Visva-Bharati
B.Sc.(hons) Examination NEP, 2025
Semester–IV
Computer Science
Course: MJCS07T
[Object Oriented Programming]

Time: 3 hours | Full Marks: 60

Questions are of values indicated in the margin
Answer question 1 and any four from the rest

1. a) What is static data in the context of C++?
   b) Write a program to count the number of objects created for a particular class.
   c) Write a C++ program to convert Rectangular to Polar coordinate. Use constructors appropriately.
   2+5+5 =12

2. a) Define a class "vector" to represent vectors of dimension n (to be supplied at runtime). Include function for dot product of two vectors. Also include function to display the vector in the format "(a,b,.....,z)".
   b) What is function overloading? Explain with example.
   8+4 =12

3. a) What is call by reference? Explain with example.
   b) Write a C++ program to create a class called "Matrix" to represent the matrices of dimension m x n which will be supplied at runtime. Hence include methods "mult" for multiplication and "display" for display of matrices respectively.
   5+7 =12

4. a) Create a class "link" to handle linked list using C++. Include a method to insert a node into the link list.
   b) Explain the inline function with example.
   (4+4)+4=12

5. a) What is operator overloading? What are the restrictions related to it?
   b) Define a class called "complex" to represent complex numbers. Overload the operator "*" for multiplication of two complex numbers and display the result in proper format.
   (2+3)+ 7=12

6. a) What are the different forms of inheritance supported by C++? Explain with examples.
   b) What is a Pure Virtual Function? Explain with a suitable example.
   8+4=12

7. a) What is a template? Write a template for adding two numbers of different data types.
   b) Differentiate between early binding and late binding with example(s).
   7+5=12

Four Year Undergraduate Examination, 2025
Semester-IV
Computer Science (Major)
Paper: MJCS09T (Theory)
(Operating Systems)

Time: 3 Hours

Full Marks: 60

Questions are of value as indicated in the margin.
Answer **Question No. 1** and **any five** from the rest.

1. Answer **any five** of the following:
a) What is a process control block?
b) Differentiate between a process and a thread.
c) What is spin-lock?
d) Consider two concurrently running processes: P_1 with a statement S_1 and P_2 with a statement S_2. Suppose we require that S_2 be executed only after S_1 has completed. Solve the synchronization problem using semaphores.
e) What is thrashing?
f) Differentiate between Unix internal and external commands.
g) What is a Unix shell?

2×5=10

2. a) Considering the following list of concurrently executed jobs, determine the CPU Gantt chart and calculate the average turnaround time and average waiting time for each of the preemptive shortest-job-first and round-robin CPU scheduling techniques, where time quantum is 4. Further, calculate the CPU utilization for the round-robin scheduling algorithm where context-switching overhead is 0.2 ms.

Process	CPU burst time (ms)	Arrival time
P_0	8	0
P_1	6	1
P_2	4	2
P_3	10	3

b) How can the exponential average be used to implement the shortest-job-first CPU scheduling technique?
c) What is the major problem with the priority scheduling technique? How can the problem be resolved?

6+2+2=10

3. a) Briefly explain two different ways to prevent deadlock.
b) Consider the following snapshot of a system:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	1	2	1	5	2	0
P_1	1	0	0	0	1	7	5	0				
P_2	1	3	5	4	2	3	5	6				
P_3	0	6	3	2	0	6	5	2				
P_4	0	0	1	4	0	6	5	6				

Answer the following questions using the banker's algorithm:
Is the system in a safe state? If a request from process P_1 arrives for (0, 4, 2, 0), can the request be granted immediately? Justify in support of your answer.
c) When is a cycle in the resource-allocation graph a necessary but not sufficient condition for deadlock? Answer with a proper example.

2+(3+2)+3=10

4. a) What are the purposes of *fork()* and *exec()* system calls in connection with the process life cycle?
b) A system implements a paged virtual address space for each process using a one-level page table. The maximum size of virtual address space is 16 MB. The page table for the running process includes the following entries:

Page No.	Frame No.
0	1
1	3
2	5
3	2
4	4

The page size is 1 KB, and the maximum physical memory size of the machine is 4 MB. How many bits are required for each page table entry? How many entries are there in a page table? How many bits are there in a virtual address? To which physical address will the virtual address 2050 be translated? Which virtual address will translate to physical address 1024?

3+(1+1+1+2+2)=10

5. a) Find the page reference string for the following virtual addresses by the CPU in a time span. Assume that addresses are all in decimal and page size is 1000 bytes.
1050, 1000, 2030, 3020, 4003, 4100, 1000, 2050, 5005, 1010, 2020, 2010, 3000, 4050, 5050, 5030.
Find the number of page faults for the FIFO and LRU page replacement algorithms with 4 frames. You need to show the value of the counters for the LRU page replacement algorithm by assuming that it is implemented using counters. Also, assume that pure demand paging is used.
b) What is the importance of the optimal page replacement algorithm?
c) Consider a paging system with the page table stored in memory. If a memory reference takes 200 nanoseconds, how long does a paged memory reference take? If we add TLB, and 80 percent of all page-table references are found in the TLB, what is the effective memory reference time? Assume that finding a page table entry in the TLB takes 20 nanoseconds, if the entry is present.

(1+2+2)+2+(1+2)=10

6. a) State the classical readers-writers synchronization problem and provide a solution using semaphores.
b) Consider a file system that maintains a unique index node for each file in the system. Each index node includes eight direct pointers, three single indirect pointers, two double indirect pointers, and one triple indirect pointer. The block size of the file system is 1 KB, and a block pointer occupies 4 bytes. What is the maximum file size that the file system can support?
c) Briefly explain the inverted page table.

4+3+3=10

7. Write short notes on **any two** of the following:
a) System calls.
b) Resource allocation graph.
c) Segmentation.
d) SCAN disk scheduling.

5×2=10

Four-Year Undergraduate Programme under NEP-2020
Semester-IV
Year – 2025
Major – Computer Science
Paper – MJCS10(Theory): Computational Statistics

Full Marks – 60 Time – 3 hours

Questions are of value as indicated in the margin.

Answer questions 1 and 2 and any three from the rest.

1. Mark True/False against each question number. [1X12 = 12]

a) If two events A and B are mutually independent and P_A and P_B are probabilities of A and B respectively, then their joint probability $P_{AB} = P_A * P_B$.

b) All mutually independent events are also mutually exclusive.

c) For any two events A and B, Prob(A/B) = Prob(A)/Prob(B).

d) Value of probability mass function of a discrete random variable is positive at all points.

e) If the random variable denoting number of vehicles arriving at a traffic signal within time T is Poisson distributed with average number of arrivals per unit time = λ, then the probability density function f(t) of the time between two successive arrivals = $\lambda e^{-\lambda t}$.

f) Gamma density is a special case of exponential density.

g) Binomial PMF is approximated to Gaussian PMF when the success probability p of each Bernoulli trial is very small and total number of trials N is very high, so that Np is finite.

h) If X is a random variable with cumulative distribution function $F_x(x)$ and $Y = F_x(X)$ is another random variable, then the cumulative distribution function $F_Y(y)$ is uniform.

i) Variance of a random variable $X = E(X^2) + \{E(X)\}^2$, where E(X) is the mean value of X and $E(X^2)$ is the mean value of X^2.

j) Sum of a large number of independent and identically distributed random variables has Gaussian distribution.

k) If X is an exponentially distributed random variable, then $Y = x_m e^X$ is Pareto distributed random variable.

l) Cumulative distribution function of a random variable is not necessarily a monotonically increasing function.

2. A student is quite irregular in 9AM class nowadays. Some of his batch-mates get curious about the reason and find out the following facts.

He gets up at 5 am, 6 am, 7 am and 8 am with probabilities 0.3, 0.4, 0.2 and 0.1 respectively. If he gets up at 5 am, 6 am, 7 am and 8 am, he falls asleep again after one hour of waking up with probabilities 0.8, 0.6, 0.3 and 0.1 respectively. His morning sleep duration is 3 hrs, 2 hrs, 1 hr and ½-an-hour with probabilities 0.3, 0.4, 0.2 and 0.1 respectively. Assume the time for getting ready after waking up and going to the class is negligible.

Find the probability of the student attending the morning class. [8]

Given that the student attends the morning class, find the probability of him getting up at 5 am. [4]

3. a) A football player is an expert in scoring goals from direct spot kicks or penalty shots, and has a scoring probability of 0.6 from spot kicks and 0.8 from penalty shots. He takes all spot kicks and penalty shots on behalf of the team. The team gets 8, 5 or 3 direct spot kicks with probabilities 0.1, 0.2 and 0.3, and 1 or 2 penalty shots with probabilities 0.1 and 0.05 respectively. Find the probability that he scores at least one goal through spot-kicks or penalty shots he takes in the match. [6]

b) Two teams A and B are playing a cricket test match series of 5 matches. Probability(Team A winning a match) = 0.4, Probability(Team B winning) = 0.3, Probability(Draw) = 0.3 .

Find the probability of the series getting drawn. [3]

Given that the series gets drawn, find the probability that Team B has won at least 1 match. [3]

4. Vehicles arrive at a traffic signal following a Poisson distribution with mean arrival rate = 8 vehicles/minute.

a) Find the probability of 5-10 vehicles arriving within 1 minute. [4]

b) Find the probability that, inter-arrival time of two vehicles is more than 20 seconds. [4]

c) Find the probability density function of the time of arrival of 10^{th} vehicle. [4]

5. a) A train arrives at a station everyday with probability of its arrival between 6 pm to 8 pm as follows : it increases linearly from 0 to a maximum value at 6:40 pm, and then decreases linearly to 0 at 8 pm. Find the maximum probability value. Also find the probability of its arrival within 6.15 to 6.55 pm. [3+3]

b) A person catches the above train after office. His arrival probability at the station also increases linearly from 0 within 6.15 to 6.45 pm and then decreases linearly to 0 at 7.45 pm. What is the probability of the person missing the train ? [6]

6. a) Find the mean and variance of the random variable X having probability density function $f_x(x) = \lambda^k/k!\ x^{k-1}\ e^{-\lambda x}$. [4+4]

b) What is the variance of service time of a shop if the service time is exponentially distributed with average service time is 1 minute ? [4]

7. a) The maximum relative humidity in %-age and the amount of rainfall for 10 days in a month is given below. Find the Pearson's linear correlation coefficient for the two sets of data. [12]

Maximum relative humidity	Rainfall in mm
89.5%	1.5
91.3%	10.7
85.5%	6.5
94.5%	21.3
98.5%	31.3
96.3%	9.5
92.8%	15.4
93.4%	8.2
84.3%	0.5
88.6%	4.3

B.Sc. (Honourse) Examination 2025
Semester- IV
Computer Science
Course: MJCS42T
(Software Engineering)

Time: 3 Hours **Full Marks: 60**

Questions are of value as indicated in the margin
Answer Question No. **1** and **any five** from the rest

1. Answer **any ten** questions: 1x10=10

a. Write the complete form of KLOC.
b. How does a semi-detached project differ from an organic project?
c. What are the disadvantages of the classical waterfall model?
d. What is regression testing
e. What are the job responsibilities of a software project manager?
f. Why Water fall model is not suitable for large project?
g. Write one advantage of spiral model over waterfall model.
h. What do you understand by People metrics?
i. What is a bug?
j. Explain is black box testing with example.
k. What is full form of COCOMO?
l. Explain beta testing.
m. What is SRS?

2. 1+4+2+3=10
a. What does SDLC stand for?
b. Briefly describe all the steps of waterfall model.
c. Mention disadvantages of the classical waterfall model?
d. Differentiate between waterfall model and prototype model?

3. 3+3+4=10
a. Differentiate between verification and validation.
b. Draw the diagram of V- Model and explain it.
c. How does it differ from the Prototype Model, and what are its advantages and limitations?

4. 2+3+5=10
a. Explain various types of COCOMO model.
b. Assume that the size of an organic type software product has been estimated to be 32,000 line of source code. Assume that the average salary of a software developer is Rs.15, 000 per month. Determine the effort required to develop the time and the cost to develop the product. 5+5=10

5.

a. Explain the Spiral Model of software development.
b. Why Spiral model is called Meta model? How the risk is identified in this model?
c. Mention the advantages and disadvantages of the Spiral model.

3+4+3=10

6.

a. Explain the RAD model and describe different phases of it.
b. What are Halstead complexity measures in software engineering?

5+5=10

7. Consider the code segment below:

```
{ int i, j, k;
 for (i=0 ; i<=N ; i++)
 p[i] = 1;
 for (i=2 ; i<=N ; i++)
 {
   k = p[i]; j=1;
   while (a[p[j-1]] > a[k] {
      p[j] = p[j-1];
      j--;
 }
   p[j]=k;
}
```

a. Draw the Control Flow Graph (CFG) of the above programme.
b. How many predicate node are there? Indicate them.
c. How many close regions are there? Indicate them.
d. Specify various independent paths of the CFG, hence identify the longest independent path.
e. Hence calculate the cyclomatic complexity. 2+2+3+3=10

8.

a. Explain cohesion and coupling in the context of Software Engineering?
b. Illustrate their significance in software design.
c. What are the different types of coupling?
d. Name then, elaborate any one type of coupling. 3+3+2+2=10

9.

a. List and explain different types of testing done during the testing phase.
b. What is acceptance testing?
c. Explain different testings in user acceptance testing.

4+4+2=10

10.

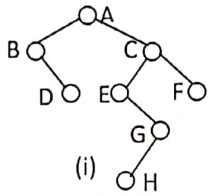
a. What is Software Requirement Specification (SRS) ?
b. What are the features of a good SRS?
c. What is feasibility study associated to software development?
d. Draw Iterative waterfall model. 3+3+2+2=10

Four Year Undergraduate Programme Semester IV Examination
Computer Science
Course : MNCS02 (Computer Science)
(Data Structure (Theory))

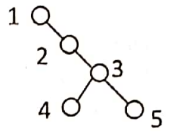
Time : 3 Hours **Full Marks : 60**

Section A

1. Answer any five from the following questions: 5×3=15
   a. What are the postfix and prefix expression for the infix expression 3*log(x+1)-a/2*b ?
   b. Explain linear and non-linear data structure?
   c. What are the inorder, preorder, and postorder traversals for the given binary trees?



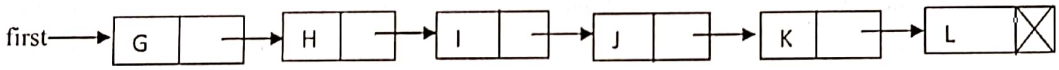
(i)



(ii)

   d. What is a sparse matrix, and what are the different representations used for sparse matrices?
   e. A[-4…10][6…20] is lower triangular matrix . Base address 1000 and each element occupies 2-bytes of space. What is the address of A[5][13] in row major and column major order?
   f. Given the input sequence a, b, c, d, what are all the possible output sequences that can be generated using a stack with push and pop operations?

2. Answer any one from the following questions: 5
   a. For a given linked list:



   What would be the output after the following sequence of steps?

```
struct node *p;
p=first→link→link→link;
p→link→link=p;
first→link→link=p→link;
printf("%c",first→link→link→link→data);
```

   b. What will be the output of the given program?

```
#include <stdio.h>
#define SIZE 5
struct test {int i; char *c;
};struct test stack[SIZE];
int top = -1;void push(struct test val) {
  if (top < SIZE - 1) { stack[++top] = val;
  } else {printf("Stack overflow!\n");}}
struct test pop() {if (top >= 0) {return stack[top--];
  } else {printf("Stack underflow!\n");struct test empty = {0, ""};return empty;}}
struct test* peek() {if (top >= 0) {return &stack[top];  } return NULL;}
int main() {struct test data[] = {{5, "become"},{4, "better"},{6, "jungle"},{8, "ancestor"},{7, "brother"}
  };
```

```
for (int i = 0; i < SIZE; i++) {push(data[i]);}pop();
struct test* current = peek();
  if (current) {current->c++;
    printf("%s\n", current->c);
    printf("%c\n", *++current->c);
    printf("%d\n", current->i);
    printf("%s\n", current->c);
  }return 0;}
```

Section B
(Any four)

3. Explain insertion sort algorithm with example. Write a C program to create and display a single linked list having 5 elements in it. 5+5=10
4. Write an algorithm to convert an infix expression into its corresponding postfix expression using a stack and convert the infix expression a↑b*c-d into postfix expression using your algorithm. 5+5=10
5. Define the concept of a queue in data structures. Explain the conditions that lead to queue underflow and overflow. Additionally, implement C functions to perform enqueue and dequeue operations on a queue using a linked list. 2+2+6=10
6. Implement binary search algorithm using recursion in C .
   Evaluate the postfix expression: 6 2 3 + - 3 8 2 / + * 2 ↑ 3 + using stack and also mention an appropriate algorithm for it. 4+3+3=10
7. What is handshaking algorithm in graph theory ? What is binary search tree? Construct the BST by inserting following key values 13,12,6,19,16,21,28,4,2 . Implement a binary search tree using C. 1+1+2+6=10
8. Write short note on any two: 5+5=10
   a. Bubble sort
   b. Recursion
   c. Selection sort

Four-Year Undergraduate Examination, 2025
Semester – IV (NEP)
English
AECC (Ability Enhancement Compulsory Course): English Language and Communication II

Time: 3 Hours **Full Marks: 40**

Questions are of equal value.
Answer any *four* questions.

1. Write an e-mail to the Principal of your Bhavana seeking permission to organise an interdepartmental debate competition.

2. As the representative of your Department, draft a notice for organising a farewell function for the outgoing students in the next month.

3. Write an essay on any one of the following topics:
a) Impact of social media on the youth of the country, b) Climate crisis and its effect on humans, c) The problem of unemployment, d) Festivals of Santiniketan

4) Read the passage carefully and answer the following questions. 5X2= 10

Rabindranath Tagore was a towering figure in Indian literature and culture. Born on May 7, 1861, in Calcutta, India, Tagore was a polymath - a renowned Bengali poet, philosopher, playwright, educator, and composer. His literary works are known for their lyricism, depth, and universality, exploring themes of love, nature, spirituality, and the human condition. Tagore's collection of poems, "Gitanjali", earned him the Nobel Prize in Literature in 1913, making him the first non-European to receive this honor. He was a key figure in India's cultural renaissance, influencing not only literature but also art, music, and education. Tagore founded Visva-Bharati University, which aimed to promote cultural exchange and holistic learning. Tagore's vision for education emphasized the importance of creativity, freedom and holistic learning. He believed in the unity of all knowledge and the interconnectedness of different cultures. His legacy extends beyond India, inspiring artists, writers, and thinkers worldwide. Today, Tagore's works continue to be celebrated for their beauty, wisdom, and relevance.

a. When was Rabindranath Tagore born?
b. What award did Tagore receive in 1913?
c. What themes did Tagore's writings explore?
d. What did Tagore emphasize in his vision for education?
e. What institution did Tagore establish, and what was its aim?

5. Write a précis of the passage given below and add a suitable title.
Unemployment in India remains a significant challenge, driven by a complex interplay of economic, demographic, and structural factors. As of 2025, the unemployment rate hovers around 7-8%, with urban areas and youth facing higher joblessness. The country's rapidly growing population, adding millions to the workforce annually, outpaces job creation, particularly in the formal sectors. While agriculture employs nearly 40% of the workforce, it contributes less to GDP, reflecting underemployment and low productivity. The manufacturing and service sectors, though growing, struggle to absorb the surplus labour due to automation and skill mismatches. Educated youth, especially graduates, face high unemployment due to a gap between academic training and industry demands. Government initiatives like Skill India and Make in India aim to boost employability and industrial growth, but their impact is gradual. Rural-to-urban migration further strains urban job markets, leading to informal employment with low wages and poor conditions. Women's participation in the workforce remains low, exacerbating gender disparities. Despite recent economic reforms, bureaucratic hurdles and inadequate infrastructure hinder job creation. Addressing unemployment requires sustained investment in education, skill development, and labour-intensive industries to align with India's demographic dividend and economic aspirations.