

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
END SEMESTER EXAMINATION 2022
SEMESTER IV
Generic Elective (GE) – IV: Mathematics (CMS)

Full Marks: 50**Time: 2 hours**

The figures in the margin indicate full marks.

Unit-I

- 1. Answer any one from the following questions:** **$1 \times 2 = 2$**

a) Evaluate: $\lim_{x \rightarrow 0} \frac{\tan x - x}{x - \sin x}$.

b) Trace the curve $xy^2 = a^2(a - x)$.

- 2. Answer any two from the following questions:** **$2 \times 4 = 8$**

a) Find the equation of the asymptotes of the curve $(x + y)(x - 2y)(x - y)^2 + 3xy(x - y) + x^2 = 0$.

b) Show that the point of inflection of the curve $y = (1 - x)/(1 + x^2)$ lie on a straight line.

c) If $y = \sin(m \sin^{-1} x)$, then show that $(1 - x^2)y_{n+2} = (2n + 1)xy_{n+1} + (n^2 - m^2)y_n$.

Unit-II

- 3. Answer any one from the following questions:** **$1 \times 2 = 2$**

a) Evaluate $\int_0^{\frac{\pi}{2}} \sin^4 x \cos^4 dx$

b) Find the area included between the parabola $y^2 = 4x$ and its latus rectum.

- 4. Answer any two from the following questions:** **$2 \times 4 = 8$**

a) Find the volume of the solid generated by revolving the cardioid $r = a(1 - \cos\theta)$.

b) If $I_n = \int_0^1 x^n \tan^{-1} x dx$, n being a positive integer greater than 2, show that $(n + 1)I_n + (n - 1)I_{n-2} = \frac{\pi}{2} - \frac{1}{n}$.

c) Find the total length of the loop of the curve $x = t^2$, $y = t - \frac{t^3}{3}$.

Unit-III

- 5. Answer any one question:** **$1 \times 2 = 2$**

a) Find the transformed equation of the straight line $\frac{x}{a} + \frac{y}{b} = 2$ when the origin is transferred to the point (a, b) .

b) Find the nature of the conic $\frac{8}{r} = 4 - 5\cos\theta$.

6. Answer any two questions:

- a) Find the polar equation of the ellipse $\frac{x^2}{36} + \frac{y^2}{20} = 1$, if the pole be at its right-handed focus and the positive direction of the x-axis be the positive direction of the polar axis.
- b) Find the angle through which the axes are to be rotated so that the equation $17x^2 + 18xy - 7y^2 = 1$ may be reduced to the form $Ax^2 + By^2 = 1, A > 0$.
- c) Prove that the equation to the straight lines through the origin each of which makes an angle α with the straight line $y = x$ is $x^2 - 2xy \sec 2\alpha + y^2 = 0$.

Unit-IV**7. Answer any one question:**

2 × 1 = 2

- a) Solve :- $\frac{d^4y}{dx^4} + 4y = 0$.
- b) Show that $\frac{1}{3x^3y^3}$ is an integrating factor of
 $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$.

8. Answer any two questions:

4 × 2 = 8

- a) Find the particular integral of the differential equation
 $(x^2D^2 - xD + 1)y = 2 \log x$.
- b) Solve :- $\left(y + \frac{y^3}{3} + \frac{x^2}{2}\right)dx + \frac{1}{4}(x + xy^2)dy = 0$.
- c) Evaluate:- $\frac{1}{D^2 - 5D + 6}x(x + e^x)$, where $D \equiv \frac{d}{dx}$.

Unit-V**9. Answer any one question:**

2 × 1 = 2

- a) If $\varphi = 3x^2yz$ and c is the curve $x = t^2, y = t^3, z = t$ from $t = 0$ to $t = 1$.
Evaluate the vector line integral $\int_c \varphi d\vec{r}$.
- b) Show that the vector $\frac{\vec{r}}{r^3}$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}, r = |\vec{r}|$ is solenoidal.

10. Answer any two questions:

4 × 2 = 8

- a) If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and \vec{a}, \vec{b} are constant vectors. Prove that
 $\vec{b} \cdot \vec{\nabla} \left[\vec{a} \cdot \vec{\nabla} \left(\frac{1}{r} \right) \right] = \frac{3(\vec{a} \cdot \vec{r})(\vec{b} \cdot \vec{r})}{r^5} - \frac{(\vec{a} \cdot \vec{b})}{r^3}$, where $r = |\vec{r}|$.
- b) Prove that
 $\vec{\nabla} \cdot \left\{ \frac{f(r)}{r} \vec{r} \right\} = \frac{1}{r^2} \frac{d}{dr} (r^2 f)$ where $f(r)$ is a scalar function having continuous derivatives and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $r = |\vec{r}|$.
- c) (i) Prove that $\vec{F} = (y^2 \cos x + z^3)\hat{i} + (2y \sin x - 4)\hat{j} + (3xz^2 + 2)\hat{k}$ is a conservative force field.
(ii) Find the work done in moving an object in this field from $(0, 1, -1)$ to $(\frac{\pi}{2}, -1, 2)$.

2 + 2

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
END SEMESTER EXAMINATION 2022
SEMESTER IV
B.Sc. COMPUTER SCIENCE HONOURS

Core Course X

Full Marks: 50

Time: 2 hours

Answer any five (5) questions from the following:

$5 \times 10 = 50$

1. a) Define the term Data Model.
 b) Name different types of database user and their role.
 c) What are the different database languages available?
 d) Distinguish between File System and Database Management System?
 $[2 + 3 + 2 + 3 = 10]$

2. a) Identify the relationship between super key and candidate key. Justify the statement “A primary key must be a candidate key but the reverse may not be true”.
 b) Discuss foreign key. What will happen if we set the option ON DELETE CASCADE while defining foreign key?
 c) Find out the number of attributes and tuples in the Cartesian product of relation A with relation B, if A has 4 attributes and 5 tuples and B has 3 attributes and 4 tuples?
 d) Justify the statement “ Each table in relational data model is a relation”.
 $[(1 + 2) + (2 + 2) + 1 + 2 = 10]$

3. Assuming two relation schemas EMP(ENO,ENAME,SAL,DOB,DNO) and DEPT(DNO,DNAME), write SQL queries on the following problems/tasks.
 a) Display employee details as per descending order of their salary.
 b) Count department (department number) wise number of employees.
 c) Retrieve the department name where “Payel” works.
 d) Increase salary by 1000 of all the employees whose name starts with ‘A’.
 e) Drop the column SAL from the EMP schema.
 $[2 + 2 + 2 + 2 + 2 = 10]$

4. a) Draw an ER Diagram for a database for school management system for a higher secondary school. The database stores names, addresses, phone nos., and other details for all teaching and non-teaching staff of the school. The school offers three streams - science, arts and commerce at the higher secondary level. For each stream, name of all students in class XI and XII are stored. The addresses, phone nos., birth date and guardians names for each student is stored. Additionally, marks obtained by each student in the 1st term and 2nd term examination are stored.
 b) Map the ER diagram onto an appropriate relational schema (write the description of each table and indicate their key attributes).
 $[7 + 3 = 10]$

5. a) Write at least two differences between equi-join and natural join with respect to relational algebra.

- b) Write at least two differences between DDL and DML command with respect to SQL.
- c) Compare between logical and physical data independence. What is meta data?
- d) Write at least three main advantages of DBMS over flat file system.
- $[2 + 2 + (2 + 1) + 3 = 10]$

6. a) Consider the following two sets of functional dependencies. Check whether or not they are equivalent.

$$F = \{A \rightarrow C, AC \rightarrow D, E \rightarrow AD, E \rightarrow H\}, \text{ and } G = \{A \rightarrow CD, E \rightarrow AH\}$$

- b) What do you mean by 'Lossless Join' and 'Dependency Preservation'?
- c) Consider the relation $R(A, B, C, D, E, F, G, H)$, with the following functional dependencies $\{A \rightarrow B, AC \rightarrow DEFGH, F \rightarrow G, FC \rightarrow H, HCD \rightarrow EFG\}$.

Decompose this relation up to 3NF and indicate the primary key in each step.

$$[3 + 3 + 4 = 10]$$

7. a) State and briefly explain the ACID properties that every transaction must follow.
- b) What do you mean by conflict serializability? Consider three transactions T1, T2 and T3 and the following non-serial schedule S1. Draw the precedence graph for S1 and state whether the schedule is serializable or not. If the schedule is serializable, then write down the equivalent serial schedule(s) (Assume x, y, z are data items).

S1: r3(y); r3(z); r1(x); w1(x); w3(y); w3(z); r2(z); r1(y); w1(y); r2(y); w2(y); r2(x); w2(x).

$$[4 + (2 + 4) = 10]$$

8. a) Compare between primary indexing, clustered indexing and secondary indexing.
- b) Assume your main file is sorted according to primary key and has 60,000 record. Suppose the size of each block is 1024 bytes, each record size in main file is 100 bytes and size of each entry into the index table is 10 bytes. Calculate the percentage of profit if we use primary indexing in comparison with no indexing.

$$[5 + 5 = 10]$$

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
END SEMESTER EXAMINATION 2022
SEMESTER IV
B.Sc. COMPUTER SCIENCE HONOURS

Core Course IX

Full Marks: 50

Time: 2 hours

N. B.:

- Draw diagrams whenever necessary.
- Numbers to right indicate marks.

Answer any five (5) questions from the following:

$5 \times 10 = 50$

1. a) Write at least three main disadvantages of classical waterfall model.
 b) What do you mean by phase containment of error?
 c) Why spiral model is called a meta model?
 d) Which model will you prefer for software development for the projects with following characteristics?
 i) Project has a lot of risk and the developers are novice.
 ii) Project uses object oriented software development and phase wise delivery of the system is accepted by the customer.
 e) Under what circumstances it is beneficial to construct a prototype before you start developing a software?

[$3 + 2 + 1 + (1 + 1) + 2 = 10$]

2. a) What are the merits and demerits of formal requirement specification?
 b) Identify the non-functional requirement issues that are considered for any given problem description.
 c) Compare between corrective, adaptive and perfective maintenance.

[$(2 + 2) + 3 + 3 = 10$]

3. a) Differentiate between association, aggregation and composition with respect to object oriented software design.
 b) Differentiate between Fan-in and Fan-out with respect to layered arrangement of modules.
 c) Discuss the properties of a good SRS (Software Requirement Specification) document.

[$3 + 3 + 4 = 10$]

4. a) In a Hospital Management System, develop a DFD (up to level 2) for a "Ward Service Management System". State all your assumptions.
 b) Distinguish between software validation and verification.

[$5 + 5 = 10$]

5. a) What is control flow graph? Draw the control flow graph of the following code for GCD computation:

```
int gcd (int x, int y)
{
    while (x!=y)
    {
        if (x>y) then
            x=x-y;
        else
            y=y-x;
    }
    return x;
}
```

- b) Find the number of test cases for the above.
 c) What do you understand by the terms change control and version control?

$$[(1+4)+3+2=10]$$

6. a) Consider the organic type of project that has been estimated to be 5000 lines of source code. Assume average salary for the software engineers Rs. 20000 per month. Determine the effort required to develop the software product, total cost and nominal development time.
 b) Consider following segment of code:

```
main()
{
    int a,b,c,avg;
    scanf("%d %d %d", &a,&b,&c);
    avg=(a+b+c)/3;
    printf("avg= %d",avg);
}
```

Calculate the estimated length and volume of the code.

$$[5+5=10]$$

7. a) What is stub? "Stub is useful during unit testing"- Justify the statement.
 b) Discuss differences between Equivalent class partitioning and Boundary value analysis with a suitable example in the context of black box testing.

$$[5+5=10]$$

8. Write short notes on (any two) : $[2 \times 5 = 10]$

- a) Reliability Testing
- b) Structure chart and Flow chart
- c) Mutation Testing.
- d) Prototyping
- e) Capability Maturity Model Integration

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
END SEMESTER EXAMINATION 2022
SEMESTER IV
B.Sc. COMPUTER SCIENCE HONOURS

Core Course VIII

Full Marks: 50

Time: 2 hours

N. B.:

- Draw diagrams whenever necessary.
- Numbers to right indicate marks.

Answer any five (5) questions from the following:

$5 \times 10 = 50$

1. Write the Quick Sort algorithm and show all the steps using an example. Deduce the worst case complexity of the quick sort. Discuss whether selecting pivot at midle or at random position except the beginning or end will improve the complexity?

$(3 + 2) + 3 + 2$

2. In recursive binary search if the mid value is not chosen at middle and chosen at any random position will it improve the performance? Explain in detail. Write down the Count Sort algorithm and show all the steps using an example. Find out the complexity of the count sort algorithm.

$3 + (3 + 2) + 2$

3. Find out the upper bound, tight bound and lower bound of $T(n)=T(n/2)+T(n/4)+n$ using recursion tree. Write down the recursive algorithm to generate the Fibonacci series 0 1 1 2 3 5 8 ... and find out the time and space complexity of the algorithm.

$5 + (3 + 2)$

4. What do you mean by a Heap? How can a Heap be represented using an array? Given a binary tree whose left and right sub trees are Heaps, write an algorithm to convert it into a Heap. What is the advantage of heapify technique in heap sort?

$(2 + 2) + 4 + 2$

5. Create a decision tree to sort in ascending order a list of 3 numbers. Do the amortized analysis and find the complexity of inserting n values in a dynamic array. What are the basic differences between radix sort and bucket sort? What is the basic difference of graph from tree?

$3 + 4 + 2 + 1$

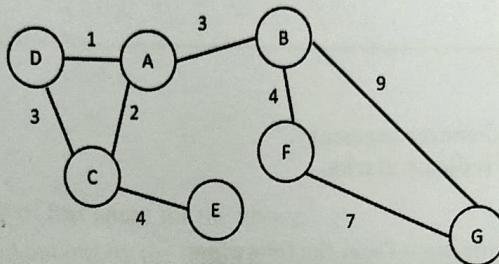
6. Define Red-Black Tree (RBT). Create a Red-Black Tree by inserting the following sequence of numbers 8, 18, 5, 15, 17, 25, 40 and 80. Why a Red Node cannot have a Red Parent or Red Child in Red-Black Tree? What is the largest possible number of internal nodes in a Red-Black Tree with black-height k?

$(2 + 4) + (2 + 2)$

7. Write Knuth-Morris-Pratt algorithm for pattern matching. What is the Time Complexity of it? Apply the KMP algorithm for the pattern="ababaca" and the string s="bacbabababacaab". Show each step.

(4 + 1) + 5

8. Define spanning tree. Write down the pseudo code of Kruskal's algorithm and deduce its complexity. Perform the DFS starting from node "A" of the following graph showing all the steps.



1 + (3 + 2) + 4

**RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA**

MID SEMESTER EXAMINATION 2022

SEMESTER IV

Generic Elective-IV: Mathematics(CMS)

Full Marks: 25

Time: 1 hour

The figures in the margin indicate full marks.

Group -I

1. Answer any one out of the following questions:

$1 \times 2 = 2$

- i) Evaluate: $\lim_{x \rightarrow \infty} \frac{\log x^2}{\log \cot^2 x}$.
- ii) Find the envelope of straight lines $\frac{x}{a} + \frac{y}{b} = 1$, where the parameters are connected by the relation $ab = c^2$.

2. Answer any two out of the following questions:

$2 \times 3 \frac{1}{2} = 7$

- i) If $y = \sin(m \sin^{-1} x)$; then show that $(1 - x^2)y_{n+2} = (2n + 1)xy_{n+1} + (n^2 - m^2)y_n$.
- ii) Show that the point of inflection of the curve $y^2 = (x - a)^2(x - b)$ lie on the line $3x + a = 4a$.
- iii) Find the rectilinear asymptotes, if any, of the curve $y = x + \log_e x$.

Group -II

3. Answer any one out of the following questions:

$1 \times 3 = 3$

- a) Transform to axes inclined at 30° to the original axes the equation $x^2 + 2\sqrt{3}xy - y^2 - 2 = 0$.
- b) If the pair of straight lines $x^2 - 2pxy - y^2 = 0$ and $x^2 - 2qxy - y^2 = 0$ be such that each pair bisects the angles between the other pair, then prove that $pq = -1$.

4. Answer any one out of the following questions:

$1 \times 4 = 4$

- a) To what point the origin is to be moved so that one can get rid of the first degree terms from the equation $x^2 + xy + 2y^2 - 7x - 5y + 12 = 0$?
- b) Show that the equation to the pair of straight lines through the origin perpendicular to the pair of straight lines $ax^2 + 2hxy + by^2 = 0$ is $bx^2 - 2hxy + ay^2 = 0$.

Group -III

Answer the following question:

5. Solve $xydx + (2x^2 + 3y^2 - 20)dy = 0$

Or

Solve $(x^4 + y^4)dx - xy^3dy = 0$

4

6. Evaluate $\frac{1}{D^2 + 2D + 1} x \cos x$, Where $D \equiv \frac{d}{dx}$

5

**RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
MID SEMESTER EXAMINATION 2022
SEMESTER IV
B.Sc. COMPUTER SCIENCE HONOURS
Core Course X**

Full Marks: 25**Time: 1 hour****Answer any 5 questions only** **$5 \times 5 = 25$**

1. (a) Define and give an example of each: composite attribute, derived attribute, multivalued attribute.
(b) Give an example of recursive relationship in context of ERD. [3 + 2 = 5]
2. (a) Differentiate with example between total and partial participation in a relation involving entities in ERD.
(b) What do you mean by the term “Generalization” in context of ERD? State with an example. [3 + 2 = 5]
3. (a) What is the relationship between super key and candidate key? “A primary key must be a candidate key but the reverse may not be true”-justify the statement. [(1+2) + 2 = 5]
(b) Define foreign key.
4. Assuming two relation schemas EMP(ENO,ENAME,SAL,DOB,DNO) and DEPT(DNO,DNAME), write SQL queries on the following problems/tasks.
 - (i) Add a column called age with number (2) in EMP relation.
 - (ii) Retrieve dept. number wise maximum and minimum salary.
 - (iii) Retrieve the department name where “Madhu” works.
 - (iv) Increase the salary by 500 of all the employees who earns less than 10000.

[1 + 1 + 2 + 1 = 5]

5. Assuming two relation schemas EMP(ENO,ENAME,SAL,DOB,DNO) and DEPT(DNO,DNAME), write RA(relational algebra) queries on the following problems/tasks.
 - (i) Find all the employees who work for the ‘IT’ department.
 - (ii) Find the list of all employee names and also the name of the departments they work if they happen to work for a department. [2.5 + 2.5 = 5]
6. (a) Write at least two differences between equijoin and natural join with respect to relational algebra.
(b) Write at least two differences between DDL and DML command with respect to SQL.
(c) What will be the number of attributes and tuples in the Cartesian product of relation A with relation B, if A has 4 attributes and 5 tuples and B has 3 attributes and 4 tuples?

[2 + 2 + 1 = 5]

7. (a) Briefly discuss about the ACID properties that must be followed by each transaction.
(b) When do two operation pairs said to be conflict operation pair? [3 + 2 = 5]

* * *

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
MID SEMESTER EXAMINATION 2022
SEMESTER IV
B.SC. COMPUTER SCIENCE HONOURS
Core Course IX

Full Marks: 25**Time: 1 hour****Answer question no. 5 and any two from the rest**

1. Explain the activities of project scheduling . What are the major job responsibilities of a Project Manager ? 5+5=10
2. Define LOC with respect to software metric. Compute the function point for an application software with Inputs=8,output=12,inquiries =4,logical files=2,interfaces=1 , $\sum F_i=41$ 4+6=10
3. (a)What is feasibility study? Why we need to carry out feasibility study before starting to develop the software?
 (b)Write the major phases in the classical waterfall model of software development and briefly explain them.
 (c)What are the major advantages of first constructing a working prototype before starting to develop the actual software?
 (d)What do you mean by the term “phase containment of error”?

$$(2+1)+4+2+1=10$$

4. (a) When is a module said to be functionally independent of the other modules? What are the advantages associated with functionally independent modules.
 (b) Briefly explain different types of coupling with an example for each.
 (c) Differentiate between Fan-in and Fan-out with respect to layered arrangement of modules.

$$(1+2)+5+2=10$$

5. Write short notes on (any one) : 5
 - a) Work Breakdown Structure
 - b) PERT chart

RAMAKRISHNA MISSION
VIVEKANANDA CENTENARY COLLEGE, RAHARA, KOLKATA
MID SEMESTER EXAMINATION 2022
SEMESTER IV
B.Sc. COMPUTER SCIENCE HONOURS

Core Course VIII

Full Marks: 25

Time: 1 hour

N. B.:

- Draw diagrams whenever necessary.
- Numbers to right indicate marks.

Answer any four (5) questions from the following:

5×5=25

1. What is the purpose of devising an algorithm? Write down the properties of an algorithm. What is the need of validation of an algorithm? 2+2+1
2. Write down the iterative algorithm of Selection sort and deduce the worst case complexity. 2+3
3. Why efficiency of an algorithm is important and how to measure them. What are the criteria of defining a recursive function? 3+2
4. Write the merge sort algorithm and deduce the best case time and space complexity. 3+2
5. Find out the upper bound, lower bound and tight bound of $T(n)=4T(n-1)+2T(n-1)$ 5
6. Why divide-and-conquer is chosen over conventional iterative methods of sorting. In merge sort if the division is not from the middle rather after the 1st element will it increase the complexity? Justify your answer. 2+3
7. Write down the iterative binary search algorithm and deduce the complexity (time and space) of it. 2+3