattern match search condition (LIKE/NOT LIKE) can be used in SELECT statement part of SQL in database management system. **(6)**
- (c)** Differentiate between Data Manipulation Language (DML) and Data Definition Language (DDL) of structured query language (SQL) in database management system (DBMS). **(6)**

COMPUTER SCIENCE, PAPER-II

- Q. 6.** (a) A transaction is a unit of program execution that accesses and possibly updates various data items. Usually, a transaction is initiated by a user program written in a data manipulation language. Explain the ACID property of transaction processing. (8)
- (b) Distinguish among functional dependency, Fully functional dependency and Transitive dependency. (6)
- (c) A trigger is a statement that the system executes automatically as a side effect of a modification to the database. What are the different forms of triggers and how they are defined? (6)
- Q. 7.** (a) Write down a short note on Array versus Matrix Operations (6)
- (b) Differentiate between CMY and CMYK Colour Models used in digital image processing. (6)
- (c) Explain the Boundary Extraction Algorithm used for basic morphology. (8)
- Q. 8.** (a) Explain the principals of requirement engineering of web applications. (8)
- (b) Elaborate the term E-Commerce. Discuss in detail about the effects of E-Commerce in Islamic Banking in Pakistan. (6)
- (c) What are the components of Generic web application architecture? (6)



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PART-II
SECTION-I

- Q. 2. (a)** The internet era has given rise to the problem of cybercrimes. Given the need to maintain privacy which is an ethical responsibility of the government, what technical means would you suggest to curb this problem? **(8)**
- (b)** Describe the difference between Harvard and Von-Neumann architectures of computers. Also discuss their traits in the light of their capabilities. **(6)**
- (c)** Virtual memory is used by the computer to support the running of heavy applications. Describe the functioning of virtual memory in the computer. Also comment on the management of virtual and physical memory by an operating system. **(6)**
- Q. 3. (a)** Three types of languages exist for use in programming of computers, Machine, Low Level and High Level languages. Elucidate on these three types, giving details of the conversion process between Low Level and High Level language into Machine language. **(8)**
- (b)** Write a function that calculates the quadratic equation in $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. You may use the math library for this purpose. The program should ask the user to enter values of a, b and c and should print the result. A sample execution of the program is shown below: **(6)**
Enter value of a: 1
Enter value of b: 2
Enter value of c: 1
The values of x are -1, -1
- (c)** Consider that you are required to create a program for a supermarket checkout machine. The machine has a database of the items available in the supermarket which consists of the items name, code and price. Make a program that requires the cashier (user) to enter the code or name of the product and the quantity that has been bought. It should allow for multiple entries to be made. Once all the entries have been made. The program prints the total amount to be charged on the screen. A sample execution is shown below: **(6)**
Enter product name or code: 1
Enter quantity: 1
Do you have more products to add (Y/N): N
The total amount is 500
You may construct the database as a structure.
- Q.4. (a)** What factors should be considered when choosing particularly between evolutionary and incremental models? Elucidate the characteristics of Rapid Application Development, Joint Application Development and Agile Software Engineering. **(8)**
- (b)** Differentiate between Software Validation and Verification. Discuss some of the techniques used for empirical software evaluation. **(6)**
- (c)** Discuss the importance of Requirements Engineering in the success of a software project. Explain in detail the process of 'Requirements Sign-off'. **(6)**

- Q. 5.** (a) Draw and build a Red-black tree for the following keys (50, 60, 70, 80, 90) and (50, 40, 30, 20, 10). (8)
Would a binary tree be suitable for the insertion of these keys?
- (b) Hash tables enable for fast insertion and searching within the database. Describe the process of hashing with a suitable example. (6)
- (c) Describe the process of Bubble Sorting. Write down the output after each pass of the Bubble Sort algorithm for sorting the sequence (3, 8, 2, 6, 1, 10). (6)

SECTION-II

- Q. 6.** (a) The design methodologies of programs can have multiple approaches including the Big Bang, Code and Fix, Water Fall and the Spiral Model. Consider a test application and describe the development of the application while following each of these four approaches. (8)
- (b) Discuss the design issues of Task Partitioning and Task Allocation in Distributed Software Engineering tasks. (6)
- (c) Explain the importance of Design Patterns under the umbrella of Agile software design and programming. Explain Software Testing and different methodologies. (6)
- Q. 7.** (a) The handling of syntax errors involves the use of parser and the lexical analyzer. Comment on its functioning. (8)
- (b) Using a suitable example, compare the operation of a top-down and a bottom-up Parser based compiler. (6)
- (c) Explain the two different methods of code optimization that is Loop optimization and Peephole optimization by giving a suitable example. (6)
- Q. 8.** Write short notes on any FOUR of the following: (5 each) (20)
- (a) Global, Local and shared variables for nested function access
 - (b) Protecting IP rights in the digital domain
 - (c) Parallel processing and the use of pipelining for this purpose
 - (d) Resource allocation during runtime processes
 - (e) Intermediate Code Generation
 - (f) Searching Algorithms



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PART-II
SECTION-A

- Q. 2. (a) Discuss the following methods of storage systems: (8)**
(i) Direct Access (ii) Random Access
- (b) If clock speed reaches its maximum then what are the two methods to increase the performance of a computer? Briefly explain. (6)**
- (c) Draw and explain instruction execution state diagram with interrupt. (6)**
- Q. 3. (a) Explain the following network protocols: (8)**
(i) HTTP and SIP (ii) TCP and UDP
- (b) What is the transmission time of a packet sent by a station if the length of the packet is 1 million bytes and the bandwidth of the channel is 200 Kbps? (6)**
- (c) Given the IP address 10.5.118.3 and the network mask 255.255.240.0, what are the assignable IP addresses and broadcast in this subnet? (6)**
- Q. 4. (a) What are differences between Optimal & LRU (Least Recently Used) page Replacement Policies? (8)**
- (b) Discuss the four necessary conditions for deadlock to occur. How can we deny any two of these conditions? (6)**
- (c) Consider three processes given in the table. Find average waiting time and average turnaround (completion) time when these processes are scheduled using Round-Robin scheduling using time quantum (TQ) = 4. (6)**

Process	CPU Burst
P1	24
P2	7
P3	10

- Q. 5. (a) Explain the functionality and purposes of following registers with diagrams: (8)**
(i) Memory Address Register (MAR)
(ii) Memory Buffer Register (MBR)
(iii) Instruction Register (IR)
- (b) Discuss the functionality of Ethernet LAN and its types. (6)**
- (c) What happens in the following cases? (6)**
(i) If the job size is kept very low in time sharing systems.
(ii) If the page size is kept very small in paged memory management.

SECTION-B

- Q. 6.** (a) What is Normalization? Discuss 1NF, 2NF and 3NF with example(s). (8)
- (b) Write short notes on the following: (6)
- (i) Data (ii) Database (iii) Database Management System
- (c) Differentiate between Centralized Database and Distributed Database. (6)
- Q. 7.** (a) Define image histogram. What is meant by histogram equalization? Explain their applications in image processing. (8)
- (b) Find the storage in bytes required to store a 256 x 200 colored image using RGB color model with 24 bit color depth. (6)
- (c) Briefly explain Geometric Transformations. (6)
- Q. 8.** (a) Explain the following web concepts: (8)
- (i) localStorage and sessionStorage objects
- (ii) Application cache in HTML5
- (iii) Manifest file
- (iv) Web Worker
- (b) What is SVG? What are the advantages of SVG over JPEG or GIF? (6)
- (c) Explain Non Breaking space in HTML with example. (6)



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PART-II

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PART-II
SECTION-I

- Q. 2. (a) How many layers are in the TCP/IP stack? What are the names? (4)**
- (b) How digital evidences can be preserved from a crime scene. Write in details by taking examples of digital devices commonly used these days. (4)**
- (c) What are the responsibilities of Operating system kernel? (3)**
- (d) List down any four best practices for coding standards. (3)**
- (e) Why do modern processors use more power when their clock frequency is increased? (2)**
- (f) Ali is telling Ahmad that he is representing a -ve number and its most significant bit is 1, Ahmad immediately shouted you are representing numbers using 2's compliment. True or False. And why? (2)**
- (g) If time slice is of 50 milliseconds and context switch requires a microsecond, how many processes can the machine service in a second? (2)**
- Q. 3. (a) Write a program grade average calculator, User will input marks for five subjects and program will output the average of its marks. Print appropriate message on the base of its mark's average e.g.; Well done, Keep it up, Better luck next time etc. (5)**
- (b) Given that i,j,k,n & m are integer variables. Write a condition such that: (2)**
- i- hello is only printed when, any of the following conditions are met: i is twice the value of j, j is smaller than k and less than n, or m is negative.
- ```
inti, j, k, n, m; cin>>i>>j>>k>>n>>m;
if()
cout<<"hello";
```
- ii. hello is only printed when i does not lies in the interval 6-9
- ```
inti; cin>>i;
if( )
cout<<"hello";
```
- (c) Write equivalent instruction to following instruction without the use of += operator: (1)**
- where w,z are integers.
- ```
w+=2*z+4;
```
- (d) Predict the values of variables a & b after every instruction (2)**

```
integer a=5 b=6
a=(b++) + 3;
b=- -a;
```

**(e) Complete the code such that it prompts the user for +ve number n. Then displays the output.(whatever the value of n is)(HINT: instead of triangles of stars its triangles of increasing numbers)[marks (5)**

```
1 2 3 4 . . . n
1 2 3 4 . . n-1
. . .
. . .
1 2
1
```

```
for n=4 it will print
1 2 3 4
1 2 3
1 2
1
void main()
{
int n; cin>>n;
// your loops will go here

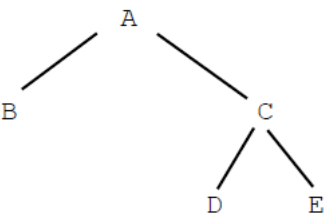
}
```

(f) In following code replace the character at pos<sup>th</sup> location in the string st with the ,character ch. For example in string helloworld replacing 2nd character with i would result in helloworld (5)

```
void main()
{char st[15]; int pos; char ch;
int size=0;
cin>>st;
cin>>pos>>ch;
while(st[size]!='\0')
{
size++; // calculating length of current string
}
// write your code here

}
```

Q. 4. Consider the inheritance hierarchy shown below. Each part of this question is independent.

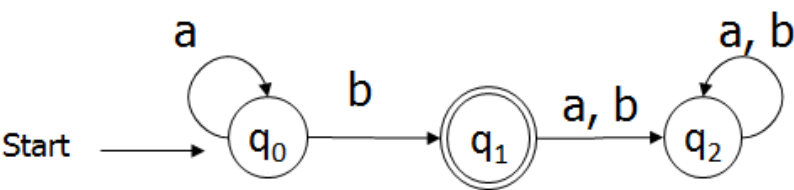


- (a) In which class(es) would it make most sense to have protected members? Which class(es) would be able to access those protected members directly? (5)
- (b) Which class(es) can access private members of class C directly? (5)
- (c) Suppose class C contains a pure virtual function. Suppose we wish to instantiate objects of this hierarchy. Which class(es) are or could be abstract and which are concrete? (5)
- (d) Consider the following list of classes: Car, SteeringWheel, Vehicle, Van, Minivan, AudioSystem, ParkingLot. Your task is to describe all of the is-a and has-a relationships between these classes. Include an inheritance hierarchy for all classes that fit. Fill in the table with is-a or has-a relationship while leaving the cells empty where no relation is applicable. (5)

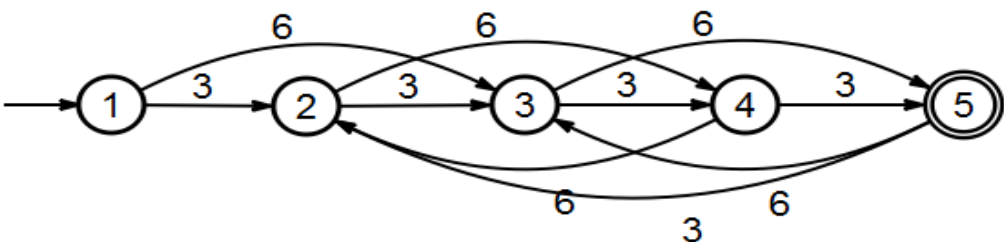
|                | Vehicle | Car | Van | Mini Van | Steering Wheel | Audio System | Parking Lot |
|----------------|---------|-----|-----|----------|----------------|--------------|-------------|
| Vehicle        |         |     |     |          |                |              |             |
| Car            | is-a    |     |     |          |                |              |             |
| Van            |         |     |     |          |                |              |             |
| Mini Van       |         |     |     |          |                |              |             |
| Steering Wheel |         |     |     |          |                |              |             |
| Audio System   |         |     |     |          |                |              |             |
| Parking Lot    |         |     |     |          |                |              |             |

SECTION-II

- Q. 5. (a) What is dangling pointer? (3)
- (b) What data structure would employ to build a text editor and why? (5)
- (c) Random insertion of nodes into a binary search tree would result in what types of tree shape. Elaborate. (7)
- (d) How would you modify a link list based queue so that first and last node can be accessed in a constant time regardless of data nodes in the queue? (5)
- Q. 6. (a) Define balanced tree both for AVL and Binary search tree. (4)
- (b) What is informed or heuristic search what type of algorithm is used to do such a search? (6)
- (c) Differentiate between graph and trees. Which is special case of the other? (5)
- (d) Explain what type of problems can be solved by genetic algorithm. (5)
- Q. 7. (a) Outline the difference between software verification and software validation. (4)
- (b) Give an outline of the unit testing process for verification. (4)
- (c) Agile Development is a process that values responding to change over following a plan. Discuss three issues a Software Engineer should be mindful of when adopting this approach during software development. (4)
- (d) What type of project is not suited to incremental methods? (4)
- (e) Outline the difference between Black box and White box testing. (4)
- Q. 8. (a) What is the difference between lexers and parsers? (5)
- (b) Write a grammar (BNF) for the language of palindromes. (5)
- (c) Here DFA is given for the language L find the DFA for  $L^2$  (5)



- (d) Convert the following DFA to a RE: (5)



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**COMPUTER SCIENCE, PAPER-II**

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| <b>TIME ALLOWED: THREE HOURS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PART-I (MCQS)</b> | <b>MAXIMUM MARKS = 20</b> |
| <b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>PART-II</b>       | <b>MAXIMUM MARKS = 80</b> |
| <b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b><br><b>(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.</b><br><b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b><br><b>(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b><br><b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b><br><b>(vi) Extra attempt of any question or any part of the attempted question will not be considered.</b> |                      |                           |

**PART – II**  
**SECTION – A**

- Q. No.2.** (A) Briefly describe the functionality of the following CPU special-purpose registers: Instruction Register (IR), Memory Data Register (MDR) and Program Counter (PC). (8)
- (B) Differentiate between Address, Data and Control bus. (6)
- (C) Discuss instruction pipelining in the context of fetch-decode-execute cycle. (6)
- Q. No.3.** (A) Differentiate between hub, bridge, switch and router. (8)
- (B) Discuss how Network Address Translation (NAT) works and why is it useful? (6)
- (C) Elaborate the working of multiplexing/de-multiplexing at the transport layer. (6)
- Q. No.4.** (A) There are three processes  $P_A$ ,  $P_B$  and  $P_C$  and three resources  $R_A$ ,  $R_B$  and  $R_C$ . Resources  $R_A$  and  $R_B$  have one instance each while resource  $R_C$  has two instances.  $P_A$  is holding one instance of  $R_C$  and has requested for  $R_A$ . Process  $P_B$  is holding  $R_A$  and has requested for  $R_B$ .  $R_B$  is allocated to  $P_C$  which has also requested an instance of  $R_C$ . Represent the scenario with a resource allocation graph. Discuss whether there is a deadlock or not? If yes, which processes are blocked? (8)
- (B) In the context of Paging, consider the case where memory addresses are 32 bits i.e. 20 bits Virtual Page Numbers and 12 bits of offset. How many virtual pages are there and what is the size of each page? Given the virtual address 0x7589, find the virtual page number and offset. If the respective page table entry contains 0x900DF, find the physical address. (6)
- (C) In the context of I/O management, differentiate between Pooling and Interrupts. (6)

**Section – B**

- Q. No.5.** (A) Given two relations  $R$  and  $S$ , where  $R$  contains  $M$  tuples,  $S$  contains  $N$  tuples, and  $M > N > 0$ , give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by each of the following relational algebra expressions. (8)
- i.  $R - S$
- ii.  $R \cup S$
- iii.  $R \cap S$
- iv.  $R \bowtie S$
- (B) Elaborate the concepts of super key, candidate key and foreign key with examples. (6)
- (C) Discuss the difference between physical data independence and logical data independence. (6)

**COMPUTER SCIENCE, PAPER-II**

- Q. No.6.

(A)

Differentiate between image sampling and quantization. Discuss how these concepts relate to spatial and intensity resolutions.

(8)

(B)

In the context of image smoothing, discuss the differences between mean and median filters.

(6)

(C)

For the image ‘X’ shown in Figure 1, show the result of applying the given morphological operators. Assume zero padding for border pixels.

i.

Dilation of X by structuring element [1 1 1].

(6)

ii.

Erosion of X by structuring element [1 1 1]<sup>T</sup>

iii.

Dilation of X by a 3x3 structuring element containing all ones.
- |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
- Q. No.7.

(A)

Perform histogram equalization on the 8-bit image shown in Figure 2.

(8)
- |     |     |     |     |     |
|-----|-----|-----|-----|-----|
| 5   | 5   | 5   | 5   | 5   |
| 10  | 10  | 10  | 10  | 10  |
| 30  | 30  | 30  | 30  | 30  |
| 100 | 100 | 100 | 100 | 100 |
| 100 | 100 | 100 | 100 | 100 |
- (B)

For the 3x3 image shown in the following, apply the horizontal and vertical Sobel operators and compute the magnitude of gradient at the central pixel with intensity value 50.

|   |    |   |
|---|----|---|
| 5 | 5  | 5 |
| 5 | 50 | 5 |
| 5 | 5  | 5 |

(6)

(C)

In the context of compression, differentiate between coding, spatial and temporal redundancies.

(6)
- Q. No.8.

(A)

Elaborate the concept of three tier architecture with reference to presentation, business logic and data access layers.

(8)

(B)

Differentiate between XHTML and XML.

(6)

(C)

Discuss Agile and Water Fall methodologies in the context of web application development.

(6)

\*\*\*\*\*



**FEDERAL PUBLIC SERVICE COMMISSION**  
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**UNDER THE FEDERAL GOVERNMENT**

Roll Number

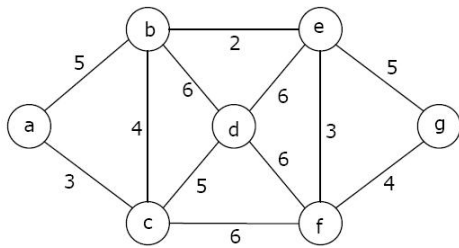
**COMPUTER SCIENCE, PAPER-I**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                      |                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|
| <b>TIME ALLOWED: THREE HOURS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>PART-I (MCQS)</b> | <b>MAXIMUM MARKS = 20</b> |
| <b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PART-II</b>       | <b>MAXIMUM MARKS = 80</b> |
| <b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b><br><b>(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.</b><br><b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b><br><b>(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b><br><b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b><br><b>(vi) Extra attempt of any question or any part of the question will not be considered.</b> |                      |                           |

**PART – II**  
**SECTION – I**

- Q. 2. (a)** Give a detailed note on a revised BSD 3-clause license. Also name 5 softwares using this license. (10)
- (b)** How do artificial intelligence may facilitate us in improving cyber security? (5)
- (c)** What are the main parts and phases of a computer virus program? (5) **(20)**
- Q. 3. (a)** See the following C++ program to declare whether an input number is a prime number or not. Identify the logical errors in the given program (if any). Give your correct statement(s) exactly at the same line number. (10)
- ```
1. n, i;  
2. bool is Prime = false;  
3. cout<< "Enter a positive integer: ";  
4. cin>> n;  
5. for(i = 1; i< n / 2; ++i)  
6. {  
7. if(n / i == 0)  
8. {  
9. is Prime = false;  
10. break;  
11. }  
12. }  
13. if (is Prime)  
14. cout<< "This is a prime number";  
15. else  
16. cout<< "This is not a prime number";
```
- (b)** What is the difference between call by value and call by reference? (5)
- (c)** What is the role of preprocessor directives? Give three examples in C++. (5) **(20)**
- Q. 4. (a)** How do the OOP paradigm can be associated with the real-world problems? Explain. (10)
- (b)** Discuss critical reasons given by the professionals for not supporting the OOP paradigm. (10) **(20)**
- Q. 5. (a)** Discuss the security issues associated with the cloud computing. (10)
- (b)** What is bit twiddling? Give brief description. (5)
- (c)** An image is a representation of some information. Discuss how does a computer represents an image internally? Name different algorithms used to extract features from images. (5) **(20)**

- Q. 6. (a) Discuss the limitations of genetic algorithms. (10)
- (b) What is AVL tree? Under what condition, a binary tree becomes AVL tree? (5)
- (c) Consider the following graph. Find out the sequence of edges added to the minimum spanning tree using Kruskal's algorithm. (5) (20)



- Q. 7. (a) Discuss the architecture of aspect-oriented system. (10)
- (b) Briefly discuss the motivation for aspect-oriented programming. (5)
- (c) What is the significance of quantification and obliviousness? (5) (20)
- Q. 8. (a) Write down the major steps involved in code generation. (10)
- (b) How would you optimize a loop? Describe the techniques briefly. (5)
- (c) Differentiate machine-dependent optimization and machine-independent optimization. (5) (20)



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COMPUTER SCIENCE, PAPER-II

TIME ALLOWED: THREE HOURS	PART-I (MCQS)	MAXIMUM MARKS = 20
PART-I(MCQS): MAXIMUM 30 MINUTES	PART-II	MAXIMUM MARKS = 80
NOTE: (i) Part-II is to be attempted on the separate Answer Book. (ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks. (iii) All the parts (if any) of each Question must be attempted at one place instead of at different places. (iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper. (v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed. (vi) Extra attempt of any question or any part of the question will not be considered.		

PART – II
SECTION-A

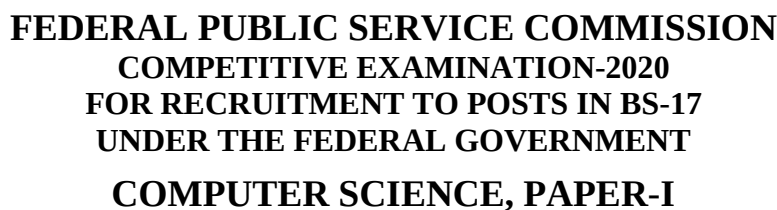
- Q. No. 2.** (a) Compare the main features of CISC and RISC architectures. Which type of architecture is suitable for pipelining? (8)
(b) Demonstrate use of superscalar approach to achieve instruction level parallelism using a suitable example. (6)
(c) List all basic functions of buses in the context of computer architecture. (6) **(20)**
- Q. No. 3.** (a) Show field by field comparison for IPv4 and IPv6 packets. (8)
(b) Explain the following routing techniques using suitable examples. (6)
(i) Link State Routing
(ii) Distance Vector Routing
(c) Show step by step procedure of error detection using cyclic redundancy check method for a 7 bit code block "1001001". Assume appropriate generator polynomial. (6) **(20)**
- Q. No. 4.** (a) Demonstrate step by step procedure for process swapping between main memory and secondary memory. (8)
(b) Show flow chart of a process scheduling mechanism using various queues. (6)
(c) Explain the difference between Sequential Access and Indexed Sequential Access in the context of file access using a suitable example (6) **(20)**
- Q. No. 5.** (a) Demonstrate various types of multiplexing techniques in the context of computer networks using suitable examples. (8)
(b) Show step by step procedure to find MAC address of a node in a network using Address Resolution Protocol. (6)
(c) For transmission of voice signal in real time over the network, select a suitable switching technique. Justify your answer using an example. (6) **(20)**

SECTION-B

- Q. No. 6.** (a) Analyze the following noise models in the context of digital image processing.
(i) Gaussian Noise Model
(ii) Uniform Noise Model
(b) Compare RGB and HSI color models in the context of digital image processing. (6)
(c) Describe step by step process of application of compression based technique for image segmentation. (6) **(20)**

COMPUTER SCIENCE, PAPER-II

- Q. No. 7.**
- (a) A Medium advertising company is reviewing its IT requirements and is considering using a Cloud solution for web applications as opposed to investing in existing infrastructure. Is this an appropriate strategy? Justify your answer using an example. (8)
 - (b) Describe briefly the role of validation in requirement engineering process. (6)
 - (c) Explain the difference between functional and non-functional requirement in the context of web engineering using a suitable example. (6)
- (20)**
- Q. No. 8.**
- (a) Demonstrate the use of ER Model in database designing process using an example. (8)
 - (b) Describe an appropriate security scheme for a database maintained by a bank. Justify your answer using an example. (6)
 - (c) Explain the difference between top-down and bottom-up approaches in the context of distributed database design using a suitable example. (6)
- (20)**



Roll Number

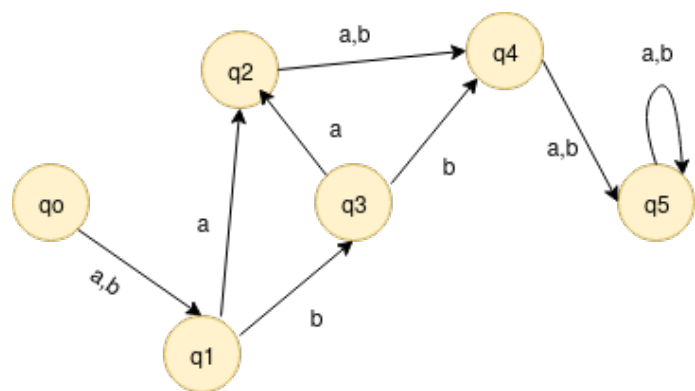
PART-II
SECTION-A

- Page 1 of 2

SECTION-B

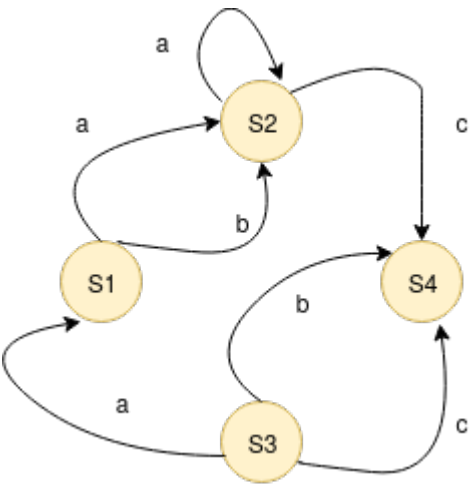
- Q. No. 6.** John rides a Van service from new square (S) to the city harbor (T). The van service charges Rs 10 per Km. There are numerous routes between the two points.
- (a) In order to rip off his customers, John always wanted to use the longest path. To find the longest path, John evaluates all the possible paths and selects the longest path. Write an algorithm to select the longest path using this approach. (7)
 - (b) Compute the complexity of this algorithm and determine that whether it is in P, NP, or NP-complete. (3)
 - (c) Write an algorithm to find a minimum distance between 'S' and 'T'. (7)
 - (d) Derive the complexity of this algorithm. (3)

- Q. No. 7.**
- (a) How many tokens are there in in this C code : (5)
printf("k = %d, &k = %x", k, &k);
 - (b) Create State Transition Table from the following graph (5)



- (c) Draw Finite State Automata which accepts following input. (4)
 - i. JIM
 - ii. JMI
 - iii. JJIIM
 - iv. JJMMII
- (d) Determine which of these inputs are valid for the FSM shown below: (6)

- i. aaaaa
- ii. ababa
- iii. abcabc
- iv. abccba
- v. acbcd
- vi. acbcdcd



- Q. No. 8.**
- (a) Is P = NP? Comment (4)
 - (b) Suppose you are representing a social network (such as facebook) as a graph. Devise an algorithm through which you can determine friends of friends. (7)
 - (c) Explain the complexity of this algorithm (5)
 - (d) Optimal problems are generally NP hard problems. Is it appropriate to use heuristics based approaches? (4)



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COMPUTER SCIENCE, PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	PART-I (MCQS)	MAXIMUM MARKS = 20
PART-I(MCQS): MAXIMUM 30 MINUTES	PART-II	MAXIMUM MARKS = 80
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PART – II
SECTION – A

- Q. No.2.** (a) Explain Moore's law. List high computing requirements in contemporary computing. (7)
(b) List and briefly define two approaches to dealing with multiple interrupts. (6)
(c) What is instruction-level parallelism? What are some typical distinguishing characteristics of RISC organization? (7)
- Q. No.3.** (a) What is the kernel of an operating system? Explain the difference between a monolithic and microkernel. (7)
(b) What is the difference between simple and virtual memory paging? Also explain the purpose of translation lookaside buffer. (6)
(c) Why do we have deadlock in the multiprocessing environment? Explain different techniques for dealing with deadlocks. (7)
- Q. No.4.** (a) Compare IPv4 and IPv6 headers. Explain the use of NAT technology to overcome IPv4 scarcity. (8)
(b) Find the maximum number of valid subnets and usable hosts per subnet that you can get from the network 172.23.0.0/23. (6)
(c) List and briefly define any THREE file organization techniques. Also explain basic Linux file system security. (6)
- Q. No.5.** (a) What is signal encoding? Explain different encoding techniques used in data communication. (8)
(b) Explain the functions and needs of ARP and RARP protocols in computer networks. (5)
(c) Explain multiplexing and demultiplexing at the transport layer. Explain in the context of TCP/IP protocol. (7)

SECTION – B

- Q. No.6.** (a) What is the purpose of a join in SQL? Explain inner, left, right and full join with the help of examples. (8)
(b) Construct an E-R diagram for a hospital with a set of patients and a set of medical doctors. Associate with each patient a log of the various tests and examinations conducted. (7)
(c) Explain Two-phase locking (2PL) as a concurrency control mechanism in the database systems. (5)
- Q. No.7.** (a) What is Histogram equalization? Explain the process and discuss its uses. (6)
(b) Explain types of color models. Also discuss the most common hardware oriented color models in detail. (8)
(c) What is translation and scaling? Find the number of bits required to store a 256x256 image with 32 gray levels. (6)
- Q. No.8.** (a) "Web engineering is more challenging than traditional software engineering". Argue for or against. (7)
(b) Briefly discuss the role of validation and verification in requirement engineering. (6)
(c) Explain functional and non-functional requirements in the context of a web application development. (7)



FEDERAL PUBLIC SERVICE COMMISSION
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COMPUTER SCIENCE, PAPER-I

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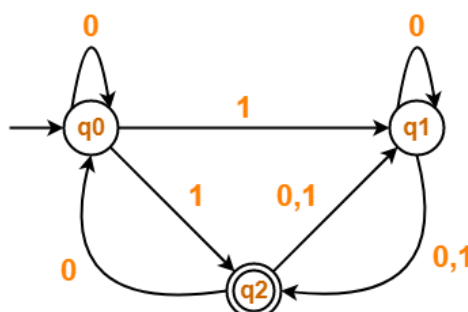
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PART-II
SECTION-A

- Q. No. 2.** (a) What are office productivity tools? Explain uses of any two productivity tools in your home or workplace. (7)
- (b) Write a detailed note on computer crimes and ethical challenges. (7)
- (c) What are the different types of computers? Explain the benefits of miniaturization. (6)
- Q. No. 3.** (a) Describe any two of the following briefly: ISP, HTML, SSD, Cloud Computing. (6)
- (b) Write a program that should output the factors of the number passed as input – one factor on each line. Factors of a number, say x, are those whole numbers which can be multiplied with other whole numbers to get x. (5)
- (c) What are IDEs? How do they help in software development? List the IDEs you have ever used. (5)
- (d) Write a program in C/C++ to convert a decimal number to hexadecimal. (4)
- Q. No. 4.** (a) Explain object oriented programming paradigm. Write a detailed note on any two of the principles of object oriented programming paradigm. (8)
- (b) Why do we need interfaces in OOP? How does it help in achieving abstraction? (6)
- (c) What do you mean by runtime and compile time errors? (6)

SECTION-B

- Q. No. 5.** (a) What is a tree in data structure? Describe its types with the help of examples. (8)
- (b) What is pass by value and pass by reference? Can we pass an object as a parameter to call a method in java? (6)
- (c) Convert following infix notation to prefix (6)
- (i) $(30+23)*(43-21)/(84+7)$
- (ii) $2*(1+(4*(2+1)+3))$
- Q. No. 6.** (a) Convert following NFA to DFA: (8)



- (b) Differentiate between overloading and overriding with the help of an example. (6)
- (c) What is recursion in data structures? Explain three conditions of a recursive function with the help of an example. (6)

COMPUTER SCIENCE, PAPER-I

- Q. No. 7.** (a) Write detailed notes on any TWO of the following: (8)
- i. PERT chart ii. Unified Modeling Language iii. AVL Trees
- (b) What is a Software Process Model? Explain the Spiral model in detail. (7)
- (c) What do you mean by software quality? List at least five quality attributes. (5)
- Q. No. 8.** (a) Consider the grammar (4)
- $S \rightarrow cAd$
 $A \rightarrow a b \mid a$
- construct a top-down parse tree for the input string $w = cad$
- (b) Is the above given grammar ambiguous or unambiguous? Justify your answer. (4)
- (c) Write similarities and differences of CFG and regular expression. (4)
- (d) Design grammar for the following language: (4)
- “The set of all strings of 0s and 1s such that every 0 is immediately followed by at least one 1”.*
- (e) Write a note on Aspect Oriented Programming (4)



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COMPUTER SCIENCE, PAPER-II

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PART – II (SECTION – A)

- Q.2. (a) The addressing in a typical instruction format are done by using different addressing modes. Examine any five addressing modes with an example based on the contents of address field, actual address and contents of memory location. (10)
- (b) The decimal value of address field in an instruction is 120. The addressing mode of the machine's architecture is register direct and register indirect addressing. Calculate the address of corresponding operand. (5)
- (c) Compare the set of addressing modes of RISC and CISC machines. Give one example of addressing modes used in RISC and CISC respectively. (5)

- Q.3. Memory managed by BITMAP is shown below:

1	1	1	1	1	0
0	1	1	0	0	0
1	0	0	1	1	1
1	0	0	0	0	0
1	1	0	0	0	0
0	0	0	0	1	1

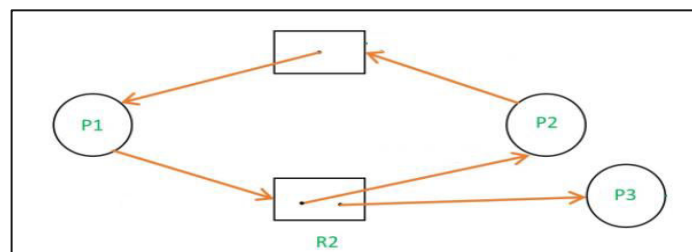
- (a) Show properly filled memory according to the BITMAP where memory index starts from zero. (3)
- (b) Insert a page H of size 3 allocation units in memory drawn in part 'a' using first-fit algorithm. Redraw memory and the BITMAP after insertion. (3)
- (c) Now insert another page K of size 2 allocation units in memory drawn in part 'b' using next-fit algorithm. Redraw memory and the BITMAP after insertion. (3)
- (d) Use linked list data structure for the above memory mapping (Only give equivalent figure). (6)
- (e) Use hash table to keep track of active pages in the above memory (Only give figure). (5)

- Q.4. Do as directed:

- (a) Calculate effective memory access time using following data: (3)
- TLB hit ratio is 85%,
 - TLB access time=20nsec
 - Memory access time=115nsec

Effective memory access time=Hit rate * (TLB access time+ Mem access time)+(1-Hit rate)(TLB access time+Process_table access time+ Mem access time)

- (b) Consider a logical address and physical address of 31 and 22 bits respectively. What will be total logical and physical address space? (4)
- (c) Does resource allocation graph shown below consist of a deadlock or not? Justify with reason. (3)



(Figure: Resource Allocation Graph)

- (d) What is race condition? What are the different techniques to avoid race condition in the processes? Which one is optimal and why? (10)

COMPUTER SCIENCE, PAPER-II

- Q.5.

(a)

Compare Transmission Control Protocol and User Datagram Protocol. How they are used in wireless networks?

(6)

(b)

What mechanism is used by TCP to protect itself from miss delivery?

(6)

(c)

Calculate the TCP window size to fully utilize the line on which WAN link is 2 Mbps and RTT between source and destination is 300 msec.

(8)

SECTION – B

- Q.6.

Consider the following database schema and write the relational algebra expression for the following queries.

Students (Stu_Reg, Stu_Name, Stu_Address)

Instructor (Ins_ID, Ins_Name, Ins_Dept_ID)

Course (Cr_Code, Cr_Title, Cr_CrHours)

Dept (Dept_ID, Dept_Name)

Results (Res_Stu_Reg, Res_Cr_Code, Res_Marks, Res_Ins_ID, Res_Grade)

(a) Write relational algebraic expression for:

(i) To display all the students details in section BSSE.

(ii) To display all Instructor Names and their respective Department Names, (if an instructor is not assigned any Dept his name should be displayed as well).

(iii) To display Stu_Reg, Stu_Name, Cr_Code, Cr_Title and Res_Marks for students who got 75 or more marks.

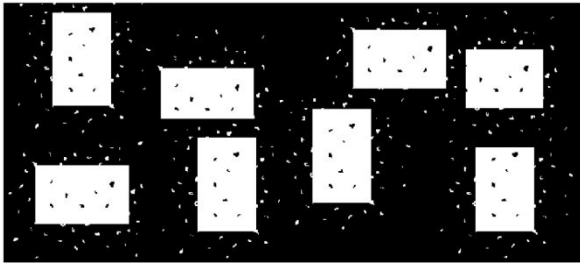
(iv) To display Res_Stu_Reg, Ins_Name, Res_Grade for Instructors whose Dept_ID is 1.

(b) What is the concept of gerund in database? Give one example of gerund. Is this essential to eliminate gerunds from the database? If yes, how and if no, why?

- Q.7.

(a) Write code/pseudo code to locate all of the large boxes in the image below using morphological image processing.

(8)



- (b) Is there a need for more than 1 color model? Mention different colors models and there uses.

(6)

(c) Explain CMY color model, its use and how is it different from CMYK?

(6)
- Q.8.

(a) Analyze the code and draw resulting table as drawing on the paper

<table border="1" cellspacing="0">

<tr><td>1</td><td colspan="3">2</td></tr>

<tr><td rowspan="2">3</td><td colspan="2">4</td><td>5</td></tr>

<tr><td>6</td><td>7</td><td>18</td></tr>

<tr><td colspan="3">9</td></tr>

<tr><td>10</td><td colspan="3">11</td></tr>

<tr><td>12</td><td>13</td><td>14</td></tr>

<tr><td rowspan="2">15</td><td colspan="2">16</td><td>17</td></tr>

</table>

(b) What is the role of requirement engineering in web engineering? List functional and non-functional requirements for a website.

(6)

(c) What are different security mechanisms used for encrypting the contents of a website? Explain one in detail.

(6)



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2022 FOR RECRUITMENT TO
POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT
COMPUTER SCIENCE, PAPER-I

Roll Number

TIME ALLOWED: THREE HOURS
PART-I(MCQS): MAXIMUM 30 MINUTES

PART-I (MCQS)
PART-II

MAXIMUM MARKS = 20
MAXIMUM MARKS = 80

- NOTE:** (i) **Part-II** is to be attempted on the separate **Answer Book**.
(ii) Attempt **ONLY FOUR** questions from **PART-II**, by selecting **TWO** questions from **EACH SECTION**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.

PART-II
SECTION-A

- Q. No. 2.** (a) Using C++ write a function pattern (int n) that produces the following output. Pay special attention to the spaces and clearly state the return type of the function. Note that the following is just an example; your solution should work for any input “n”. **(8)**

```
      1
    1 2
  1 2 3
1 2 3 4
  1 2 3 4 5
    1 2 3 4 5 6
      1 2 3 4 5 6 7
```

- (b) Write the differences between Computer Science, Software Engineering, Information Technology, Information Systems, Computer Engineering, and Bioinformatics. **(6)**
- (c) Write output of the following C++ code assuming that there is no error in the code: **(6)**
- ```
int ary[4] = {1,2,3,4};
int *p1 = ary + 3;
cout << p1[-2] << endl;
int *p2 = &p1[-2];
*p2 = 10;
cout << ary[1] << endl;
```

- Q. No. 3.** (a) Complete the C++ code below to find the number of distinct elements in an array in O(n) time (linear time complexity) where “n” is the number of elements in the array. For example, if the array is {3,1,3,8,2,1,8,2}, the number of distinct elements is 4 (to be returned from the function below) as the distinct elements are {1,2,3,8}. All the elements of the array are in the range [1,100]. Also, n >> 100 (n is significantly greater than 100). **(8)**

```
int numDistinctElements(int[] array, int n)
{
 int count = 0;
 // write your code here
 return count;
}
```

- (b) Write a detailed note on the principles of Information Security/ Privacy. **(6)**
- (c) Write output of the following C++ code assuming that there is no error in the code: **(6)**
- ```
int v1 = 55;
int* p1 = &v1;
int* p2;
p2 = p1;
*p1 = 20;
cout << *p2 << endl;
cout << v1 << endl;
```

COMPUTER SCIENCE, PAPER-I

- Q. No. 4.** (a) Write a C++ program to check whether a string is palindrome or not. A palindrome is a string, which when read in both forward and backward ways is the same, e.g., “radar”, “madam” etc. Note that these are only examples, you will take the string as an input from a user using the `cin.getline` function and your code should be general that can work on any input string. You are not allowed to use any string-related library function. (12)

- (b) Write output of the following C++ code assuming that there is no error in the code: (8)

```
#include <iostream.h>
int main() {
    int a = 12, b = 25;
    cout << "a = " << a << endl;
    cout << "b = " << b << endl;
    cout << "a | b = " << (a | b) << endl;
    return 0;
}
```

SECTION-B

- Q. No. 5.** (a) Define a class called Circle using C++. An object of the class Circle can be created using any of the following ways (implement all the ways): (10)

- (1) by default, the circle will be of radius 1 inch and centered at (0,0)
- (2) with a given value for radius, centered at (0,0)
- (3) by providing the center coordinates and the radius is assumed to be 1
- (4) by providing the radius and the coordinates for the center
- (5) by providing another Circle object to initialize.

In the main function (driver program), separately create 5 different objects of the Circle class using a different way of object creation (mentioned above) for each of them.

- (b) What is a virtual function in C++? Using an example, explain how does a virtual function mechanism work. (10)

- Q. No. 6.** (a) Complete the following recursive function using C++ to calculate k raised to the power n , i.e., k^n . Use of any built-in (library) function is not allowed. (8)

```
int power(int k, int n)
{
    // write your code here
}
```

- (b) Compare and contrast the DES, AES, and RSA encryption algorithms. (8)

- (c) Write the time complexity of the following C++ code in terms of Big-O notation. Assume that there is no error in the code. (4)

```
int isPrime (unsigned int n)
// returns true if the argument value is prime and
// false otherwise
{
    for (unsigned int i = 2; (i * i) < n; i++)
    {
        // if i is a factor, then not prime
        if (n % i == 0)
            return 0;
    }

    // if we end loop without finding factor then
    // number must be Prime
    return 1;
}
```

COMPUTER SCIENCE, PAPER-I

- Q. No. 7.** (a) The following function performs binary search on a given array of n numbers: (8)
- ```
1. int binarySearch (int x, int v[], int n)
2. {
3. int low, high, mid;
4. low = 0;
5. high = n - 1;
6. while (low <= high)
7. {
8. mid = (low + high)/2;
9. if (x < v[mid])
10. high = mid - 1;
11. else if (x > v[mid])
12. low = mid + 1 ;
13. else return mid;
14. }
15. return -1;
16. }
```

Draw control flow graph for the above function. Also find its cyclomatic complexity.

- (b) What is the difference between white box (Glass Box) testing and black box testing? Which of these testing techniques helps in identifying more errors in a system under evaluation? Explain. (6)
- (c) Requirements can be specified using natural language specification. Write one user requirement and one system requirement for the following function: (6)

Automatically highlight incorrect spelling mistakes in an MS Word document.

- Q. No. 8.** (a) Draw a finite automaton over  $\Sigma = \{0, 1\}$  that accepts all binary strings starting and ending with 0 (single-0 string counts). (8)
- (b) Write a regular expression over  $\Sigma = \{0, 1\}$  to represent a set of strings that begin with 101 and end with 110. (6)
- (c) Write a Context-Free Grammar (CFG) over  $\Sigma = \{0, 1\}$  for the language of all binary strings of the form  $0^a 1^b 0^c$  where  $a+c=b$ . (6)

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FEDERAL PUBLIC SERVICE COMMISSION  
COMPETITIVE EXAMINATION-2022 FOR RECRUITMENT TO  
POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT

Roll Number

COMPUTER SCIENCE, PAPER-II

TIME ALLOWED: THREE HOURS

PART-I(MCQS): MAXIMUM 30 MINUTES

PART-I (MCQS)

PART-II

MAXIMUM MARKS = 20

MAXIMUM MARKS = 80

NOTE: (i) Part-II is to be attempted on the separate Answer Book.

(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.

(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.

(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.

(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.

(vi) Extra attempt of any question or any part of the attempted question will not be considered.

PART – II (SECTION – A)

- Q. 2. (a) The following processes are being scheduled using a preemptive, round robin scheduling algorithm. Each process is assigned a numerical priority, with a higher number indicating a higher relative priority. In addition to the processes listed below, the system also has an *idle* task (which consumes no CPU resources and is identified as  $P_{idle}$ ). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue. (10)

| Process | Priority | Burst | Arrival |
|---------|----------|-------|---------|
| P1      | 40       | 20    | 0       |
| P2      | 30       | 25    | 25      |
| P3      | 30       | 25    | 30      |
| P4      | 35       | 15    | 60      |
| P5      | 5        | 10    | 100     |
| P6      | 10       | 10    | 105     |

Show the scheduling order of the processes using a Gantt chart. What is the turnaround time and waiting time for each process?

- (b) Suppose the disk head is initially located at track 20, set to move in order of increasing tracks. Assume a disk with 100 tracks and that the disk request queue has random requests in it. The requested tracks, in the order received by the disk scheduler, are (6)

18, 25, 73, 46, 9, 92

Using C-SCAN algorithm, find the performance in terms of average seek time.

- (c) What design and management issues are raised by the existence of concurrency? (4)

- Q. 3. (a) Consider the following snapshot of the system. (12)

|    | R1 | R2 | R3 | R4 |
|----|----|----|----|----|
| P1 | 5  | 1  | 1  | 7  |
| P2 | 3  | 2  | 1  | 1  |
| P3 | 3  | 2  | 2  | 1  |
| P4 | 4  | 6  | 1  | 7  |
| P5 | 6  | 3  | 2  | 3  |

Claim Matrix C

| R1 | R2 | R3 | R4 |
|----|----|----|----|
| 12 | 13 | 6  | 8  |

Resource Vector

|    | R1 | R2 | R3 | R4 |
|----|----|----|----|----|
| P1 | 4  | 0  | 1  | 4  |
| P2 | 2  | 2  | 1  | 0  |
| P3 | 2  | 1  | 2  | 1  |
| P4 | 0  | 5  | 1  | 0  |
| P5 | 4  | 2  | 1  | 2  |

Allocation Matrix A

| R1 | R2 | R3 | R4 |
|----|----|----|----|
| 0  | 2  | 0  | 1  |

Available Vector

Using banker's algorithm, determine whether the state is safe or unsafe. If the state is safe, illustrate the order in which the processes may complete. Otherwise, illustrate why the state is unsafe.

- (b) Give an account of different functions of Logical File System. (4)

- (c) What resources are used when a thread is created? How do they differ from those used when a process is created? (4)

**COMPUTER SCIENCE, PAPER-II**

- Q. 4.

(a)

Assume a pipeline with four stages: fetch instruction (FI), decode instruction and calculate addresses (DA), fetch operand (FO), and execute (EX). Draw a diagram for a sequence of 7 instructions, in which the third instruction is a branch that is taken and in which there are no data dependencies.

(8)
- (b)

A set associative cache consists of 64 lines, or slots, divided into 4-slot sets. Main memory contains 4K blocks of 128 words each. Show the format of main memory addresses.

(6)
- (c)

Why is DMA access to main memory given higher priority than CPU access to main memory?

(6)
- Q.5.

(a)

Describe any one of the routing algorithms in detail, which is used to resolve the conflict between path selections.

(8)
- (b)

A company occupies four buildings on a campus. Each of these building has a 100 base T network running to all the floors. The buildings form a square 100 meter on each side. The network must support 100 Mbps data transfer rate. What will be the proposed design solution under the given condition?

(6)
- (c)

What is the main fault in TCP 3-way handshake which makes it a boon for attackers? Many operating systems generally associate a “Backlog” parameter with a listening socket that sets cap on the number of TCBs simultaneously in SYN-RECEIVED state. Does this parameter solve the problem in TCP 3-way handshake?

(6)

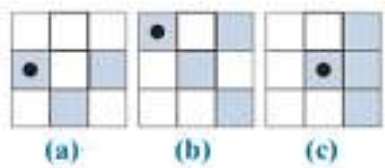
**SECTION – B**

- Q.6.

(a)

Find the reflection,  $\hat{B}$ , of each of the following Structuring Elements (SE). The dot indicates the origin of the SE.

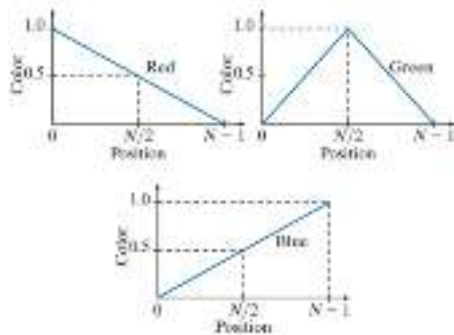
(8)



- (b)

The R, G, and B component images of an RGB image have the horizontal intensity profiles shown in the following diagram. Show your working to identify color that a person would see in the middle column of this image?

(8)



- (c)

How Digital Image Processing and Computer Vision are related? Discuss.

(4)
- Q.7.

(a)

Explain 3-tier web application architecture.

(8)
- (b)

Write the jQuery code to slide elements up and down. Also write the code to fade the elements in and out of visibility. Use HTML, CSS, and jQuery.

(6)
- (c)

What is web application promotion? Discuss some of the common webvertising methods.

(6)
- Q.8.

(a)

Explain process of Web Application Testing.

(8)
- (b)

Explain in detail the Document Object Model (DOM). Also discuss XML and RSS.

(6)
- (c)

Explain how can you access a database from a JSP page? Give the database connectivity issues in details.

(6)



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**COMPETITIVE EXAMINATION-2023 FOR RECRUITMENT TO**  
**POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT**

Roll Number

**COMPUTER SCIENCE, PAPER-II**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------|
| <b>TIME ALLOWED: THREE HOURS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PART-I (MCQS)</b> | <b>MAXIMUM MARKS = 20</b> |
| <b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>PART-II</b>       | <b>MAXIMUM MARKS = 80</b> |
| <b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b><br><b>(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.</b><br><b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b><br><b>(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b><br><b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b><br><b>(vi) Extra attempt of any question or any part of the attempted question will not be considered.</b> |                      |                           |

**PART – II (SECTION – A)**

- Q. 2.** (a) Suggest reasons why RAMs traditionally have been organized as only one bit per chip whereas ROMs are usually organized with multiple bits per chip. (7)
- (b) Consider a dynamic RAM that must be given a refresh cycle 64 times per ms. Each refresh operation requires 150 ns; a memory cycle requires 250 ns. What percentage of the memory's total operating time must be given to refreshes? (7)
- (c) In the context of RAID, what is the distinction between parallel access and independent access? (6) (20)
- Q. 3.** (a) The CPU in a router can process 2 million packets/sec. The load offered to it is 1.5 million packets/sec. If a route from source to destination contains 10 routers, how much time is spent being queued and serviced by the CPUs? (7)
- (b) An IP datagram using the strict source routing option has to be fragmented. Do you think the option is copied into each fragment, or is it sufficient to just put it in the first fragment? Explain your answer. (7)
- (c) Give two examples of computer applications for which connection-oriented service is appropriate and also give two examples for which connection-less service is best. (6) (20)
- Q. 4.** (a) A 32-bit computer has two selector channels and one multiplexor channel. Each selector channel supports two magnetic disk and two magnetic tape units. The multiplexor channel has two line printers, two card readers, and ten VDTs terminals connected to it. Assume the following transfer rates.
- Disk drive 800 Kbytes/s  
Magnetic tape drive 200 Kbytes  
Line printer 6.6 Kbytes/s  
Card Reader 1.2 Kbytes/s  
VDT 1 Kbytes/s
- Estimate the maximum aggregate I/O transfer rate in this system. (12)
- (b) Consider a program that access a single I/O device and compare un- buffered I/O to the use of a buffer. Show that the use of buffer can reduce the running time by at most a factor of two. (8) (20)
- Q. 5.** (a) An I/O -bound program is one that, if run alone, would spend more time waiting for I/O than using the processor. A processor-bound program is the opposite. Suppose a short term scheduling algorithm favors those programs that have used little processor time in the recent past. Explain why this algorithm favors I/O bound programs and yet does not permanently deny processor time to processor-bound programs? (10)
- (b) Suppose that instead of using 16-bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been? (5)
- (c) What is the distinction between instruction-level parallelism and machine parallelism? (5) (20)

**(SECTION – B)**

- Q. 6.** (a) Explain the following different SELECT statement search conditions with examples using any database schema of your choice: (12)
1. Compound Comparison Search Condition
  2. Range search condition (BETWEEN/NOT BETWEEN)
  3. Set membership search condition (IN/NOT IN)
  4. Pattern match search condition (LIKE/NOT LIKE)
- (b) Explain ACID property of a transaction (4)
- (c) Explain Transitive dependency using any example. (4) **(20)**
- Q. 7.** (a) A common measure of transmission for digital data is the baud rate, defined as the number of bits transmitted per second. Generally, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using these facts, answer the following: (10)
- How many minutes would it take to transmit a  $1024 \times 1024$  image with 256 intensity levels using a 56k baud modem?
  - What would the time be at 750K baud, are representative speed of a phone DSL (Digital subscriber line) connection?
- (b) What effect would setting to zero the lower-order bit planes have on the histogram of an image in general? (5)
- (c) What would be the effect on the histogram if we set to zero the higher order bit planes instead? (5) **(20)**
- Q. 8.** (a) How SEO improves your website traffic? Explain with proper reasons and coding examples. (8)
- (b) Suppose your web team is going to make a contract with the customer and you need to estimate the cost of application development. What pricing factors you consider to estimate the cost? (8)
- (c) Write the jQuery code to slide elements up and down. Use HTML, CSS, and jQuery (4) **(20)**

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FEDERAL PUBLIC SERVICE COMMISSION  
COMPETITIVE EXAMINATION-2024 FOR RECRUITMENT TO  
POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT

Roll Number

COMPUTER SCIENCE, PAPER-I

|                                                                                                                                                                                                                                                                |                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| TIME ALLOWED: THREE HOURS<br>PART-I (MCQs) : MAXIMUM 30<br>MINUTES                                                                                                                                                                                             | (PART-I MCQs) MAXIMUM MARKS: 20<br>(PART-II) MAXIMUM MARKS: 80 |
| NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes.<br>(ii) Overwriting/cutting of the options/answers will not be given credit.<br>(iii) There is no negative marking. All MCQs must be attempted. |                                                                |

PART-I (MCQs)(COMPULSORY)

- Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)  
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.
- Which of the following ports is used to connect external devices such as printers, scanners, and cameras to a computer? (A) USB (Universal Serial Bus) (B) HDMI (High-Definition Multimedia Interface) (C) VGA (Video Graphics Array) (D) None of these
  - Which type of monitor technology offers the widest viewing angles and accurate color reproduction? (A) CRT (Cathode Ray Tube) (B) OLED (Organic Light-Emitting Diode) (C) LCD (Liquid Crystal Display) (D) None of these
  - Which component is responsible for providing power supply to all other components in a computer system? (A) Power Supply Unit (PSU) (B) Central Processing Unit (CPU) (C) Motherboard (D) None of these
  - What is an example of system software from the list below? (A) Windows (B) Google Chrome (C) Adobe Photoshop (D) None of these
  - Which of the following is NOT an agile software development methodology? (A) Scrum (B) Waterfall (C) Kanban (D) None of these
  - Which was the first purely object-oriented programming language developed? (A) Java (B) C++ (C) SmallTalk (D) None of these
  - Which language does not allow for inheritance in all four forms? (A) Kotlin (B) Java (C) C++ (D) None of these
  - Which programming language allows for polymorphism but not classes? (A) C++ programming language (B) Java programming language (C) Ada programming language (D) None of these
  - Which of the following is considered as the world's first antivirus program? (A) Tinkered (B) Reaper (C) Creeper (D) None of these
  - If an employee requests root access to a UNIX system in which you serve as the administrator, you shouldn't provide them access or this authority unless their job necessitates certain rights and privileges. Which cyber security notion may it be seen as an excellent example of: (A) Least privileges (B) Separation of Privileges (C) Open Design (D) None of these
  - After a certain amount of time, say thirty minutes, the online application, similar to banking websites, should prompt users to log in again. Which cyber security concept may it be seen as a prime example of: (A) Compromise recording (B) Psychological acceptability (C) Complete mediation (D) None of these
  - Which of the following malware types does not infect others and duplicate or clone itself? (A) Rootkits (B) Trojans (C) Worms (D) None of these
  - When compiled, which of the following class of statement often yields no executable code? (A) Assignment statement (B) Structural statements (C) Input and output statements (D) None of these
  - A high-level language compiler that runs on one computer and generates code for another is known as: (A) One pass compiler (B) Multipass compiler (C) Cross compiler (D) None of these
  - Compiler can check \_\_\_\_ error. (A) Syntax (B) Content (C) Logical (D) None of these
  - Select the correct output of the following code.  

```
#include <stdio.h>
int main()
{
 int arr[5]={10,20,30,40,50};
 printf("%d", arr[5]);

 return 0;
}
```

(A) Garbage value (B) 20 (C) 30 (D) None of these

## COMPUTER SCIENCE, PAPER-I

17. When we attempt to add the eleventh element to a stack with a size of 10, we encounter a circumstance known as:  
(A) Garbage collection (B) Underflow (C) Overflow (D) None of these
18. Regarding Binary Trees, which of the following is true?  
(A) Every binary tree has two states: full and complete.  
(B) Every binary tree that is full is also a complete binary tree.  
(C) All complete binary trees are likewise full binary trees. (D) None of these
19. What is the name of a linear collection of data components where the linear node is provided by a pointer?  
(A) Linked list (B) Primitive List (C) Node list (D) None of these
20. How much time would it take to add an element to the linked list asymptotically?  
(A)  $O(1)$  (B)  $O(n)$  (C)  $O(n^2)$  (D) None of these

## PART-II

- NOTE:** (i) Part-II is to be attempted on the separate **Answer Book**.  
(ii) Attempt **ONLY FOUR** questions from **PART-II**, by selecting **TWO** questions from **EACH SECTION**. **ALL** questions carry **EQUAL** marks.  
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.  
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.  
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.  
(vi) Extra attempt of any question or any part of the question will not be considered.

### SECTION-A

- Q. No. 2** (a) Discuss the future of Information Technology (IT) in Pakistan and its huge impact on all our daily lives. (6)  
(b) Discuss the difference between a computer virus a trojan and a worm? (6)  
(c) Discuss the pros and cons of LaTeX in comparison to other document processors. (8)
- Q. No. 3** (a) Write a program that prompts the user to enter a letter grade A, B, C, D, or F and displays its corresponding numeric value 4, 3, 2, 1, or 0. (6)  
(b) Write pseudocode OR C-language script for the following expression. (6)
- $$\vec{a} \cdot \vec{b} = \sum_{i=1}^n a_i b_i = a_1 b_1 + a_2 b_2 + \dots + a_n b_n$$
- (c) Write a version of Breadth First Search (BFS) that finds the distances from the start node to each of the others, rather than the actual paths. (8)
- Q. No. 4** (a) Write a program that displays the area and perimeter of a rectangle with the width of 4.5 and height of 7.9 using the following formula: area = width \* height. (6)  
(b) Write a program that reads a Celsius degree from the console, then converts it to Fahrenheit and displays the result. The formula for the conversion is as follows: Fahrenheit =  $(9 / 5) * \text{Celsius} + 32$ . (6)  
(c) Write a program that prompts the user to enter the month and year and displays the number of days in the month. For example, if the user entered month 2 and year 2024, the program should display that February 2024 had 29 days. If the user entered month 3 and year 2015, the program should display that March 2015 had 31 days. (8)

### SECTION-B

- Q. No. 5** (a) Show the output of the following code? (6)
- ```
public class Test {  
    public static void main(String[] args) {  
        Double x = 3.5;  
        System.out.println(x.intValue());  
        System.out.println(x.compareTo(4.5));  
    }  
}
```
- (b) Illustrate the difference between overriding and overloading by the piece of pseudocode or program. (6)

COMPUTER SCIENCE, PAPER-I

- (c) How do you prevent a class from being extended? How do you prevent a method from being overridden? Exemplify with simple piece of code. (8)
- Q. No. 6** (a) For the following data sets, which sorting algorithms would work well, and which would not? (8)
- a. 10 floating-point values
 - b. 1,000 integers
 - c. 1,000 names
 - d. 100,000 integers with values between 0 and 1,000
 - e. 100,000 integers with values between 0 and 1 billion
 - f. 100,000 names
 - g. 1 million floating-point values
 - h. 1 million names
 - i. 1 million integers with uniform distribution
 - j. 1 million integers with non-uniform distribution
- (b) Write an algorithm that implements binary search recursively. Does this version have any advantages or disadvantages compared to the non-recursive version? (6)
- (c) Write an algorithm that deletes a specified cell from a doubly linked list. Draw a picture that shows the process graphically. (6)
- Q. No. 7** (a) Discuss the phases of project management including conception and initiation, project planning, project execution, performance/monitoring, and project close. (6)
- (b) What are the different types of test design techniques? When would you use these types of test design techniques? (6)
- (c) Exemplify the difference between Quality Assurance, Quality Control, and Testing? (8)
- Q. No. 8** Write Regular Expression(s) for the following (5 each) (20)
- I. For date Format of standard e.g. (10.03.2024 | 12/30/2023 | 01/01/2022)
 - II. Write a Regular Expression that will match URL e.g. (http://example.edu.pk)
 - III. Write a Regular Expression that will match an IP address. e.g. 192.168.0.1
 - IV. Write a Regular Expression that will match an email address. e.g. (abc@example.com)



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COMPUTER SCIENCE, PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II)	MAXIMUM MARKS: 80
NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes . (ii) Overwriting/cutting of the options/answers will not be given credit. (iii) There is no negative marking. All MCQs must be attempted.		

PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the **OMR Answer Sheet.(20x1=20)**
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. **Which of the following are computer architectures different from conventional von Neumann architecture?** (A) MIT architecture (B) Harvard architecture (C) Turing architecture (D) None of these
2. **A computer is in System mode when:**
(A) CPU is executing a program which is part of the operating system
(B) The process execution is halted to listen to device inputs
(C) The system is switching between processes (D) None of these
3. **Making a system store data in memory contiguously would:**
(A) Results in lesser computation while searching for data
(B) Results in more computation while searching data
(C) Makes storing data very easy as one doesn't have to search for available memory to store
(D) None of these
4. **Network traffic estimation is:**
(A) Impossible (B) Easily computable via linear equations
(C) Can only be solved using AI techniques (D) None of these
5. **The time complexity of finding a shortest path in a network is:**
(A) Fairly low with Dijkstra's algorithm (B) Very efficient with A* search given spatial heuristics
(C) Better than the above two using some randomization mechanism in large networks (D) None of these
6. **Which of the following is the most efficient encoding to send data via networks? Also consider the reasoning in your answer.**
(A) 3-Excess codes because it is not weighted
(B) Binary, because its representation can be done simply with zeros and ones
(C) Decimal, because a decimal requires lesser space to represent the same number (D) None of these
7. **Which is better, Time slicing or time sharing?**
(A) Time slicing is better because it deals with process allocation at the CPU level
(B) Time sharing is better because it gives multiple users the illusion of each having his own processor
(C) The comparison is not possible because one is part of the other (D) None of these
8. **Which type of algorithms are applicable to scheduling resources in operating systems?**
(A) State space search (B) Machine learning (C) Bayesian learning (D) None of these
9. **Which of the following are/is true?**
(A) In the era of platform independence all Operating systems can be made without considering low level details of machines
(B) Operating systems can be made without using assembly languages
(C) Operating systems aren't needed because everything can run on the internet (D) None of these
10. **In the RISC architecture, the _____ is updated whenever a function is called:**
(A) Frame pointer and Return address register (B) Stack pointer (C) Both (A) & (B) (D) None of these
11. **A child entity in ER diagrams is:**
(A) The entity on the one side of a one to many relationship
(B) Entity that inherits attributes and relations from another entity (C) A row of a table (D) None of these
12. **Boyce Codd Normal Form:**
(A) Addresses certain type of multivalued dependencies (B) Makes sure that data in each column is atomic
(C) Makes sure that every determinant is a candidate key (D) None of these
13. **DDL is used to:**
(A) Represent the database structure (B) Define and manage the structure of a database
(C) Deals with manipulation of data stored in the database (D) None of these
14. **Dynamic range in image processing is:**
(A) Refers to span of wavelengths covered by a particular band in a multispectral image
(B) Maximum or minimum values present in an image
(C) Range of values spanned by grey scale (D) None of these

COMPUTER SCIENCE, PAPER-II

15. **Which of the following is true?**
(A) Brightness gives a measure of degree to which a pure color is diluted by white light
(B) Saturation gives a measure of degree to which a pure color is diluted by white light
(C) Hue gives a measure of degree to which a pure color is diluted by white light (D) None of these
16. **SIFT is:**
(A) An image deblurring algorithm (B) Basic edge detection algorithm
(C) Used to identify and define local features (D) None of these
17. **Optical character recognition:**
(A) Cannot be done without non deterministic algorithms
(B) Can be done without non deterministic algorithms
(C) Can be done more efficiently and robustly with deterministic algorithms (D) None of these
18. **Which of the following statement/s are true about PHP?**
(A) Echo and print are same (B) Echo takes a single parameter (C) Both (A) & (B) (D) None of these
19. **Which of the following are true about the Wiener filter?**
(A) It is a deterministic algorithm (B) It minimizes the quadratic error
(C) It uses the binary cross entropy (D) None of these
20. **Php allows dynamic code execution using:**
(A) Eval() (B) Reflection API (C) File Manipulation (D) None of these

PART – II

- NOTE:** (i) **Part-II** is to be attempted on the separate **Answer Book**.
(ii) Attempt **ONLY FOUR** questions from **PART-II** by selecting **TWO** questions from **EACH SECTION**.
ALL questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.

(SECTION – A)

- Q. No. 2.** (a) Why are multi-processor systems considered advantageous in computer architecture? How does parallel processing fundamentally improve the performance and scalability of a computer system? (7)
(b) How does the choice of architectural level impact the performance of a computer system? Provide a numerical comparison between two different architectural levels, highlighting their strengths and weaknesses. (7)
(c) If a processor executes 1 billion instructions per second and has an instruction execution cycle of 4 cycles per instruction. Calculate the overall execution time for a program with 1 million instructions. Discuss how reducing the number of cycles per instruction can impact performance. (6)
- Q. No. 3.** (a) Why cache memory is considered a critical component in a computer system? How does the internal and external data representation contribute to optimizing memory usage and system efficiency? (7)
(b) Explain the concept of parallelism in computer architecture. How does the internal structure of a microprocessor contribute to parallel processing capabilities? (7)
(c) Break down the stages of the instruction execution cycle in a computer system. How do the characteristics of CISC and RISC architectures influence the execution cycle? (6)
- Q. No. 4.** (a) Compare the OSI and TCP/IP models in terms of their simplicity and practicality. Why is a layered approach beneficial in network design? (7)
(b) Explain how overlay networks and content distribution networks enhance the performance and scalability of internet services? Provide a numerical example to illustrate their impact on content delivery. (7)
(c) If the internet were a city, and each device had its own unique street address, how does IP addressing work in this scenario? Explain the purpose of subnetting using a neighborhood analogy. (6)

COMPUTER SCIENCE, PAPER-II

- Q. No. 5.** (a) Compare the file systems of UNIX and Windows in terms of structure, permissions, and file organization. How do these file systems cater to the needs of diverse computing environments? (7)
- (b) How does an operating system mediate between application programs and the computer hardware? Discuss the key roles and responsibilities of an operating system in managing resources. (7)
- (c) What is process management in the context of operating systems? How does the operating system handle processes, and what role does it play in multitasking? (6)

(SECTION – B)

- Q. No. 6.** (a) Elaborate on the evolution of database systems, highlighting major milestones. Discuss the impact of emerging technologies on the field of database systems. (7)
- (b) Write a SQL query involving multiple tables and incorporating JOIN operations. Discuss the potential pitfalls and optimizations related to complex SQL queries. (7)
- (c) What are distributed databases, and why are they used? Discuss the advantages and challenges of managing data in a distributed environment. (6)
- Q. No. 7.** (a) Explain the algorithms used for point detection, line detection, edge detection, and boundary detection in digital images. Discuss the strengths and limitations of these techniques. (7)
- (b) Provide detailed explanations and applications of morphological operators like erosion, dilation, opening, closing, skeletonization, and thinning in image processing. (7)
- (c) Compare and contrast various image sensing and acquisition techniques. Discuss the advantages and limitations of different methods such as CCD and CMOS. (6)
- Q. No. 8.** (a) Develop a numerical comparison between client-side functionalities implemented using different JavaScript patterns. Discuss how these patterns impact code maintainability and performance? (7)
- (b) Discuss data aspect architectures in web development. How do these architectures address challenges related to data storage, retrieval, and management? (7)
- (c) Create a numerical comparison of the efficiency of data exchange using different APIs, such as REST and GraphQL. Discuss the considerations in choosing the appropriate API for a given scenario. (6)



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Roll Number

COMPUTER SCIENCE, PAPER-I

TIME ALLOWED: THREE HOURS	(PART-I MCQs) MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II) MAXIMUM MARKS: 80
NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes. (ii) Overwriting/cutting of the options/answers will not be given credit. (iii) There is no negative marking. All MCQs must be attempted.	

PART-I (MCQs)(COMPULSORY)

- Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)**
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. **What is the degree of leaf node in a tree?**
(A) 0 (B) 1 (C) 2 (D) None of these
2. **What is the main goal of Capability Maturity Model Integration (CMMI)?**
(A) To enhance maturity of software process (B) To increase the quality of software
(C) To provide user friendly experience (D) None of these
3. **Which type of software testing is used to confirm whether the software is according to customer's requirements?**
(A) Performance testing (B) Acceptance testing (C) Regression testing (D) None of these
4. **Which of the following is commonly used for measuring the performance of supercomputers?**
(A) Gigahertz (GHz) (B) Teraflops (Tflops) (C) Petabyte (PB) (D) None of these
5. **Which software development model uses iterative cycles and continuous development?**
(A) Agile model (B) Spiral model (C) V-model (D) None of these
6. **Which of the following is the false statement in C language?**
(A) static a = 10; (B) static int func (int); (C) static static int a; (D) None of these
7. **Which programming language uses the concept of friend function?**
(A) Python (B) Java (C) C# (D) None of these
8. **What is meant by refactoring code in SDLC?**
(A) To modify the functionality of software (B) To improve the code quality
(C) To find out bugs in a software (D) None of these
9. **What is the main purpose of using Trojans?**
(A) To get passwords (B) To delete data (C) To corrupt files (D) None of these
10. **What is the correct data structure for implementing Huffman algorithm?**
(A) Priority queue (B) Linked list (C) Binary Tree (D) None of these
11. **Which asymptotic notation gives the strict upper bound for a function?**
(A) Omega notation (B) Big O notation (C) Theta notation (D) None of these
12. **Which one of the following is the fastest way of searching for a given key?**
(A) Sorted array (B) Linked list (C) Binary search tree (D) None of these
13. **What is the role of parser?**
(A) To check logical errors (B) To find syntax errors
(C) To identify run-time errors (D) None of these
14. **Which optimization method involves minimizing the memory access count in a program?**
(A) Constant folding (B) Register allocation (C) Instruction scheduling (D) None of these
15. **What is the output of the following code?**

```
int main(){  
    int a = 40;  
    int* ptr = &a;  
    int& ref = *ptr;  
    ref = 60;  
    cout << a;  
}
```


(A) 40 (B) 60 (C) Error (D) None of these
16. **The process of deleting an element from an empty stack is called:**
(A) Overflow (B) Deletion (C) Underflow (D) None of these
17. **How is the head node deleted in a doubly circular linked list?**
(A) By adjusting the prev pointer of the new head node to null.
(B) By setting the next pointer of prev node to point to new head.
(C) By pointing the next pointer of last node to null. (D) None of these

COMPUTER SCIENCE, PAPER-I

18. Which technique works by selecting the local optimal choice at each step?
(A) Dynamic Programming (B) Divide and Conquer (C) Greedy Algorithm (D) None of these
19. What is the time complexity of searching for an element in a hash table?
(A) $O(1)$ (B) $O(n)$ (C) $O(n \log n)$ (D) None of these
20. Which phase of compiler is responsible for abstract syntax tree (AST) generation?
(A) Syntax analysis (B) Semantic analysis (C) Lexical analysis (D) None of these

PART-II

- NOTE:** (i) Part-II is to be attempted on the separate Answer Book.
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(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.

SECTION-A

- Q. No. 2.** (a) How is the Generative AI creating impacts on our society? Discuss the benefits and challenges associated with its use. Support your answer by adding examples. (6)
(b) Provide a comparison of different data storage devices in terms of speed, size, access time and cost. (6)
(c) What are Two's Complement numbers? Explain the working of it with examples. Discuss the practical scenarios where these numbers are used. (8)
- Q. No. 3.** (a) What is the difference between shallow copy and deep copy of creating objects in C++. Discuss the cases where a specific copy should be used by providing examples. (6)
(b) State the difference between const keyword and static keyword in C++. Illustrate each keyword with suitable examples. (6)
(c) Explain the role of pure virtual functions in implementing abstract classes in C++. How do they differ from virtual functions? Give an example of C++ classes where both types of functions are used. (8)
- Q. No. 4.** (a) Write a C++ program to output the arithmetic series of n terms. The series formula for calculating the sum of n terms is as follows: $S_n = \frac{n}{2} [2a + (n-1)d]$, with values $a = 5$, $d = 3$ and $n = 6$, where a = first term, d = common difference and n = number of terms. (6)
(b) Write a C++ program to calculate and display the product of two matrices of order 2×2 . The program should prompt the user to provide values of both matrices (6)
(c) Write a C++ program to demonstrate the two different complex numbers using structure. The program should use function to calculate the sum of complex numbers and display their result in the specific format such as $(a + bi)$, where a and b are the real and imaginary part respectively and i is imaginary unit such as $i = \sqrt{-1}$. (8)

SECTION-B

- Q. No. 5.** (a) Demonstrate the use of stream insertion and extraction operators for creating custom objects. Provide a suitable coding example for illustrating the functional difference between them. (10)
(b) Implement a Book Management System consisting of three different classes. The book class should have data members such as book name, ISBN number, and publication year. The author class should have attributes such as author name, and author email. The publisher class contains attributes such as publisher name, publisher email and publisher address. Each book has an author and a publisher. The author and publisher are created and destroyed with books. When the book is deleted, the corresponding author and publisher should also be deleted. Write a C++ code of this system and explain how the composition relationship is used in this system. (10)

COMPUTER SCIENCE, PAPER-I

- Q. No. 6.** (a) What are self-balancing Binary Search Trees? Under what circumstances, the self-balancing Binary Search Trees are preferred over Binary Search Tree? (6)
- (b) Give pseudocode of implementing Fibonacci sequence recursively. Find the time complexity of this approach and explain how it is calculated. (6)
- (c) Suppose you are the owner of a small manufacturing company that delivers goods to customers. During the sale season, you received a huge number of orders. To efficiently manage the orders, you need to sort the packages based on their weights. You are provided with the weights of 10 parcels (in kilograms) as shown below. Use the quick sort method to sort these parcels in ascending order. (8)
- Weights:** [30, 45, 10, 20, 75, 15, 85, 40, 05, 65]
- Clearly indicate the choice of pivot and reason for it. Provide a graphical representation with explanation at each step.
-
- Q. No. 7.** (a) A project management involves different types of planning stages to finalize the project. Discuss the different types of planning phases conducted during software development with list of specific tasks performed during each planning stage. (6)
- (b) Illustrate the difference between software validation and software verification testing techniques. Give examples to strengthen your answer. Clearly elaborate the case where each type of technique should be used. (6)
- (c) What is the Software Process Improvement (SPI) framework? Highlight the different steps of SPI framework and the key elements involved. Also provide the description of the models used within SPI framework and how to determine the projects for which SPI framework should be used. (8)
-
- Q. No. 8.** (a) Create a regular expression for the language that always starts with string “ baa ”. Also draw the deterministic finite automata (DFA) for such language. Provide a clear explanation of each step. (6)
- (b) What is Instruction Scheduling? Explain its role during code generation process. (6)
- (c) What is a parse tree? How the parse tree is used to check whether a specific string belongs to a language or not. Provide example to elaborate this. (8)



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COMPUTER SCIENCE, PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II)	MAXIMUM MARKS: 80
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PART-I (MCQs)(COMPULSORY)

- Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)**
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.
- A stack is:**
(A) An 8 bit register in microprocessor (B) A 16 bit register in microprocessor
(C) A set of memory location in R/WM reserved for storing information temporarily during the execution of computer. (D) A 16-bit memory address stored in program counter
 - Data hazards occur when:**
(A) Greater performance loss (B) Pipeline changes the order of read/write access to operands
(C) Some functional unit is not fully pipelined (D) Machine size is limited
 - If computer A executes a program in 10 seconds & Computer B runs same in 15 seconds, how much faster is computer A than B?**
(A) 5.1 times (B) 1.4 times (C) 1 time (D) 1.5 times
 - Processor having Clock cycle of 0.25ns will have clock rate of:**
(A) 2 GHz (B) 3 GHz (C) 4 GHz (D) 8 GHz
 - Which of the following comes under the application of image blurring?**
(A) Object detection (B) Gross representation (C) Object motion (D) Image segmentation
 - For a continuous image $f(x, y)$, Quantization is defined as:**
(A) Digitizing the coordinate values (B) Digitizing the amplitude values
(C) Both (A) & (B) (D) None of these
 - What is the method that is used to generate a processed image that has a specified histogram?**
(A) Histogram linearization (B) Histogram equalization
(C) Histogram matching (D) Histogram processing
 - A _____ in a table represents a relationship among a set of values.**
(A) Column (B) Key (C) Row (D) Entry
 - Which forms are based on the concept of functional dependency?**
(A) 1NF (B) 2NF (C) 3NF (D) 4NF
 - In case of any shutdown during transaction before commit, which of the following statement is done automatically?**
(A) View (B) Commit (C) Rollback (D) Flashback
 - Process synchronization can be done on:**
(A) Hardware level (B) Software level (C) Both (A) & (B) (D) None of these
 - Which module gives control of the CPU to the process selected by the short-term scheduler?**
(A) Dispatcher (B) Interrupt (C) Scheduler (D) None of these
 - If the semaphore value is negative:**
(A) Its magnitude is the number of processes waiting on that semaphore (B) It is invalid
(C) No operation can be further performed on it until the signal operation is performed on it
(D) None of these
 - For 3 page frames, the following is the reference string:**
7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1
How many page faults does the LRU page replacement algorithm produce?
(A) 10 (B) 15 (C) 11 (D) 12
 - What is DOM?**
(A) Hierarchy of objects in ASP.NET (B) Application programming interface
(C) Convention for representing and interacting with objects in html documents
(D) Language dependent application programming

COMPUTER SCIENCE, PAPER-II

16. Which error is invoked when SQLTransaction Callback does not execute?
(A) INVALID_ACCESS_ERR (B) UNKNOWN_ERR
(C) TIMEOUT_ERR (D) INVALID_STATE_ERR
17. Which of the following property defines labels for a list of items?
(A) List-shape (B) List-style (C) List-type (D) List-style-type
18. ICMP is primarily used for:
(A) Error and diagnostic functions (B) Addressing (C) Forwarding (D) Routing
19. Which multiplexing technique is used to transmit digital signals?
(A) FDM (B) TDM (C) WDM (D) FDM & WDM
20. DHCP (dynamic host configuration protocol) provides _____ to the client.
(A) IP address (B) MAC address (C) Url (D) None of these

PART – II

NOTE: (i) Part-II is to be attempted on the separate Answer Book.
(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the attempted question will not be considered.

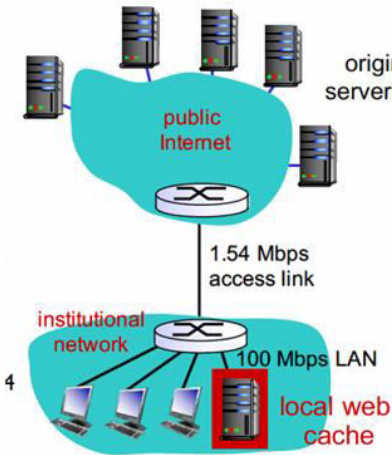
(SECTION – A)

- Q. No. 2. (a)** An instruction requires five stages to execute: (3)
- | | | |
|--------------------------------------|---|-------|
| Stage-1 (instruction fetch) requires | = | 30 ns |
| Stage-2 (instruction decode) | = | 9 ns |
| Stage-3 (instruction execute) | = | 20 ns |
| Stage-4 (Memory access) | = | 35 ns |
| Stage-5 (Store results) | = | 10 ns |
- An instruction must proceed through the stages in sequence. What is the minimum asynchronous time for any single instruction to complete?
- (b) Consider a single-level cache with an access time of 2.5 ns, a line size of 64 bytes, and a hit ratio of $H = 0.95$. Main memory uses a block transfer capability that has a firstword (4 bytes) access time of 50 ns and an access time of 5 ns for each word thereafter.
- (i) What is the access time when there is a cache miss? Assume that the cache waits until the line has been fetched from main memory and then re-executes for a hit. (3)
- (ii) Suppose that increasing the line size to 128 bytes increases the H to 0.97. Does this reduce the average memory access time? (4)
- (c) (i) Compare the set of addressing modes of RISC and CISC machines. Give one example of addressing modes used in RISC and CISC respectively. (5)
- (ii) Explain Parallel Processing, and also draw pipeline processing for instruction: $A_i * B_i + C_i$ (5)

- Q. No. 3. (a) Answer the Following Questions:**
- (i) Is it possible for an organization's Web server and mail server to have exactly the same alias for a hostname (for example, foo.com)? What would be the type for the RR that contains the hostname of the mail server? (2)
- (ii) Draw the structure of Internet in terms of ISPs, also show the concept in terms of Edge and Core networks. (3)
- (iii) A packet switch receives a packet to be forwarded. When the packet arrives, one other packet is halfway done being transmitted on this outbound link and four other packets are waiting to be transmitted in FIFO manner. Suppose all packets are 1,500 bytes and the link rate is 2 Mbps. What is the queuing delay for the packet? (3)
- (iv) Why do HTTP, FTP, SMTP, and POP3 run on top of TCP rather than on UDP? (2)

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- (b) (i) Why do we need conditional GET when we have regular GET with respect to HTTP?
What is its difference in comparison to GET? (4)
- (ii) With respect to web caching, if an average object size is 100K bits and the average request rate from browsers to origin servers is 15/sec. Suppose RTT from an institutional router to any origin server is 2 sec. If LAN speed is 100Mbps and access link speed is 1.54 Mbps then with a cache hit of 50%, how much total delay will be there? (6)



- Q. No. 4. (a) A benchmark program is run on a 40 MHz processor. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count: (10)

Instruction Type	Instruction Count	Cycles per Instruction
Integer arithmetic	45,000	1
Data transfer	32,000	2
Floating point	15,000	2
Control transfer	8000	2

Determine the effective CPI, MIPS rate, and execution time for this program.

- (b) What are the differences among sequential access, direct access, and random access? Also, write and explain the general relationship among access time, memory cost, and capacity. (10)

- Q. No. 5. (a) Consider the following pseudo code for producer and consumer: (10)

<pre>// producerdo { //produce an item //place in buffer }while(true);</pre>	<pre>// consumerdo { // remove item from buffer // consumes item }while(true);</pre>
---	---

- (i) What is race condition? (2)
- (ii) Is there any possibility of the race condition if two threads named producer and consumer simultaneously execute the above functions? Provide the reasoning in two-three sentences. (2)
- (iii) Add the necessary synchronization in the above functions, you may use semaphores or mutex. You may provide just pseudo code or exact C/C++ code. (3)
- (iv) Consider a process that uses a user level threading library to spawn 10 user level threads. The library maps these 10 threads on to 2 kernel threads. The process is executing on a 8-core system. What is the maximum number of threads of a process that can be executing in parallel? (3)
- (b) Consider a multi-level memory management scheme with the following format for virtual addresses:

Virtual Page # (10 bits)	Virtual Page # (10 bits)	Offset (12 bits)
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COMPUTER SCIENCE, PAPER-II

Virtual addresses are translated into physical addresses of the following form:

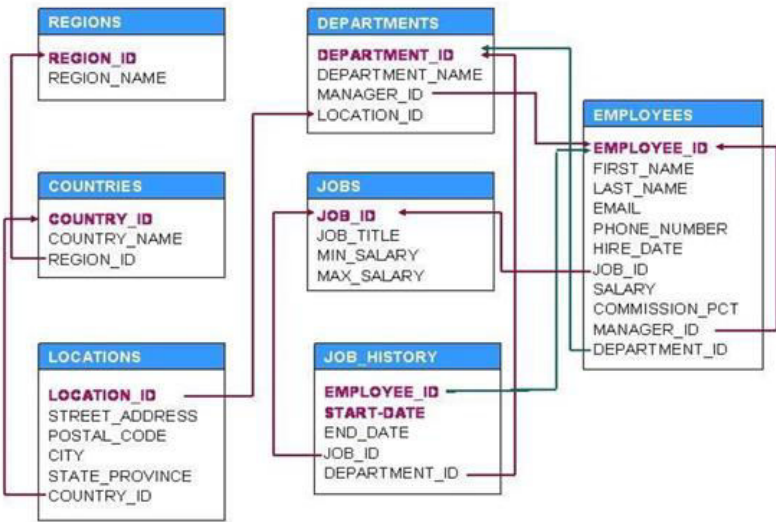
Physical Page # (20 bits)	Offset (12 bits)
------------------------------	---------------------

Page table entries (PTE) are 32 bits and contain the 20-bit physical page number and OS bookkeeping bits (e.g., valid, dirty, used, etc.).

- (i) How big is a page? (1)
- (ii) What is the maximum amount of memory (in bytes) in a single virtual address space? Explain your answer. (3)
- (iii) What is the maximum amount of physical memory (in bytes) that this memory management scheme supports? Explain your answer. (3)
- (iv) Sketch the format of the page table for the multi-level virtual memory management scheme. Illustrate the process of resolving an address as well as possible. Assume there is no TLB or cache. (3)

(SECTION – B)

Q. No. 6. (a) Answer the questions i, ii, according to given schema.



- (i) Display the length of first name and length of second name for employees where last name contains character ‘b’ after 3rd position. (2)
- (ii) Display job title, department name, employee last name, starting date for all jobs from 1992 to 1998. (3)
- (iii) Differentiate between Left outer join, Right outer join and Full outer join. Explain your answer with the help of Venn Diagram. (5)
- (b) Provide brief answers to the following questions: (5)
- (i) Differentiate between Single row Sub-Query and Multi row Sub-Query and write a sample query too. (5)

(ii) Discuss the role of Primary Keys, foreign keys, and indexes in database schema. Also, explain their significance in ensuring data accuracy, enforcing referential integrity and improving query performance. (5)
- Q. No. 7. (a) In the context of compression, differentiate between coding, spatial and temporal redundancies. (6)
- (b) What is translation and scaling? Find the number of bits required to store a 256x256 image with 32 gray levels. (6)
- (c) What is Histogram equalization? Explain the process and discuss its uses. (8)
- Q. No. 8. (a) What is the role of requirement engineering in web engineering? List functional and non- functional requirements for a website. (6)
- (b) What are different security mechanisms used for encrypting the contents of a website? Explain any one in detail. (6)
- (c) Explain 3-tier web application architecture. (8)



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2026 FOR RECRUITMENT TO
POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT

Roll Number

COMPUTER SCIENCE, PAPER-I

TIME ALLOWED: THREE HOURS	(PART-I MCQs) MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II) MAXIMUM MARKS: 80
NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes. (ii) Overwriting/cutting of the options/answers will not be given credit. (iii) There is no negative marking. All MCQs must be attempted.	

PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the OMR Answer Sheet.(20x1=20)
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. **A company wants to upgrade its storage media for fastest possible data access. Which one is the best option?**
(A) Hard Disk Drive (HDD) (B) Optical Drive (C) Solid State Drive (SDD) (D) None of these
2. **A programmer is developing software and needs to consider ethical challenges. What is a major concern?**
(A) Data encryption (B) Plagiarism (C) User interface (D) None of these
3. **A programmer wants to group different data types. What should he/she use?**
(A) Structures (B) Arrays (C) Unions (D) None of these
4. **A class needs to allow different implementations of a method. What concept to use?**
(A) Inheritance (B) Polymorphism (C) Encapsulation (D) None of these
5. **What is the purpose of using virtual functions in inheritance?**
(A) To prevent overriding (B) To hide members (C) To enable polymorphism (D) None of these
6. **How does the history of computing influence modern computer architecture?**
(A) By dictating hardware design (B) By shaping software development
(C) By influencing both hardware and software (D) None of these
7. **A function needs to modify an input variable. How should the parameter be passed?**
(A) By value (B) By reference (C) By pointer (D) None of these
8. **A developer wants to define a class with methods that can be used with different data types. What to use?**
(A) Templates (B) Inheritance (C) Polymorphism (D) None of these
9. **Which operator is typically overloaded for stream insertion?**
(A) << (B) >> (C) + (D) None of these
10. **What does the Standard Template Library (STL) provide in C++?**
(A) Pre-defined classes for GUI (B) Pre-defined functions for math operations
(C) Pre-defined containers and algorithms (D) None of these
11. **You are analyzing an algorithm's efficiency. What do you consider?**
(A) Code length (B) Time and space complexity (C) Programmer's experience (D) None of these
12. **In Hash Tables, what is a collision resolution technique?**
(A) Linear Search (B) Binary Search (C) Chaining (D) None of these
13. **In Recursion, what is crucial to prevent infinite loops?**
(A) Base case (B) Recursive call (C) Loop usage (D) None of these
14. **You are leading an Agile team developing a mobile app. What's the primary focus?**
(A) Detailed upfront planning (B) Strict adherence to initial requirements
(C) Both (A) & (B) (D) Iterative development and customer feedback
15. **A compiler needs to recognize tokens. Which phase does this?**
(A) Syntax Analysis (B) Lexical Analysis (C) Code Generation (D) None of these
16. **What is the advantage of using LL(1) grammars in the Syntax Analysis?**
(A) More complex parsing (B) Predictive parsing with less complexity
(C) No need for grammar rules (D) None of these
17. **What is the difference between Top-down and Bottom-up parsers?**
(A) Top-down is always faster (B) Bottom-up handles more grammars
(C) Top-down starts from start symbol (D) None of these
18. **What do compilers use for recognizing tokens?**
(A) Regular expressions (B) Context-free grammars (C) Machine code (D) None of these
19. **A project is behind schedule. What is a likely Agile response?**
(A) Add more developers (B) Work longer hours
(C) Both (A) & (B) (D) Review scope and priorities with team
20. **A project is using open-source components with security vulnerabilities. What is the risk?**
(A) Security breaches or compliance issues (B) Non-technical issues
(C) Open-source issues (D) None of these

PART-II

- NOTE: (i) Part-II is to be attempted on the separate Answer Book.
(ii) Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION. ALL questions carry EQUAL marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.

SECTION-A

- Q. 2. (a) Your team needs to share large files quickly but email limits attachments. What computing method should they use and how will it solve the issue? (6)
(b) You receive an email asking for your banking details. What kind of risk or security issue this might be? How to respond? (6)
(c) Your office plans to upgrade hardware but employees don't know what components matter. Which computer hardware components would you explain to help them choose better systems? (8)
- Q. 3. (a) What is bit manipulation in programming and why is it used? Give two examples of its use. (6)
(b) What are arrays? Describe one advantage and one limitation. (6)
(c) Write pseudocode to reverse an array using pointers. (8)
- Q. 4. (a) Why cannot we instantiate an abstract class directly, even though it may contain complete functions? (6)
(b) A class library contains many book objects. Should this be modeled using inheritance or composition? Why? (6)
(c) Demonstrate method overriding using a base class Account and derived class Current Account. Make balance a protected data member. (8)

SECTION-B

- Q. 5. (a) Why is Binary Search not suitable for an unsorted list? (6)
(b) What is the difference between Time Complexity and Space Complexity? Explain with examples. (6)
(c) Write an algorithm with an example showing how Stack can be used to evaluate a postfix expression. (8)
- Q. 6. (a) Why is Maintenance the most expensive phase of the software lifecycle? (6)
(b) What is the purpose of Use Case Diagrams? (6)
(c) Why do Agile projects need frequent customer interaction? (8)
- Q. 7. (a) Construct a Deterministic Finite Automaton (DFA) for the regular expression (a|b)*abb. (6)
(b) Explain the difference among lexeme, token, and pattern with examples. (6)
(c) Consider the three-address code: (8)
t1 = a + b
t2 = t1 + c
t3 = t2 + d
If the machine has only two registers, how should the compiler allocate registers to minimize memory spills?
- Q. 8. (a) Suppose a lexical analyzer is scanning code and encounters the following input string: (6)
9var = x + 12abc;
Describe step-by-step how the lexical analyzer processes this input, identifies errors, and generates tokens. Explain which specific rules of lexical analysis it uses.
(b) A software team is building an online examination system. During requirements gathering, the client says they want "very strong security," but teachers want "fast login without multiple checks." The development team becomes confused because the requirements conflict. Explain how the team should resolve this conflict using proper Software Engineering techniques. Also describe the impact of wrong requirement handling on the SDLC. (6)
(c) A company maintains millions of product IDs and frequently performs searching, insertion, and deletion. The data volume is extremely large, and performance is critical. Which data structure would be most suitable—Binary Search Tree, AVL Tree, Hash Table, or Array? Justify your answer logically using time complexity and memory considerations. (8)



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COMPUTER SCIENCE, PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	MAXIMUM MARKS: 20
PART-I (MCQs) : MAXIMUM 30 MINUTES	(PART-II)	MAXIMUM MARKS: 80
NOTE: (i) First attempt PART-I (MCQs) on separate OMR Answer Sheet which shall be taken back after 30 minutes . (ii) Overwriting/cutting of the options/answers will not be given credit. (iii) There is no negative marking. All MCQs must be attempted.		

PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ☐ on the **OMR Answer Sheet.(20x1=20)**
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. **Which of the following statement is true about overloading and overriding?**
(A) Overloading and overriding is same
(B) Overloading and overriding are different but inheritance is not involved in to implement any concept
(C) Overloading is performed within same class but overriding is performed among different classes
(D) None of these.
2. **Which of the following statement is true about private data members?**
(A) Can't accessible outside class but through public methods of that class.
(B) Can be accessible outside class using objects of that class
(C) Can be accessible outside class
(D) None of these
3. **In histogram equalization, applying the technique to each RGB channel independently often causes:**
(A) Improved color constancy
(B) Better noise suppression
(C) Color distortions due to channel imbalance
(D) None of these
4. **In a pipelined processor, what is the primary purpose of the instruction pipeline?**
(A) To increase the clock speed of the processor
(B) To execute multiple instructions simultaneously
(C) To reduce the number of instructions in a program
(D) None of these
5. **When applying a 2D Fourier Transform to an image, shifting the image spatially causes which corresponding effect in the frequency domain?**
(A) Phase modulation
(B) Amplitude scaling
(C) Frequency doubling
(D) None of these
6. **In morphological image operations, the key property that distinguishes opening from closing is that opening tends to:**
(A) Fill narrow gaps
(B) Remove thin protrusions
(C) Produce higher contrast
(D) None of these
7. **The main purpose of using a Laplacian of Gaussian (LoG) operator in image analysis is to:**
(A) Detect extremely low-frequency patterns
(B) Identify regions of uniform color
(C) Localize edges by combining smoothing and second-order derivatives
(D) None of these
8. **The Data Definition Language (DDL) describes**
(A) How data are structured in the data base
(B) The DBMS what is required; the techniques used to process data
(C) How data must be structured to produce the user's view
(D) None of these
9. **Data Encryption Standard (DES) generates _____ bit round keys.**
(A) 16
(B) 32
(C) 48
(D) None of these
10. **In symmetric key cryptography, sender and the receiver uses _____ keys.**
(A) Shared
(B) Two
(C) No
(D) None of these
11. **In modern micro-frontend architectures, the primary benefit of independently deployed UI fragments is:**
(A) Tighter coupling across teams
(B) Improved runtime bundling only
(C) Enhanced isolation and autonomous deployment pipelines
(D) None of these
12. **HTTP/3 improves performance over HTTP/2 mainly because it:**
(A) Uses TCP with modified congestion control
(B) Replaces TLS with a custom encryption protocol
(C) Operates over QUIC to avoid head-of-line blocking
(D) None of these
13. **A major advantage of using Web Assembly in computationally intensive web applications is that it:**
(A) Eliminates the need for JavaScript entirely
(B) Enables near-native execution speed in browsers
(C) Works only on server-side rendering engines
(D) None of these
14. **The _____ is one of the fundamental components of a DBMS.**
(A) System catalogue
(B) Metadata
(C) Information Resource Dictionary System
(D) None of these
15. **Which of the following is not a function of DBMS?**
(A) Recovery services
(B) Support for data communication
(C) Funneling
(D) None of these
16. **Which of the following is not involved in DBMS?**
(A) HTML
(B) Application Request
(C) End Users
(D) None of these
17. **In peer-to-peer networking:**
(A) There is only one server and many clients
(B) Every computer is capable of playing the role of client, server or both at the same time
(C) There is only one client and many servers
(D) None of these

COMPUTER SCIENCE, PAPER-II (2026)

18. **You got a hardware resource conflict, it will more likely be an IRQ conflict rather than an i/o conflict because:**
(A) The BIOS sometimes has more of a problem controlling IRQs (B) I/O addresses cannot conflict
(C) There are a lot more I/O addresses than IRQs. (D) None of these
19. **The part of OS which decides what to do when main memory full is:**
(A) Process Scheduler (B) Memory Manager (C) File System (D) None of these
20. **Which of these is a method of file protection?**
(A) Access Control (B) Deleting a file (C) Hiding a file (D) None of these

PART – II

NOTE: (i) Part-II is to be attempted on the separate Answer Book.	
(ii)	Attempt ONLY FOUR questions from PART-II by selecting TWO questions from EACH SECTION . ALL questions carry EQUAL marks.
(iii)	All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv)	Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
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SECTION – A

- Q. No. 2.** Machine instructions serve as a critical interface between hardware and software. (20)
Compare the representation and execution behavior of machine instructions in CISC and RISC based architectures. Evaluate how the instruction-cycle organization shapes the design of the control unit hardwired vs. microprogrammed.
- Q. No. 3.** Explain the synergistic relationship between instruction-level parallelism (ILP), (20)
superscalar execution, and multi-core architectures in modern CPU design. Analyze how their combined use affects the design of the instruction pipeline, the mitigation of control hazards, and the resultant overall processor throughput.
- Q. No. 4.** In large-scale distributed networks, congestion control and avoidance mechanisms are (20)
essential for maintaining service quality. Provide a detailed analysis of the congestion-handling strategies employed in TCP, and contrast them with the limitations of UDP in similar conditions. Explain why transport-layer design decisions influence overall network stability.
- Q. No. 5.** Modern operating systems balance efficiency and fairness while scheduling processes. (20)
Critically evaluate how multi-level feedback queues evolve process priorities over time. Discuss how this design influences CPU utilization and starvation compared to simpler scheduling algorithms.

SECTION – B

- Q. No. 6.** Normalization aims to improve schema quality. Discuss how violations of functional and (20)
multivalued dependencies lead to structural anomalies. Evaluate whether higher normal forms (3NF, BCNF, 4NF) always benefit large-scale Online Transaction Processing (OLTP) databases systems.
- Q. No. 7.** Morphological operations offer powerful tools to manipulate shape-based features. (20)
Discuss the mathematical foundation of dilation, erosion, opening, and closing, and evaluate their use in tasks such as document analysis or medical image preprocessing.
- Q. No. 8.** Feature extraction is central to computer vision. Describe how edge detection techniques (20)
differ in their response to noise, texture, and illumination variations. Compare boundary localization accuracy among classical detectors such as Sobel, Canny, and Laplacian-based methods.