1.1.1. The Institution ensures effective curriculum delivery through a well planned and documented process

PATRICIAN COLLEGE OF ARTS AND SCIENCE

DEPARTMENT OF COMPUTER APPLICATIONS

MATHEMATICS BRIDGE COURSE

Program Name : **Mathematics Bridge Course**

Date and Time : **Mon, 20th Sep 2021 to Fri 25th Sep 2021**

Number of Beneficiaries : **100 Students**

Program Objective:

To fill the gap between the Higher Secondary maths paper and BCA Allied maths paper the bridge course program was conducted for the first year student.

Invite

Course Module

PATRICIAN COLLEGE OF ARTS AND SCIENCE

DEPARTMENT OF COMPUTER APPLICATIONS

SHIFT 1

ALLIED MATHEMATICS- I

Bridge Course Material – I BCA

MODULE FOR ALLIED MATHEMATICS – I

I BCA A AND B

Date- 20th Sep 2021 – 23rd Sep 2021

Timings – 10:00 Am – 11:00 Am

20th Sep
- Algebra
- Matrices

21st Sep
- Theory of Equations
- Numerical Methods

22nd Sep
- Trignometry

23rd Sep
- Differential Equations

Assessment 24-9-2021 10:00 am - 11:00 am

Mrs.B.Anandapriya

Head and Associate Professor

Department of Computer Applications – Shift I

Unit I

Algebra – Summation of Series

Arithmetic Progression

The general form of an Arithmetic Progression is a, a + d, a + 2d, a + 3d and so on.

Thus nth term of an AP series is $T_n = a + (n - 1) d$, where $T_n = n^{th}$ term and a = first term.

Here d = common difference = $T_n - T_{n-1}$.

Geometric Progression

A geometric progression is a sequence in which each term is derived by multiplying or dividing the preceding term by a fixed number called the common ratio. For example, the sequence 4, -2, 1, - 1/2,.... is a Geometric Progression (GP) for which - 1/2 is the common ratio.

The general form of a GP is a, ar, ar^2, ar^3 and so on.

The nth term of a GP series is $T_n = ar^{n-1}$, where a = first term and r = common ratio = T_n/T_{n-1}) .The formula applied to calculate sum of first n terms of a GP:

$$S_n = \frac{a(r^n - 1)}{(r-1)}$$

Harmonic Progression

A series of terms is known as a HP series when their reciprocals are in arithmetic progression.
Example: 1/a, 1/(a+d), 1/(a+2d), and so on are in HP because a, a + d, a + 2d are in AP.The n^{th} term of a HP series is $T_n = 1/ [a + (n -1) d]$.In order to solve a problem on Harmonic Progression, one should make the corresponding AP series and then solve the problem.nth term of H.P. = 1/(nth term of corresponding A.P.)

If three terms a, b, c are in HP, then b =2ac/(a+c).

Numerical Methods

Newton Rapson Method

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$f'(x) = 3x^2 - 14x + 8$$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 5 - \frac{f(5)}{f'(5)} = 5 - \frac{-13}{13} = 6$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 6 - \frac{f(6)}{f'(6)} = 6 - \frac{9}{32} = 5.71875$$

Newtons Forward Differences

Formula

Newton's Backward Difference formula

$$p = \frac{x - x_n}{h}$$

$$y(x) = y_n + p\nabla y_n + \frac{p(p+1)}{2!}\cdot\nabla^2 y_n + \frac{p(p+1)(p+2)}{3!}\cdot\nabla^3 y_n + \frac{p(p+1)(p+2)(p+3)}{4!}\cdot\nabla^4 y_n + \ldots$$

Formula

Newton's Forward Difference formula

$$p = \frac{x - x_0}{h}$$

$$y(x) = y_0 + p\Delta y_0 + \frac{p(p-1)}{2!}\cdot\Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!}\cdot\Delta^3 y_0 + \frac{p(p-1)(p-2)(p-3)}{4!}\cdot\Delta^4 y_0 + \ldots$$

Newton Forward And Backward Interpolation

Interpolation is the technique of estimating the value of a function for any intermediate value of the independent variable, while the process of computing the value of the function outside the given range is called **extrapolation**.

Forward Differences : The differences y1 – y0, y2 – y1, y3 – y2, ……, yn – yn–1 when denoted by dy0, dy1, dy2, ……, dyn–1 are respectively, called the first forward differences. Thus the first forward differences are :

Forward difference table

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$	$\Delta^5 y$
x_0	y_0					
		Δy_0				
x_1 $(= x_0 + h)$	y_1		$\Delta^2 y_0$			
		Δy_1		$\Delta^3 y_0$		
x_2 $(= x_0 + 2h)$	y_2		$\Delta^2 y_1$		$\Delta^4 y_0$	
		Δy_2		$\Delta^3 y_1$		$\Delta^5 y_0$
x_3 $= (x_0 + 3h)$	y_3		$\Delta^2 y_2$		$\Delta^4 y_1$	
		Δy_3		$\Delta^3 y_2$		
x_4 $= (x_0 + 4h)$	y_4		$\Delta^2 y_3$			
		Δy_4				
x_5 $= (x_0 + 5h)$	y_5					

Backward difference table

x	y	∇y	$\nabla^2 y$	$\nabla^3 y$	$\nabla^4 y$	$\nabla^5 y$
x_0	y_0					
		∇y_1				
x_1 $(= x_0 + h)$	y_1		$\nabla^2 y_2$			
		∇y_2		$\nabla^3 y_3$		
x_2 $(= x_0 + 2h)$	y_2		$\nabla^2 y_3$		$\nabla^4 y_4$	
		∇y_3		$\nabla^3 y_4$		$\nabla^5 y_5$
x_3 $(= x_0 + 3h)$	y_3		$\nabla^2 y_4$		$\nabla^4 y_5$	
		∇y_4		$\nabla^3 y_5$		
x_4 $(= x_0 + 4h)$	y_4		$\nabla^2 y_5$			
		∇y_5				
x_5 $(= x_0 + 5h)$	y_5					

NEWTON'S GREGORY BACKWARD INTERPOLATION FORMULA :

Example for forward differences

θ°	45°	50°	55°	60°
sin θ	0.7071	0.7660	0.8192	0.8660

$x°$	$10^4 y$	$10^4 \Delta y$	$10^4 \Delta^2 y$	$10^4 \Delta^3 y$
45°	7071			
		589		
50°	7660		−57	
		532		−7
55°	8192		−64	
		468		
60°	8660			

```
Value at Sin 52 is 0.788003
```

Example for Backward Differences

6

Year (x):	1891	1901	1911	1921	1931
Population (y): (in thousands)	46	66	81	93	101

x	y	∇y	$\nabla^2 y$	$\nabla^3 y$	$\nabla^4 y$
1891	46				
		20			
1901	66		−5		
		15		2	
1911	81		−3		−3
		12		−1	
1921	93		−4		
		8			
1931	101				

```
Value in 1925 is 96.8368
```

Unit II

MATRICES

After studying this chapter you will acquire the skills in

- knowledge on matrices
- Knowledge on matrix operations.
- Matrix as a tool of solving linear equations with two or three unknowns.

Introduction of Matrices

Definition 1:

A rectangular arrangement of mn numbers, in m rows and n columns and enclosed within abracket is called a matrix. We shall denote matrices by capital letters as *A*,*B*, *C* etc.

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ \vdots & & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} = (a_{ij})_{m\times n}$$

A is a matrix of order $m\,n$. ith row jth column element of the matrix denoted by

Remark: A matrix is not just a collection of elements but every element has assigned a definite position ina particular row and column.

Special Types of Matrices:

1. **Square matrix**:

A matrix in which numbers of rows are equal to number of columns is called a square matrix.

Example:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} 2 & 5 & -8 \\ 0 & -3 & -4 \\ 6 & 8 & 9 \end{pmatrix}$$

2. **Diagonal matrix**:

A square matrix $A = (a_{ij})_{n\times n}$ is called a diagonal matrix if each of its non-diagonalelement is zero

That is $a_{ij} = 0 \ if \ i \neq j$ and at least one element $a_{ii} \neq 0$.

Example:

$$A = \begin{pmatrix} a_{11} & 0 & 0 \\ 0 & a_{22} & 0 \\ 0 & 0 & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} 2 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & 9 \end{pmatrix}$$

3.Identity Matrix

A diagonal matrix whose diagonal elements are equal to 1 is called identitymatrix and denoted by I_n.

That is $a_{ij} = \begin{cases} 0 & if \ i \neq j \\ 1 & if \ i = j \end{cases}$

Example:

$$I_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

4. **Upper Triangular matrix**:

A square matrix said to be a Upper triangular matrix if $a_{ij} = 0 \ if \ i > j$.

Example:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ 0 & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} 2 & 0 & 8 \\ 0 & -2 & 5 \\ 0 & 0 & 7 \end{pmatrix}$$

5. **Lower Triangular Matrix**:

A square matrix said to be a Lower triangular matrix if $a_{ij} = 0$ if $i < j$.

Example:

$$A = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} -1 & 0 & 0 \\ 7 & 0 & 0 \\ 9 & 6 & 2 \end{pmatrix}$$

6. **Symmetric Matrix**:

A square matrix $A = (a_{ij})_{n\times n}$ said to be a symmetric if for all i and j.

Example:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{12} & a_{22} & a_{23} \\ a_{13} & a_{23} & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} 8 & -2 & 7 \\ -2 & -9 & 3 \\ 7 & 3 & 5 \end{pmatrix}$$

7. **Skew- Symmetric Matrix**:

A square matrix $A = (a_{ij})_{n\times n}$ said to be a skew-symmetric if for all i and j.

Example:

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ -a_{12} & a_{22} & a_{23} \\ -a_{13} & -a_{23} & a_{33} \end{pmatrix} \qquad B = \begin{pmatrix} 8 & -2 & 7 \\ 2 & -9 & 3 \\ -7 & -3 & 5 \end{pmatrix}$$

8. **Zero Matrix**:

A matrix whose all elements are zero is called as Zero Matrix and order $n \times m$ Zero matrix denoted by $0_{n\times m}$.

Example:

$$0_{3\times 2} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$$

9.Row Vector

A matrix consists a single row is called as a row vector or row matrix.

Example:

$A = (a_{11} \quad a_{12} \quad a_{13})$ $\qquad B = (7 \quad 4 \quad -3)$

10. Column Vector

A matrix consists a single column is called a column vector or column matrix.

Example:

$A = \begin{pmatrix} a_{11} \\ a_{21} \\ a_{31} \end{pmatrix}$ $\qquad B = \begin{pmatrix} 0 \\ -7 \\ 3 \end{pmatrix}$

:Matrix Algebra

Equality of two matrices:

Two matrices A and B are said to be equal if

(i) They are of same order.
(ii) Their corresponding elements are equal.

That is if $A = (a_{ij})_{m\times n}$ and $B = (b_{ij})_{m\times n}$ then $a_{ij} = b_{ij}$ for all i and j.

Addition of two matrices:

Let $A = (a_{ij})_{m \times n}$ and $B = (b_{ij})_{m \times n}$ are two matrices with same order then sum of thetwo matrices are given by

$$A + B = (a_{ij})_{m \times n} + (b_{ij})_{m \times n} = (a_{ij} + b_{ij})_{m \times n}$$

Example 2.1: let

$$A = \begin{pmatrix} 1 & -2 & 3 \\ 4 & 5 & -4 \end{pmatrix} \text{ and } B = \begin{pmatrix} 3 & 0 & 2 \\ -1 & 1 & 8 \end{pmatrix}.$$

Find (i) 5B (ii) A + B (iii) 4A – 2B (iv) 0 A

Multiplication of two matrices:

Two matrices A and B are said to be confirmable for product AB if number of columns in A equals to the number of rows in matrix B. Let $A = (a_{ij})_{m \times n}$ $and\ B = (b_{ij})_{n \times r}$ be two matrices the product matrix $C = AB$, is matrix of order $m \times r$ where

$$c_{ij} = \sum_{k=1}^{n} a_{ik}\, b_{kj} = a_{i1}b_{1j} + a_{i2}b_{2j} + \dots\dots\dots + a_{in}b_{nj}$$

Example 2.2: Let $A = \begin{pmatrix} 1 & 2 & -3 & 4 \\ 0 & -5 & -1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 3 \\ -5 & 0 \\ 6 & -2 \\ -1 & -3 \end{pmatrix}$

Calculate (i) AB (ii) BA

(iii) is AB = BA ?

Transpose:

The transpose of matrix $A = (a_{ij})_{m \times n}$, A^t written $(A' \text{ or } A^T)$ is the matrix obtainedby writing the rows of A in order as columns.

That is $A^t = (a_{ji})_{n \times m}$.

Example 2.3: Using the following matrices A and B, Verify the transpose properties

$$A = \begin{pmatrix} 1 & -1 & 2 \\ 5 & -4 & 3 \\ 1 & -2 & -3 \end{pmatrix}, B = \begin{pmatrix} -2 & 6 & -2 \\ -1 & 0 & 1 \\ -2 & 1 & 0 \end{pmatrix}$$

A square matrix A is said to be symmetric if $A = A^t$.

Example:

$A = \begin{pmatrix} 1 & -1 & 1 \\ -1 & -4 & -2 \\ 1 & -2 & -3 \end{pmatrix}$, A is symmetric by the definition of symmetric matrix.

Then

$$A^t = \begin{pmatrix} 1 & -1 & 1 \\ -1 & -4 & -2 \\ 1 & -2 & -3 \end{pmatrix}$$

That is $A = A^t$

A square matrix A is said to be skew- symmetric if $A = -A^t$

Example:

$$A = \begin{pmatrix} 1 & 3 & -1 \\ -3 & -5 & 8 \\ 1 & 8 & 9 \end{pmatrix}$$

(i) AA^t and A^tA are both symmetric.

(ii) $A + A^t$ is a symmetric matrix.

(iii) $A - A^t$ is a skew-symmetric matrix.

(iv) If A is a symmetric matrix and m is any positive integer then A^m is also symmetric.

(v) If A is skew symmetric matrix then odd integral powers of A is skew symmetric, while positive even integral powers of A is symmetric.

If A and B are symmetric matrices then

(vi) $(AB + BA)$ is symmetric.
(vii) $(AB - BA)$ is skew-symmetric.

Exercise 2.1: Verify the (i) , (ii) and (iii) using the following matrix A.

$$A = \begin{pmatrix} 1 & 3 & 5 \\ -3 & -5 & 10 \\ 1 & 8 & 9 \end{pmatrix}$$

Determinant, Minor and Adjoint Matrices

Let $A = (a_{ij})_{n\times n}$ be a square matrix of order n , then the $|A|$ number called determinantof the matrix A.

(i) Determinant of 2 × 2 matrix

Let A= $\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$ then $|A|$= $\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} = a_{11}a_{22} - a_{12}a_{21}$

(ii) Determinant of 3 × 3 matrix

Let B = $\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$ Then

$|B| = a_{11}\begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12}\begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13}\begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$

$$|B| = a_{11}(a_{22}a_{33} - a_{23}a_{32}) - a_{12}(a_{21}a_{33} - a_{23}a_{31}) - a_{13}(a_{21}a_{32} - a_{31}a_{22})$$

Exercise 3.1: Calculate the determinants of the following matrices

(i) $A = \begin{pmatrix} 1 & 3 & 4 \\ 2 & 6 & 8 \\ 1 & 9 & 5 \end{pmatrix}$ (ii) $B = \begin{pmatrix} 2 & -3 & 4 \\ 5 & 6 & 7 \\ 8 & 9 & 1 \end{pmatrix}$

Properties of the Determinant:

a. The determinant of a matrix A and its transpose A^t are equal.

$$|A| = |A^t|$$

b. Let A be a square matrix

(i) If A has a row (column) of zeros then $|A| = 0$.

(ii) If A has two identical rows (or columns) then $|A| = 0$.

c. If A is triangular matrix then $|A|$ is product of the diagonal elements.

d. If A is a square matrix of order n and k is a scalar then $|kA| = k^n|A|$

Singular Matrix

If A is square matrix of order n, the A is called singular matrix when $|A| = 0$ and non-singular otherwise.

Minor and Cofactors:

Let A = $(a_{ij})_{n \times n}$ is a square matrix. Then M_{ij} denote a sub matrix of A × with order (n-1) (n-1) obtained by deleting its i^{th} row and j^{th} column. The determinant $|M_{ij}|$ is called the minor of the element of A.

The cofactor of a_{ij} denoted by A_{ij} and is equal to $(-1)^{i+j}|M_{ij}|$.

Exercise 3.2: Let $A = \begin{pmatrix} 5 & 4 & 2 \\ 2 & 3 & 1 \\ 3 & -2 & -1 \end{pmatrix}$

(i) Compute determinant of A.

(ii) Find the cofactor matrix.

Adjoint Matrix:

The transpose of the matrix of cofactors of the element of A denoted by $adj\ A$ is called adjoin of matrix A.

Example 3.3: Find the adjoin matrix of the above example.

(i) .

Inverse of a Matrix and Elementary Row Operations

If A and B are two matrices such that $AB = BA = I$, then each is said to be inverse of the other. The inverse of A is denoted by A^{-1}.

Thus $AB = BA = I$ hence B is inverse of A and is given by $A^{-1} = \frac{1}{|A|}\ (adj\ A)$

Unit III

Theory of Equations

If a quadratic equation is given in standard form, we can find the sum and product of the roots using coefficient of x^2, x and constant term.

Let us consider the standard form of a quadratic equation,

$$ax^2 + bx + c = 0$$

(Here a, b and c are real and rational numbers)

Let α and β be the two zeros of the above quadratic equation.

Then the formula to get sum and product of the roots of a quadratic equation is,

sum of zeros : $\alpha + \beta = -\frac{b}{a} = -\frac{\text{coefficient of } x}{\text{coefficient of } x^2}$

product of zeros : $\alpha\beta = \frac{c}{a} = \frac{\text{constant term}}{\text{coefficient of } x^2}$

Find the sum and product of roots of the quadratic equation given below.

$$x^2 - 5x + 6 = 0$$

Solution :

Comparing

$$x^2 - 5x + 6 = 0$$

and

$$ax^2 + bx + c = 0$$

we get

$$a = 1, b = -5 \text{ and } c = 6$$

Therefore,

Sum of the roots = $-b/a = -(-5)/1 = 5$

Product of the roots = $c/a = 6/1 = 6$

Example 2

Find the sum and product of roots of the quadratic equation given below.

$$x^2 - 6 = 0$$

Solution :

Comparing

$$x^2 - 6 = 0$$

and

$$ax^2 + bx + c = 0$$

we get

$$a = 1, b = 0 \text{ and } c = -6$$

Therefore,

Sum of the roots = -b/a = 0/1 = 0

Product of the roots = c/a = -6/1 = -6

Find the sum and product of roots of the quadratic equation given below.

$$3x^2 + x + 1 = 0$$

Solution :

Comparing

$$3x^2 + x + 1 = 0$$

and

$$ax^2 + bx + c = 0$$

we get

$$a = 3, b = 1 \text{ and } c = 1$$

Therefore,

Sum of the roots = $-b/a$ = $-1/3$

Product of the roots = c/a = $1/3$

Polynomial with real, rational and irrational roots

If a polynomial equation has all *rational* coefficients, then we know something important about that equation's irrational roots. They come in pairs. Consider the quadratic equation $x^2 + 2x - 1 = 0$, which you can solve with the quadratic formula. You obtain the following roots:

$x = 1 + \sqrt{2}$ or $x = 1 - \sqrt{2}$.

Do you notice anything interesting about those two roots? They have the same rational part, and their irrational parts are opposites of each other. That makes sense, doesn't it? Considering what you know of the quadratic equation, it seems reasonable that this would always happen. And it does. Not only that, but it happens for higher degree polynomials as well. If $a + \sqrt{b}$ is a root, then so is $a - \sqrt{b}$.

Example: Two of the roots of a rational polynomial equation are $3 + \sqrt{2}$ and $2 - \sqrt{3}$. What are two other roots?

Solution: $3 - \sqrt{2}$ and $2 + \sqrt{3}$

Example: One root of a rational polynomial equation is $\sqrt{7}$. Can you conclude anything about other roots of the equation?

Solution: You can think of the given root as $0 + \sqrt{7}$. Thus, another root must be $0 - \sqrt{7}$, or just $-\sqrt{7}$.

Example: If $x^3 - 3x^2 - 12x + k = 0$, with k rational, and one of the roots is $-1 + \sqrt{3}$, find the value of k.

Solution: If $-1 + \sqrt{3}$ is a root, then $-1 - \sqrt{3}$ is also a root. Let m be the third root. We know that the sum of the roots must be the opposite of the coefficient of x^2, divided by the leading coefficient, so the sum of the roots is 3. Thus $-1 + \sqrt{3} - 1 - \sqrt{3} + m = 3$. Conveniently, the square roots cancel, leaving $-2 + m = 3$, or $m = 5$.

$k = -(5)(-1 + \sqrt{3})(-1 - \sqrt{3}) = -5(1 - 3) = -5(-2) = 10.$

Questions

1. If a polynomial equation has rational coefficients, and one root is $1 - \sqrt{7}$, what is another root?
2. If a polynomial equation has real coefficients, and one root is -5i, what is another root?
3. If an odd degree polynomial equation has real coefficients, that is enough information to conclude that it has at least one real root. Why?
4. One of the zeroes of a quadratic is $5 - \sqrt{2}$. What is the quadratic?
5. One of the zeroes of a quadratic is 3 + 2i. What is the quadratic?
6. One of the roots of $x^3 - 8x - k = 0$ is $1 - \sqrt{5}$. What is the value of k?
7. One root of a fourth degree equation with no leading coefficient is $1 + \sqrt{2}$, and another root is 1 - i. What is the equation?
8. Two of the zeroes of a cubic polynomial are 1 and 1 + i. If the leading coefficient is 3, what is the polynomial?

Unit IV
Trigonometry

sine

$$\sin\theta = \frac{a}{c} = \frac{\text{opposite}}{\text{hypotenuse}}$$

cosecant

$$\csc\theta = \frac{c}{a} = \frac{\text{hypotenuse}}{\text{opposite}}$$

cosine

$$\cos\theta = \frac{b}{c} = \frac{\text{adjacent}}{\text{hypotenuse}}$$

secant

$$\sec\theta = \frac{c}{b} = \frac{\text{hypotenuse}}{\text{adjacent}}$$

tangent

$$\tan\theta = \frac{a}{b} = \frac{\text{opposite}}{\text{adjacent}}$$

cotangent

$$\cot\theta = \frac{b}{a} = \frac{\text{adjacent}}{\text{opposite}}$$

Expansion of $\sin(n\theta)$, $\cos(n\theta)$, and $\tan(n\theta)$

We have the following general formulas:

- $\sin(n\theta) = \sum_{\substack{r=0 \\ 2r+1\le n}} (-1)^r \binom{n}{2r+1} \cos^{n-2r-1}(\theta)\sin^{2r+1}(\theta)$
- $\cos(n\theta) = \sum_{\substack{r=0 \\ 2r\le n}} (-1)^r \binom{n}{2r} \cos^{n-2r}(\theta)\sin^{2r}(\theta)$
- $\tan(n\theta) = \dfrac{\sum_{\substack{r=0 \\ 2r+1\le n}} (-1)^r \binom{n}{2r+1} \tan^{2r+1}(\theta)}{\sum_{\substack{r=0 \\ 2r\le n}} (-1)^r \binom{n}{2r} \tan^{2r}(\theta)}$

Expanding $\sin^n(\theta)$, $\cos^n(\theta)$, and $\tan^n(\theta)$ in terms of $k\theta$

We have the following general formulas:

If n is even,

- $\cos^n(\theta) = \frac{1}{2^{n-1}}\left[\sum_{\substack{r=0 \\ 2r<n}} \binom{n}{2r} \cos\left((n-2r)\theta\right)\right] + \frac{1}{2^n}\binom{n}{n/2}$
- $\sin^n(\theta) = \frac{(-1)^{n/2}}{2^{n-1}}\left[\sum_{\substack{r=0 \\ 2r<n}} (-1)^r \binom{n}{2r} \cos\left((n-2r)\theta\right)\right] + \frac{1}{2^n}\binom{n}{n/2}.$

Unit V

Differential Calculus

SUCCESSIVE DIFFERENTIATION AND LEIBNITZ'S THEOREM

1.1 Introduction

Successive Differentiation is the process of differentiating a given function successively n times and the results of such differentiation are called successive derivatives. The higher order differential coefficients are of utmost importance in scientific and engineering applications.

Let $f(x)$ be a differentiable function and let its successive derivatives be denoted by $f'(x), f''(x), \ldots, f^{(n)}(x)$.

Common notations of higher order Derivatives of $y = f(x)$

1st Derivative: $f'(x)$ or y' or y_1 or $\frac{dy}{dx}$ or Dy

2nd Derivative: $f''(x)$ or y'' or y_2 or $\frac{d^2y}{dx^2}$ or D^2y

⋮

n^{th} Derivative: $f^{(n)}(x)$ or $y^{(n)}$ or y_n or $\frac{d^ny}{dx^n}$ or D^ny

Differential Equation Definition

A differential equation is an equation which contains one or more terms and the derivatives of one variable (i.e., dependent variable) with respect to the other variable (i.e., independent variable)

dy/dx = f(x)

Here "x" is an independent variable and "y" is a dependent variable

For example,

dy/dx = 5x

Leibnitz Theorem Formula

Suppose there are two functions u(t) and v(t), which have the derivatives up to nth order. Let us consider now the derivative of the product of these two functions.

The first derivative could be written as;

(uv)' = u'v+uv'

CURVATURE AND RADIUS OF CURVATURE

5.1 Introduction:

Curvature is a numerical measure of bending of the curve. At a particular point on the curve , a tangent can be drawn. Let this line makes an angle Ψ with positive x- axis. Then curvature is defined as the magnitude of rate of change of Ψ with respect to the arc length s.

∴ Curvature at P = $\left|\frac{d\Psi}{ds}\right|$

It is obvious that smaller circle bends more sharply than larger circle and thus smaller circle has a larger curvature.

Radius of curvature is the reciprocal of curvature and it is denoted by ρ.

5.2

- **Radius of curvature of Cartesian curve: $y = f(x)$**

$$\rho = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\left|\frac{d^2y}{dx^2}\right|} = \frac{(1+y_1^2)^{3/2}}{|y_2|} \text{ (When tangent is parallel to x – axis)}$$

$$\rho = \frac{\left[1+\left(\frac{dx}{dy}\right)^2\right]^{3/2}}{\left|\frac{d^2x}{dy^2}\right|} \text{ (When tangent is parallel to y – axis)}$$

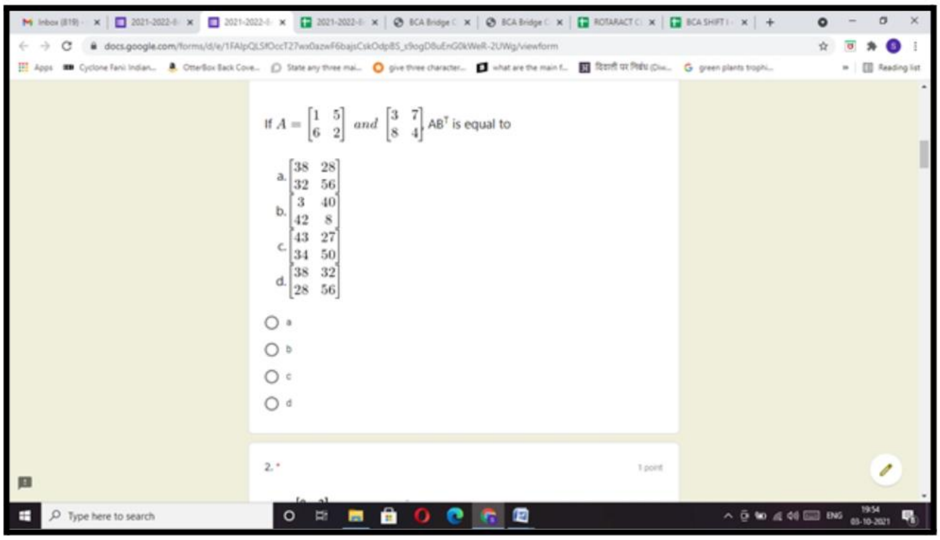
Thank You

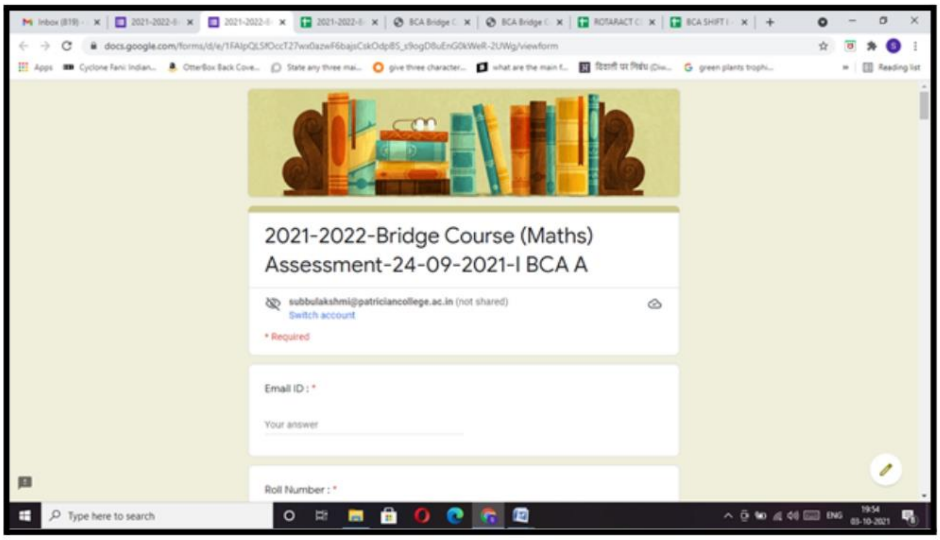
Programme Report

To fill the gap between the Higher Secondary maths paper and BCA Allied maths paper the bridge course program was conducted for the first year student by Department of BCA from Mon, 20th Sep 2021 to Fri, 24th Sept 2021 from 09.45 a.m to 11 a.m.

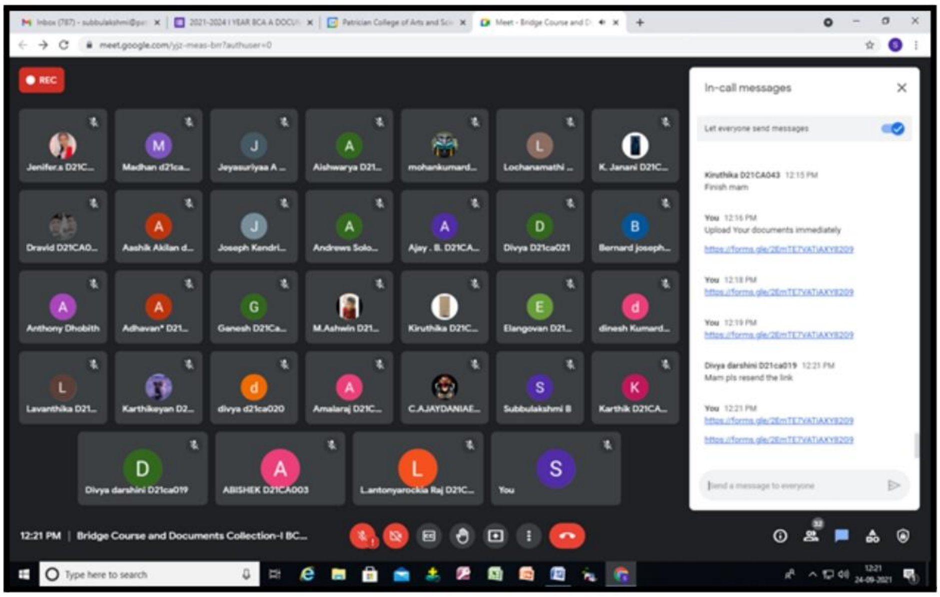
The Bridge course was conducted by Dr. Subbulakshmi B, Associate professor,Department of BCA and Mrs. Josephine Shnathi, Assistant professor,Department of BCA . The following important concepts of Mathematics, Algebra, Matrices, Theory of Equations, Trigonometry, numerical methods, Differential equations were taught. All the students actively participated. It was like a refresher course to all the students to recollect the mathematics concepts.The Bridge course was very useful and students gave good feedback .

Photo





2021-2022-Bridge Course (Maths) Assessment-24-09-2021-I BCA A
* Required
Email ID : *
Your answer
Roll Number : *



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In-call messages
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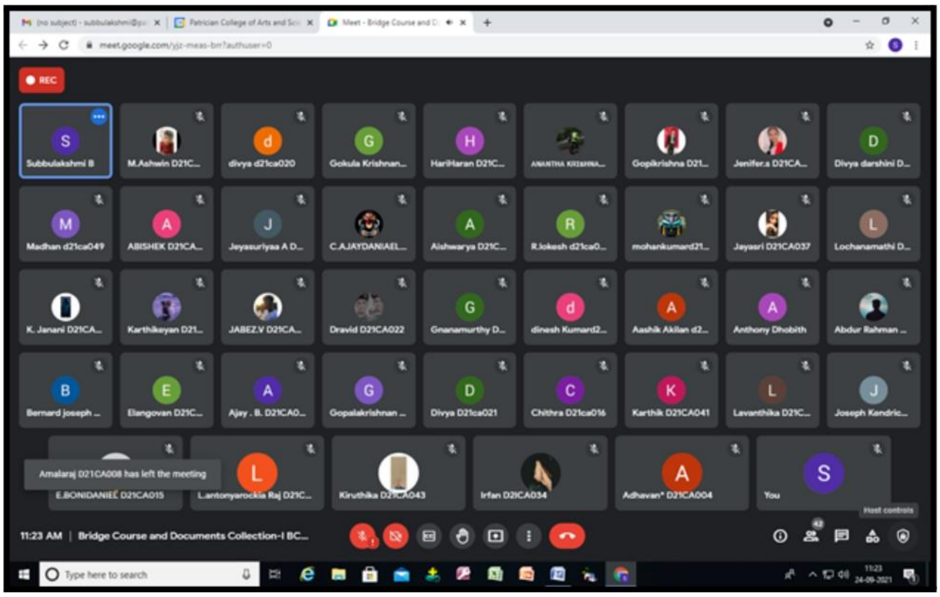

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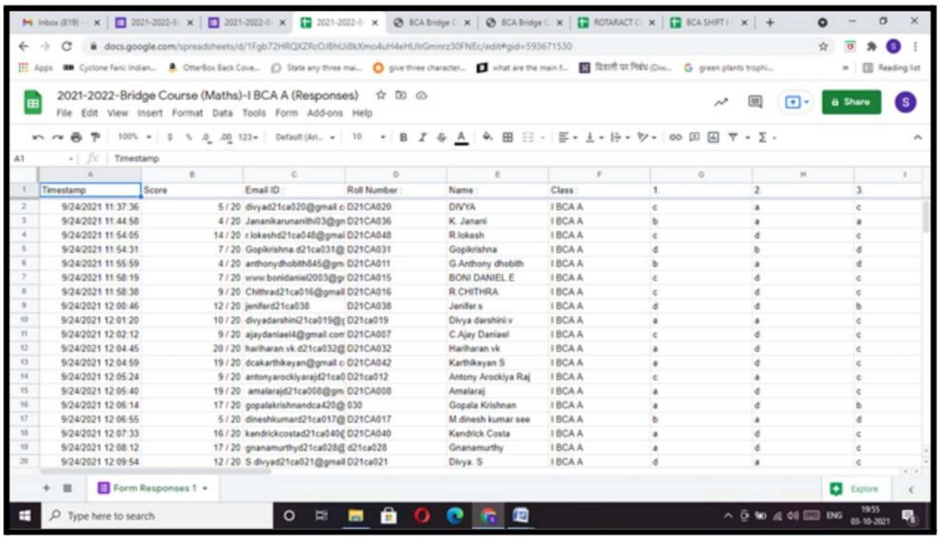


2021-2022-Bridge Course (Maths)-I BCA A (Responses)
Share
Form Responses 1

Students List and Attendance

BRIDGE COURSE 2021 - 2022							
I BCA A AND B							
SL NO	ROLL NO	NAME	20/9	21/9	22/9	23/9	24/9
1	D21CA001	AASHIK AKILAN	x	p	P	P	p
2	D21CA002	ABDUR RAHMAN K	x	p	P	P	p
3	D21CA003	ABISHEK	x	p	P	P	p
4	D21CA004	ADHAVAN A	x	A	P	P	p
5	D21CA005	AISHWARYA S	A	p	P	P	p
6	D21CA006	AJAY B	X	p	P	P	p
7	D21CA007	AJAY DANIAEL C	x	p	P	P	p
8	D21CA008	AMALARAJ V	x	P	P	P	p
9	D21CA009	ANANTHA KRISHNAN A	x	p	P	P	p
10	D21CA010	ANDREWS SOLOMON	x	p	P	P	p
11	D21CA011	ANTHONY DHOBITH	A	A	P	P	p
12	D21CA012	ANTONY AROCKIA RAJ L	x	p	P	P	p
13	D21CA013	ASHWIN.M	x	p	P	P	p
14	D21CA014	BERNARD JOSEPH.A	x	p	P	P	p
15	D21CA015	BONI DANIEL E	x	p	P	P	p
16	D21CA016	CHITHRA R	x	A	P	P	p
17	D21CA017	DINESH KUMAR M	x	p	P	P	p
18	D21CA018	DINISH JOHN J A	x	p	P	P	A

19	D21CA019	DIVYA DARSHINI V	x	A	P	P	p
20	D21CA020	DIVYA M	A	A	A	P	p
21	D21CA021	DIVYA S	x	p	P	P	p
22	D21CA022	DRAVID B	x	a	P	P	p
23	D21CA023	ELANGOVAN K	x	p	P	P	p
24	D21CA024	ELDON ROBINSON	A	A	A	P	A
25	D21CA025	FRANCIS S	A	A	A	A	A
26	D21CA026	GABRIEL JUDE SOLOMON	x	p	A	A	A
27	D21CA027	GANESH S	x	p	P	P	p
28	D21CA028	GNANAMURTY G	x	p	P	P	p
29	D21CA029	GOKUL KRISHNAN S	x	A	P	P	A
30	D21CA030	GOPALA KRISHNAN K	x	A	P	P	p
31	D21CA031	GOPI KRISHNA	x	p	P	P	p
32	D21CA032	HARIHARAN VK	x	p	P	P	p
33	D21CA033	HARISH KUMAR J P	x	A	A	A	p
34	D21CA034	IRFAN	x	p	P	P	p
35	D21CA035	JABEZ JABA KUMAR V	x	A	P	P	p
36	D21CA036	JANANI K	x	p	P	P	p
37	D21CA037	JAYASRI R	x	p	A	P	p
38	D21CA038	JENIFER	x	p	P	P	p
39	D21CA039	JEYASURIYAA.A	A	p	P	P	p
40	D21CA040	JOSEPH KENDRICK COSTA	x	p	P	P	p

41	D21CA041	KARTHIK	x	p	P	P	p
42	D21CA042	KARTHIKEYAN S	x	p	P	P	p
43	D21CA043	KIRUTHIKA E	x	p	P	P	p
44	D21CA044	LAVANTHIKA.D	x	p	P	P	p
45	D21CA045	LOCHANAMATHI	x	p	P	P	p
46	D21CA046	LOGESH I	x	A	P	A	p
47	D21CA047	LOGESH.M	x	A	P	P	p
48	D21CA048	LOKESH R	x	p	P	P	p
49	D21CA049	MADHAN KUMAR P	A	p	P	P	p
50	D21CA050	MOHAN KUMAR S	x	p	P	P	p

Feedback

Recorded Link

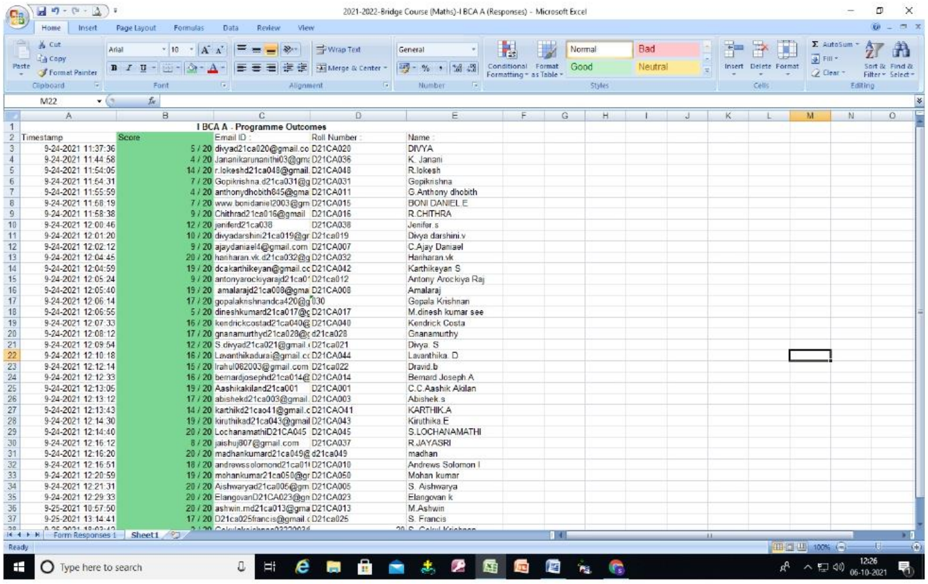
Day	Recorded Link	
	I BCA A	IBCA B
Mon, 20th Sep 2021	https://drive.google.com/file/d/1wnJkSjO7yvNsxSajZfh5d5hZ3V7bJWfi/view?usp=sharing	
Tue, 21st Sep 2021	https://drive.google.com/file/d/1dtuBmSD3ZoC-hN9ocnERcL64QuVrfBKy/view?usp=sharing	
Wed, 22nd Sep 2021	https://drive.google.com/file/d/1QQcK6oKPf7yTqgjpvv28KUIpQQFKsxf8/view?usp=sharing	
Thu, 23rd Sep 2021	https://drive.google.com/file/d/1NuomU87ypfS0s2Y6ibKKBJrVNfOWHjQR/view?usp=sharing	
Fri , 24th Sep 2021	https://drive.google.com/file/d/1G7c4ipak-tG7Ehh99b4WgeeTfgDnkbwv/view?usp=sharing	

Test Link: Fri , 24th Sep 2021

https://forms.gle/TdCbHya2QzAqWDKy9

Programme outcome

The students gained good knowledge and understanding about the allied maths paper



2021-2022-Bridge Course (Maths)-I BCA A (Responses) - Microsoft Excel

I BCA A - Programme Outcomes

Timestamp	Score	Email ID :	Roll Number :	Name :
9-24-2021 11:37:36	5 / 20	divyad21ca020@gmail.co	D21CA020	DIVYA
9-24-2021 11:44:58	4 / 20	Jananikarunanithi03@gm	D21CA036	K. Janani
9-24-2021 11:54:05	14 / 20	r.lokeshd21ca048@gmail.	D21CA048	R.lokesh
9-24-2021 11:54:31	7 / 20	Gopikrishna.d21ca031@g	D21CA031	Gopikrishna
9-24-2021 11:55:59	4 / 20	anthonydhobith845@gma	D21CA011	G.Anthony dhobith
9-24-2021 11:58:19	7 / 20	www.bonidaniel2003@gm	D21CA015	BONI DANIEL.E
9-24-2021 11:58:38	9 / 20	Chithrad21ca016@gmail	D21CA016	R.CHITHRA
9-24-2021 12:00:46	12 / 20	jeniferd21ca038	D21CA038	Jenifer.s
9-24-2021 12:01:20	10 / 20	divyadarshini21ca019@gr	D21ca019	Divya darshini.v
9-24-2021 12:02:12	9 / 20	ajaydaniael4@gmail.com	D21CA007	C.Ajay Daniael
9-24-2021 12:04:45	20 / 20	hariharan.vk.d21ca032@g	D21CA032	Hariharan.vk
9-24-2021 12:04:59	19 / 20	dcakarthikeyan@gmail.cc	D21CA042	Karthikeyan S
9-24-2021 12:05:24	9 / 20	antonyarockiyarajd21ca0	D21ca012	Antony Arockiya Raj
9-24-2021 12:05:40	19 / 20	amalarajd21ca008@gma	D21CA008	Amalaraj
9-24-2021 12:06:14	17 / 20	gopalakrishnandca420@g	030	Gopala Krishnan
9-24-2021 12:06:55	5 / 20	dineshkumard21ca017@g	D21CA017	M.dinesh kumar see
9-24-2021 12:07:33	16 / 20	kendrickcostad21ca040@	D21CA040	Kendrick Costa
9-24-2021 12:08:12	17 / 20	gnanamurthyd21ca028@	d21ca028	Gnanamurthy
9-24-2021 12:09:54	12 / 20	S.divyad21ca021@gmail.	D21ca021	Divya. S
9-24-2021 12:10:18	16 / 20	Lavanthikadurai@gmail.cc	D21CA044	Lavanthika. D
9-24-2021 12:12:14	15 / 20	lrahul062003@gmail.com	D21ca022	Dravid.b
9-24-2021 12:12:33	16 / 20	bernardjosephd21ca014@	D21CA014	Bernard Joseph.A
9-24-2021 12:13:05	19 / 20	Aashikakiland21ca001	D21CA001	C.C.Aashik Akilan
9-24-2021 12:13:12	17 / 20	abishekd21ca003@gmail.	D21CA003	Abishek.s
9-24-2021 12:13:43	14 / 20	karthikd21cao41@gmail.c	D21CAO41	KARTHIK.A
9-24-2021 12:14:30	19 / 20	kiruthikad21ca043@gmail	D21CA043	Kiruthika.E
9-24-2021 12:14:40	20 / 20	LochanamathiD21CA045	D21CA045	S.LOCHANAMATHI
9-24-2021 12:16:12	8 / 20	jaishuj807@gmail.com	D21CA037	R.JAYASRI
9-24-2021 12:16:20	20 / 20	madhankumard21ca049@	d21ca049	madhan
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9-24-2021 12:20:59	19 / 20	mohankumar21ca050@gr	D21CA050	Mohan kumar
9-24-2021 12:21:31	20 / 20	Aishwaryad21ca005@gm	D21CA005	S. Aishwarya
9-24-2021 12:29:33	20 / 20	ElangovanD21CA023@gn	D21CA023	Elangovan k
9-25-2021 10:57:50	20 / 20	ashwin.md21ca013@gma	D21CA013	M.Ashwin
9-25-2021 13:14:41	17 / 20	D21ca025francis@gmail.c	D21ca025	S. Francis

Form Responses 1 | Sheet1