S.B. Arts and K.C.P Science College VIJAYAPUR

Name: Bhagyashree - Samagond
Class: BSc 1st sem
UUCMS NO: U15KM23S0243
Subject: Maths seminar

DEPARTMENT OF MATHEMATICS

SEMINAR ON

LAGRANGE'S MEAN VALUE THEOREM

Lagrange's Mean Value Theorem

Let $f(x)$ be a function that satisfies the following two conditions.

(i) $f(x)$ is continuous on $[a,b]$

(ii) $f(x)$ is differentiable on (a,b) then there exist atleast one point $c \in (a,b)$ such that

$$f'(c) = \frac{f(b)-f(a)}{b-a}$$

Proof = Define a function $gx = f(x) - Ax \quad \forall x \in [a,b]$ where A is a constant to be determine such that

$$g(a) = g(b)$$

$$f(a) - Aa = f(b) - Ab$$

$$Ab - Aa = f(b) - f(a)$$

$$A(b-a) = f(b) - f(a)$$

$$A = \frac{f(b)-f(a)}{b-a} \quad \text{—— (1)}$$

Since $f(x)$ is continous on $[a,b]$ & differentiable on (a,b)

$g(x)$ is also continuous in $[a,b]$ & differentiable (a,b) also $g(a) = g(b)$

hence $g(x)$ satisfies three conditions of Rolle's theorem $\therefore$ there exist atleast one point $c \in (a,b)$

such that $g'(c) = 0$

$$g'(x) = f'(x) - A$$

$$g'(c) = f'(c) - A$$

$$f'(c) - A = 0$$

$$A = f'(c) \quad \text{--- (2)}$$

from equation (1) & (2)

$$f'(c) = \frac{f(b) - f(a)}{b-a}$$

<u>Example</u>

1) Verify Lagrange's Mean value theorem examples

$f(x) = (x+1)\ (x+2)$ in $[1,2]$

let $f(x) = x^2 + 2x + x + 2$

$= x^2 + 3x + 2$

i) $f(x) = x^2 + 3x + 2$ is a polynomial in x it is continuous for every value of x

$\Rightarrow f(x)$ is it on $[1,2]$

ii) Derivative $f'(x) = 2x + 3$ exist in $(1,2)$

$\Rightarrow f(x)$ is differentiable on $(1,2)$

hence $f(x)$ is satisfies two conditions of Lagrange's Mean value theorem

$\therefore \exists$ at least one point $c \in (a,b)$ such that $f'(c) = \dfrac{f(b) - f(a)}{b-a}$

$f(b) = f(2) = 4 + 6 + 2 = 12$

$f(a) = f(1) = 1 + 3 + 2 = 6$

$f'(c) = 2c + 3$

$$2c+3 = \frac{12-6}{2-1}$$

$$2c+3 = \frac{6}{1} = 6$$

$$2c+3 = 6$$

$$2c = 3$$

$$c = \frac{3}{2} \in (1,2)$$

2) Verify Lagranges Mean Value theorem.

$f(x) = (x-1)(x-2)(x-3)$ in $[0,4]$

let $f(x) = (x^2-2x-x+2)(x-3)$

$= (x^2-3x+2)(x-3)$

$= x^3-3x^2-3x^2+9x+2x-6$

$f(x) = x^3-6x^2+11x-6$

(i) $f(x) = x^3-6x^2+11x-6$ is polynomial in x it is continuous for every value of x

$\Rightarrow$ $f(x)$ is continuous on $[0,4]$

(ii) Derivative $f'(x) = 3x^2-12x+11$ exist in $(1,2)$.

$\Rightarrow$ $f(x)$ is differentiable on $(1,2)$

hence $f(x)$ is satisfies two conditions of lagrange's theorem

$\therefore \exists$ at least on point $c \in (a,b)$ such that $f'(c) = \frac{f(b)-f(a)}{b-a}$

$f(b) = f(4) = (4)^3 - 6(4)^2 + 11(4) - 6$

$= 64-96+44-6$

$= 108-102$

$= 6$

$$f(a) = f(0) = 0 - 6(0) + 11(0) - 6$$
$$= -6$$

$$f'(c) = 3c^2 - 12c + 11$$

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

$$3c^2 - 12c + 11 = \frac{6 - (-6)}{4 - 0}$$

$$3c^2 - 12c + 11 = \frac{12}{4} = 3$$

$$3c^2 - 12c + 8 = 0$$

$$c = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Put $a = 3$ $b = -12$ $c = 8$

$$c = \frac{-(-12) \pm \sqrt{144 - 4 \times 3 \times 8}}{2 \times 3}$$

$$= \frac{12 \pm \sqrt{48}}{6}$$

$$= \frac{12 \pm \sqrt{16 \times 3}}{6}$$

$$\boxed{c = \frac{12 \pm 4\sqrt{3}}{6}}$$ //

or

$$c = \frac{\cancel{4}^{2}(3 \pm \sqrt{3})}{\cancel{6}_{3}}$$

$$\boxed{c = \frac{6 \pm 2\sqrt{3}}{3}}$$ //

BLDEA's

S B Arts and KCP Science College Vijayapur

Seminar on : Numerical Analysis

Name : Bhagyanidhi Budihal

Sub : Mathematics (II) (B div)

Class : BSc VI sem

UUCMS NO: U15KM21S0339

Seen

1) Find a real root of Eqn $x^3-2x-5=0$ by the method of false position correct to 3 decimal places

let $f(x)=x^3-2x-5$ then

$f(0)=-5$, $f(1)=-6$, $f(2)=-1$, $f(3)=16$

$\therefore$ the root lies in $(2,3)$ & it may observed that value of $f(x)$ at $x=2$ being -1 is nearer to zero compared to $f(3)=16$, so that we expect root lies in right neighbourhood of 2

Now $f(2.1)=0.061>0$

$\therefore$ the roots lies b/n 2 & 2.1

I appro$^-$

here $a=2$ $\quad b=2.1$

$f(a)=-1$ $\quad f(b)=0.061$

$$x_1=\frac{a\,f(b)-b\,f(a)}{f(b)-f(a)}=\frac{2(0.061)-2.1(-1)}{0.061+1}=2.0942$$

Now,

$$f(2.0942)=9.18447-4.1884-5$$
$$=-0.0039<0$$

$\therefore$ the root lies b/n 2.0942 & 2.1

II appro$^-$

$$x_2=\frac{2.0942(0.061)-2.1(-0.0039)}{0.061+0.0039}=2.094$$

Comparing x_1 & x_2 we observe that the values are same upto 3 decimal places

hence approximate root is 2.094

2) Solve by Gauss-Jordon Method

$$2x + 5y + 7z = 52$$
$$2x + y - z = 0$$
$$x + y + z = 9$$

The given system of eqn can be written in the form of $AX = B$

$$\begin{bmatrix} 2 & 5 & 7 \\ 2 & 1 & -1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 52 \\ 0 \\ 9 \end{bmatrix}$$

Consider the augumented matrix $[A:B]$

$$[A:B] = \left[\begin{array}{ccc:c} 2 & 5 & 7 & 52 \\ 2 & 1 & -1 & 0 \\ 1 & 1 & 1 & 9 \end{array}\right]$$

$R_1 \leftrightarrow R_3$

$$\sim \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 2 & 1 & -1 & 0 \\ 2 & 5 & 7 & 52 \end{array}\right]$$

$R_2 \to R_2 - 2R_1$ & $R_3 \to R_3 - 2R_1$

$$\sim \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 0 & -1 & -3 & -18 \\ 0 & 3 & 5 & 34 \end{array}\right]$$

$R_1 \to R_1 + R_2$ & $R_3 \to R_3 + 3R_2$

$$\sim \left[\begin{array}{ccc:c} 1 & 0 & -2 & -9 \\ 0 & -1 & -3 & -18 \\ 0 & 0 & -4 & -20 \end{array}\right]$$

$R_3 \to (-1/4) R_3$

$$[A \vdots B] \sim \begin{bmatrix} 1 & 0 & 2 & \vdots & -9 \\ 0 & -1 & -3 & \vdots & -18 \\ 0 & 0 & 1 & \vdots & 5 \end{bmatrix}$$

$R_1 \to R_1 + 2R_3$

$R_2 \to R_2 + 3R_3$

$$[A \vdots B] \sim \begin{bmatrix} 1 & 0 & 0 & \vdots & 1 \\ 0 & -1 & 0 & \vdots & -3 \\ 0 & 0 & 1 & \vdots & 5 \end{bmatrix}$$

$x = 1, \quad y = 3, \quad z = 5$

Hence the required solution is

$x = 2, \quad y = 3, \quad z = 5.$

3) Find the Polynomial by using Newton forward interpolation formula.

x:	0	1	2	3
$f(x)$:	1	2	1	10

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$
0	1			
		1		
1	2		-2	
		-1		12
2	1		10	
		9		
3	10			

3) wkt Newton forward interpolation formula

$$f(x) = f(a) + u.\frac{\Delta f(a)}{1!} + u(u-1)\frac{\Delta^2 f(a)}{2!} + \cdots \frac{u(u-1)(u-2)\cdots(u-n+1)\Delta^n f(a)}{n!}$$

here, $h = 1$

$x = a + hu$

$u = \frac{x-a}{h} \Rightarrow \frac{x-0}{1} = x \quad [a=0]$

$\boxed{u = x}$

$$f(x) = f(0) + \frac{x\Delta f(0)}{1} + \frac{x(x-1)\Delta^2 f(0)}{2} + \frac{x(x-1)(x-2)\Delta^3 f(0)}{6}$$

$$= 1 + x(1) + \frac{x(x-1)}{\cancel{2}}(-\cancel{2}) + \frac{x(x-1)(x-2)}{\cancel{6}}(\cancel{12})^{2}$$

$$= 1 + x - (x^2 - x) + x(x^2 - 2x - x + 2)2$$

$$= 1 + x - x^2 + x + 2x(x^2 - 3x + 2)$$

$$= 1 + x - x^2 + x + 2x^3 - 6x^2 + 4x$$

$$f(x) = 2x^3 - 7x^2 + 6x + 1$$

Which is required Polynomial.

4) find $f'(1.5)$ from given table

x:	0.0	0.5	1.0	1.5	2.0
y:	0.3989	0.3521	0.2420	0.1295	0.0540

consider diff table

x	y	$\nabla f(x_n)$	$\nabla^2 f(x_n)$	$\nabla^3 f(x_n)$	$\nabla^4 f(x_n)$
0.0	0.3989				
		-0.0468			
0.5	0.3521		-0.0633		
		-0.1101		0.0609	
1.0	0.2420		-0.0024		-0.0215
		-0.1125		0.0394	
1.5	0.1295		0.037		
		-0.0755			
2.0	0.0540				

here $h=0.5$ $x=1.5$ $x_n=1.5$ $p=\frac{1.5-1.5}{0.5}=0$

$$f'(x_n)=\frac{1}{h}\left[\nabla f(x_n)+\frac{1}{2}\nabla^2 f(x_n)+\frac{1}{3}\nabla^3 f(x_n)\right]$$

$$f'(1.5)=\frac{1}{0.5}\left[-0.1125+\frac{1}{2}(-0.0024)+\frac{1}{3}(0.0609)\right]$$

$$=\frac{1}{0.5}\left[-0.1125-0.0012+0.0203\right]$$

$$=\frac{1}{0.5}\left[-0.0934\right]$$

$$f'(1.5)=-0.1868$$

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also $g(a) = g(b)$

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such that $g'(c) = 0$

$$g'(x) = f'(x) - A$$

$$g'(c) = f'(c) - A$$

$$f'(c) - A = 0$$

$$A = f'(c) \quad \text{—} ②$$

from equation ① & ②

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

Example

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or

$$c = \frac{\cancel{4}^{2}(3 \pm \sqrt{3})}{\cancel{6}_{3}}$$

$$\boxed{c = \frac{6 \pm 2\sqrt{3}}{3}}$$ //

Name :- Kaveri Melinakeri

UUCMS No:- U15KM22S0001

Subject :- Mathematics

Topic :- Bisection method / Bolzano method

Sem : III[rd] sem

Bisection Method / Bolzano Method

To find the root of an equation $f(x)=0$ is the interval $[a,b]$

Let $f(a)$ and $f(b)$ are of opposite signs. So that $f(a).f(b)<0$.

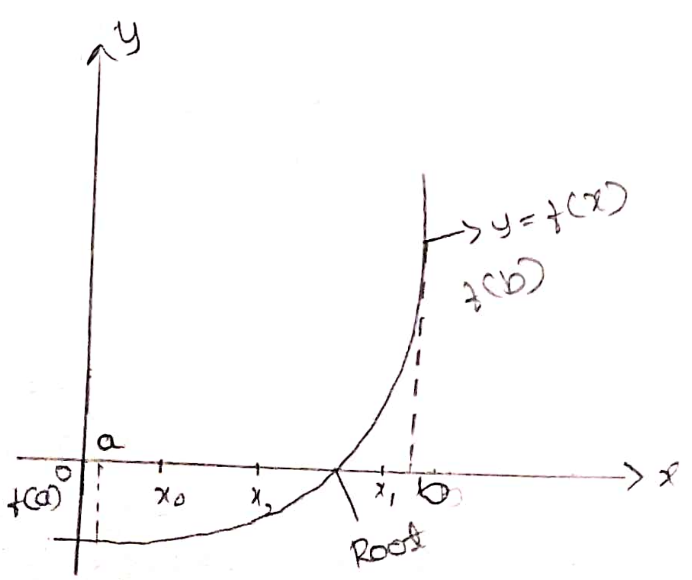
Let x_0 be the midpoint of interval (a,b) than approximate root is defined by $x_0 = \frac{a+b}{2}$

If $f(x_0)=0$ than x_0 is the designed root of $f(x)=0$
However if $f(x_0)\neq 0$, than root may be in between $[a,x_0]$ or $[x_0,b]$

If the root lies in the interval (a,x_0) then $f(a).f(x_0)<0$ and x_1 is the midpoint of (a,x_0) we define next approximation by $x_1 = \frac{a+x_0}{2}$

If the root lies in the interval (x_0,b) then $f(x_0).f(b)<0$ and x_2 be the midpoint of (x_0,b)
i.e. $x_2 = \frac{x_0+b}{2}$

This process is continued until we get desired accuracy.



Example:

1) Find the root of a equation $x^3-4x-9=0$ using Bisection method in four iteration.

Let $f(x) = x^3 - 4x - 9$

$f(0) = 0 - 0 - 9 = -9$ (-ve)

$f(1) = 1^3 - 4 - 9 = -12$ (-ve)

$f(2) = 2^3 - 4(2) - 9 = -9$ (-ve)

$f(3) = 3^3 - 4(3) - 9 = 6$ (+ve)

Since $f(2)\, f(3) < 0$

$\therefore$ The root lies between 2 and 3

1st approximation $= x_1 = \frac{2+3}{2} = 2.5$

Now $f(x_1) = f(2.5) = (2.5)^3 - 4(2.5) - 9$

$= 15.625 - 10 - 9$

$= -3.375$ (-ve)

The root lies b/w 2.5 and 3

2nd approximation $= x_2 = \frac{2.5+3}{2} = 2.75$

$f(x_2) = f(2.75) = (2.75)^3 - 4(2.75) - 9$

$= 0.7969$ (+ve)

The root lies b/w 2.5 & 2.75

3rd approximation $= x_3 = \frac{2.5+2.75}{2} = 2.625$

$f(x_3) = f(2.625) = (2.625)^3 - 4(2.625) - 9$

$= -1.4121$ (-ve)

The root lies between 2.625 and 2.75

4th approximation $= x_4 = \frac{2.625+2.75}{2} = 2.6875$ (+ve)

Iteration Method

Let $f(x)=0$ be a given equation. It can be expressed in the form of $x=\phi(x)$.

Let $x=x_0$ be the initial approximation to the desired root.

Then the first & succesive approximation to the root can be obtained as

$$x_1=\phi(x_0),\ x_2=\phi(x_1);\ x_3=\phi(x_2)\ldots x_n=\phi(x_{n-1})$$

And the iteration method is convergent.

if $|\phi'(x)|<1$ ie, $|\phi'(x)|<1$

Example:

1) Find the real root of $\cos x=3x-1$ correct to four decimal places using Iteration method.

Let $f(x)=\cos x-3x+1$

$f(0)=1-3(0)+1=2$ (+ve)

$f(1)=\cos(1)-3(1)+1=-1.4597$ (-ve)

The root lies b/w 0 and 1

$x_0=\frac{0+1}{2}=0.5$ be initial approximation.

Rewrite above eqn in the form of $x=\phi(x)$

$3x=\cos x+1$

$x=\frac{\cos x+1}{3}=\phi(x)$

$\phi'(x)=\frac{-\sin x}{3}$

$\therefore |\phi'(x)|<1$

$\therefore$ The iteration method can be applied

$x_{n+1}=\phi(x_n)$, $n=0,1,2\ldots$ $x_0=0.5$.

$x_1=\phi(x_0)=\frac{\cos x_0+1}{3}=\frac{\cos(0.5)+1}{3}=0.6258$

$$x_2 = \phi(x_1) = \frac{\cos x_1 + 1}{3} = \frac{\cos(0.6258)+1}{3} = 0.6034$$

$$x_3 = \phi(x_2) = \frac{\cos x_2 + 1}{3} = \frac{\cos(0.6034)+1}{3} = 0.6078$$

$$x_4 = \phi(x_3) = \frac{\cos x_3 + 1}{3} = \frac{\cos(0.6078)+1}{3} = 0.6069$$

$$x_5 = \phi(x_4) = \frac{\cos x_4 + 1}{3} = \frac{\cos(0.6069)+1}{3} = 0.6071$$

$$x_6 = \phi(x_5) = \frac{\cos x_5 + 1}{3} = \frac{\cos(0.6071)+1}{3} = 0.6071$$

Name :- Krupa Biradar

UUCMS NO :- U15KM2130001

Subject :- Mathematics

topic :- Angle b/n radius vector & tangent

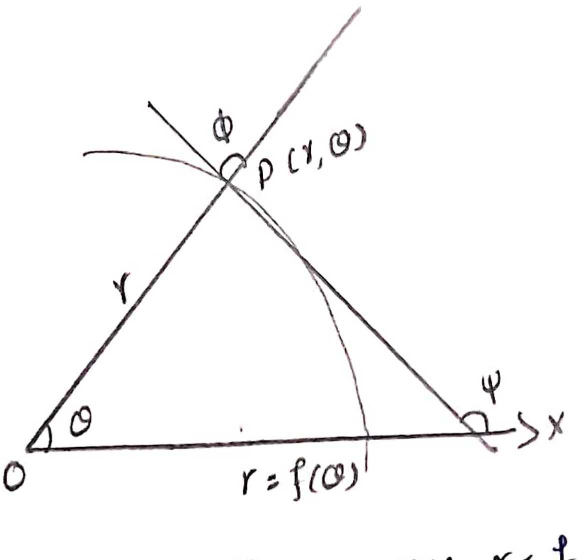
Sem :- V th sem

Angle between the Radius vector & tangent

For the $r = f(\theta)$ at any point (r, θ) the angle θ between the radius vector and the tangent is given by.

$$\tan\phi = \frac{r\,d\theta}{dr}$$

consider the angle ϕ between the radius vector and the tangent to a curve $r = f(\theta)$ is given in polar. co-ordinates as shown in the above figure.



Let $P(r, \theta)$ be any point on the curve $r = f(\theta)$ and the tangent line to the curve $r = f(\theta)$ makes an angle ϕ with respect to the x-axis and an angle ϕ with respect to the radial line at the point of tangency.

consider $\psi = \theta + \phi$ then $r = f(\theta)$ is given in polar co-ordinates by $x = r\cos\theta$ $y = r\sin\theta$ — ①

with associated derivaties given by,

$$\frac{dx}{d\theta} = r\sin\theta + \cos\theta\frac{dr}{d\theta} \quad \frac{dy}{d\theta} = r\cos\theta + \sin\theta\frac{dr}{d\theta} \quad \text{—②}$$

from the tangent of the problem in which it is evident that $2\pi - \phi - \theta = 2\pi - \psi$ we have that $\phi = \psi - \theta$ and consecequintly using a familiar multiple angle formula. from trigonometry that

$$\tan\phi = \tan(\psi - \theta) = \frac{\tan\psi - \tan\theta}{1 + \tan\psi\tan\theta}$$

since the tangent line to the curve $f(\theta)$ make an angle ϕ with respect to the x-axis

we have that.

$$\tan\psi = \frac{dy/d\theta}{dx/d\theta}$$ and trivially from the

geometry that $\tan\theta = \frac{y}{x}$

Substiute: these into (3) gives

$$\tan\phi = \frac{\dfrac{dy/d\theta}{dx/d\theta}}{1+\left[\dfrac{y}{x}\right]\dfrac{dy/d\theta}{dx/d\theta}} = \frac{x\dfrac{dy}{d\theta} - y\dfrac{dx}{d\theta}}{x\dfrac{dx}{d\theta} + y\dfrac{dy}{d\theta}}$$

$$= \frac{x\left\{r\cos\theta + r\sin\theta\dfrac{dr}{d\theta}\right] - y\left[-r\sin\theta + \cos\theta\dfrac{dr}{d\theta}\right]}{x\left(-r\sin\theta + \cos\theta\dfrac{dr}{d\theta}\right] + y\left(r\cos\theta + \sin\theta\dfrac{dr}{d\theta}\right)} \quad -(4)$$

Substituting equation (1) in (4) we get

$$\tan\phi = \frac{r\cos\theta\left\{r\cos\theta + \sin\theta\left(\dfrac{dr}{d\theta}\right)\right\} - r\sin\theta\left\{-r\sin\theta + \cos\theta\left[\dfrac{dr}{d\theta}\right]\right]}{r\cos\theta\left\{-r\sin\theta + \cos\theta\left(dr/d\theta\right)\right\} + r\sin\theta\left\{r\cos\theta + \sin\theta\left(\dfrac{dr}{d\theta}\right)\right\}}$$

$$\tan\phi = \frac{r^2}{r\dfrac{dr}{d\theta}}$$

$$\tan\phi = \frac{r}{\dfrac{dr}{d\theta}} \quad \text{or} \quad \tan\phi = r\frac{d\theta}{dr}$$

ind the angle b/w radius vector and tangent to the curve $r = a(1+\cos\theta)$ at $\theta = \pi/6$

$\Rightarrow$ Given

$r = a(1+\cos\theta)$

Applying log on b.s

$\log r = \log a + \log(1+\cos\theta)$

diff. w. r. t. θ

$$\frac{1}{r}\frac{dr}{d\theta} = 0 + \frac{1}{(1+\cos\theta)} \times (-\sin\theta)$$

$$\frac{1}{r}\frac{dr}{d\theta} = \frac{-\sin\theta}{1+\cos\theta}$$

$$\frac{r\,d\theta}{dr} = -\frac{1+\cos\theta}{\sin\theta}$$

$$\tan\phi = -\frac{(1+\cos(\pi/6))}{\sin\theta}$$

$$\tan\phi = -\frac{(1+\cos\pi/6)}{\sin\pi/6}$$

$$\tan\phi = -\frac{(1+\sqrt{3}/2)}{1/2}$$

$$\tan\phi = -\frac{\frac{(2+\sqrt{3})}{\cancel{2}}}{\frac{1}{\cancel{2}}}$$

$$\tan\phi = \left[-(2+\sqrt{3})\right]$$

Find the angle between radius vector and tangent to the curve $r = a e^{\theta \tan\alpha}$

$\Rightarrow$ Given $r = a e^{\theta \tan\alpha}$

Applying log on both side

$\log r = \log a + \log e^{\theta \cot\alpha}$

$\log r = \log a + \theta \cot\alpha \log e$

diff. w. r. t. θ

$$\frac{1}{r}\frac{dr}{d\theta} = 0 + \cot\alpha(1)(1)$$

$$\frac{r\,d\theta}{dr} = \frac{1}{\cot\alpha}$$

$\tan\phi = \tan\alpha$

$\boxed{\phi = \alpha}$

find the angle b/w radius vector & tangent to the curve $\frac{2a}{r} = 1-\cos\theta$

$\Rightarrow$ Given $= \frac{2a}{r} = 1-\cos\theta$

Applying log on both side

$$\log\frac{2a}{r} = \log(1-\cos\theta)$$

$$\log 2a - \log r = \log(1-\cos\theta)$$

$$\log r = \log 2a - \log(1-\cos\theta)$$

diff. w. r. t θ.

$$\frac{1}{r}\frac{dr}{d\theta} = 0 - \frac{1}{(1-\cos\theta)}(+\sin\theta)$$

$$\frac{1}{r}\frac{dr}{d\theta} = \frac{-(1-\cos\theta)}{\sin\theta}$$

$$\frac{r\,d\theta}{dr} = \frac{-\sin\theta}{-(1-\cos\theta)}$$

$$\frac{r\,d\theta}{dr} = \frac{-2\sin^2\theta/2}{2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}$$

$$\frac{r\,d\theta}{dr} = -\tan\frac{\theta}{2}$$

$$\tan\phi = -\tan\theta$$

$$\tan\phi = \tan(180 - \tfrac{\theta}{2})$$

$$\tan\phi = \tan(\pi - \theta/2)$$

$$\phi = \pi - \theta/2$$

1) find the angle b/w radius vector & tangent to the curve $r^n = a^m \cos m\theta$

Given: $r^m = a^m \cos m\theta$

Applying log on b.s

$$\log r^m = \log a^m + \log \cos m\theta$$

$$m \log r = m \log a + \log \cos m\theta$$

diff. w. r. t. θ

$$m \times \frac{1}{r}\frac{dr}{d\theta} = 0 + \frac{1}{\cos m\theta}(-\sin m\theta) \times m$$

$$\cancel{m} \frac{1}{r}\frac{dr}{d\theta} = \cancel{m}\left[-\frac{\sin m\theta}{\cos m\theta}\right)$$

$$\frac{r\,d\theta}{dr} = -\frac{\cos m\theta}{\sin m\theta}$$

$$\tan\phi = -\cot m\theta$$

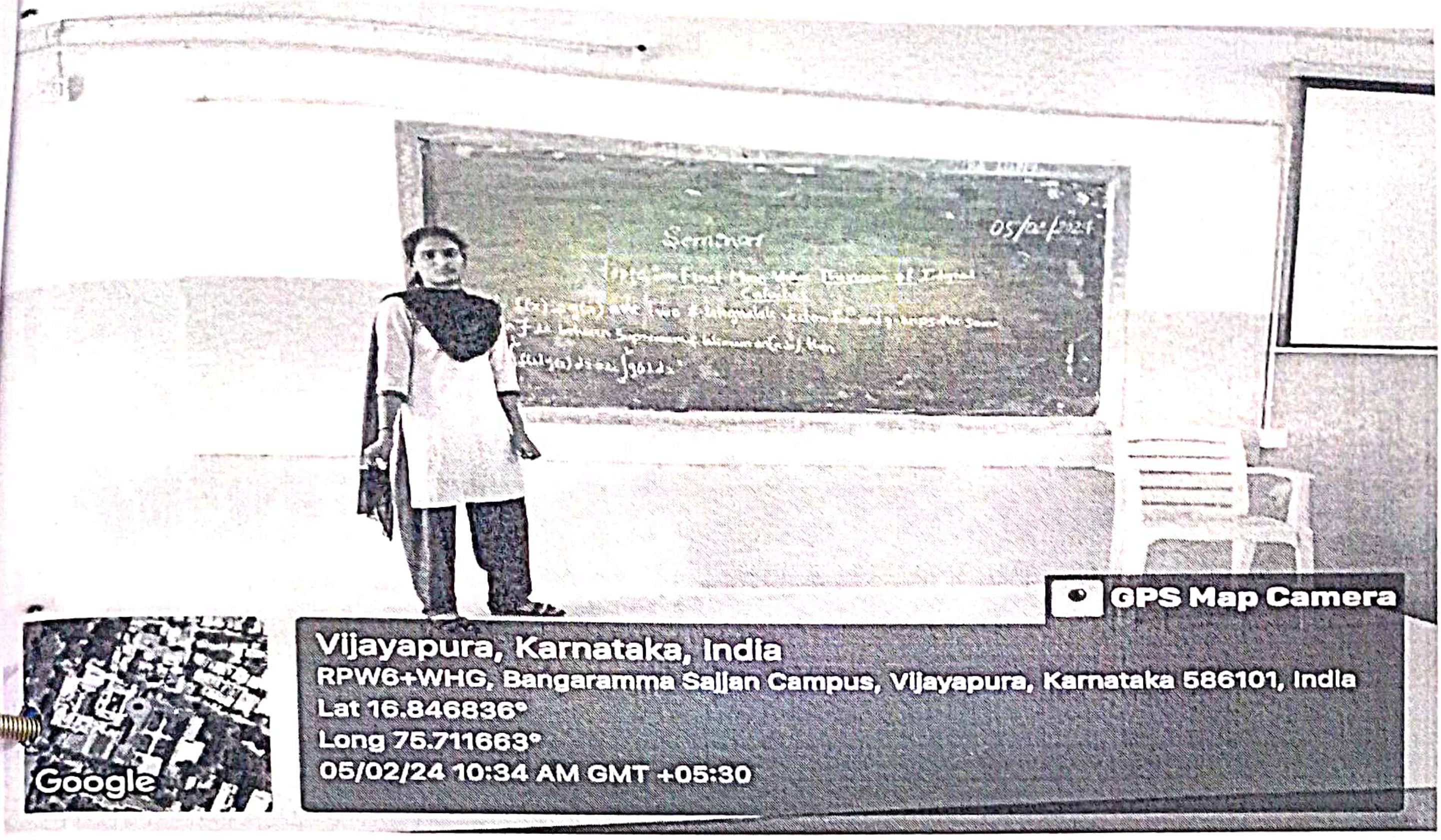
$$\tan\phi = -\tan(\pi/2 - m\theta)$$

$$\tan\phi = \tan(\pi - \{\tfrac{\pi}{2} - m\theta\})$$

$$\phi = \pi - (\pi/2 - m\theta)$$

$$\phi = \pi - \frac{\pi}{2} + m\theta$$

$$\phi = \frac{\pi}{2} + m\theta.$$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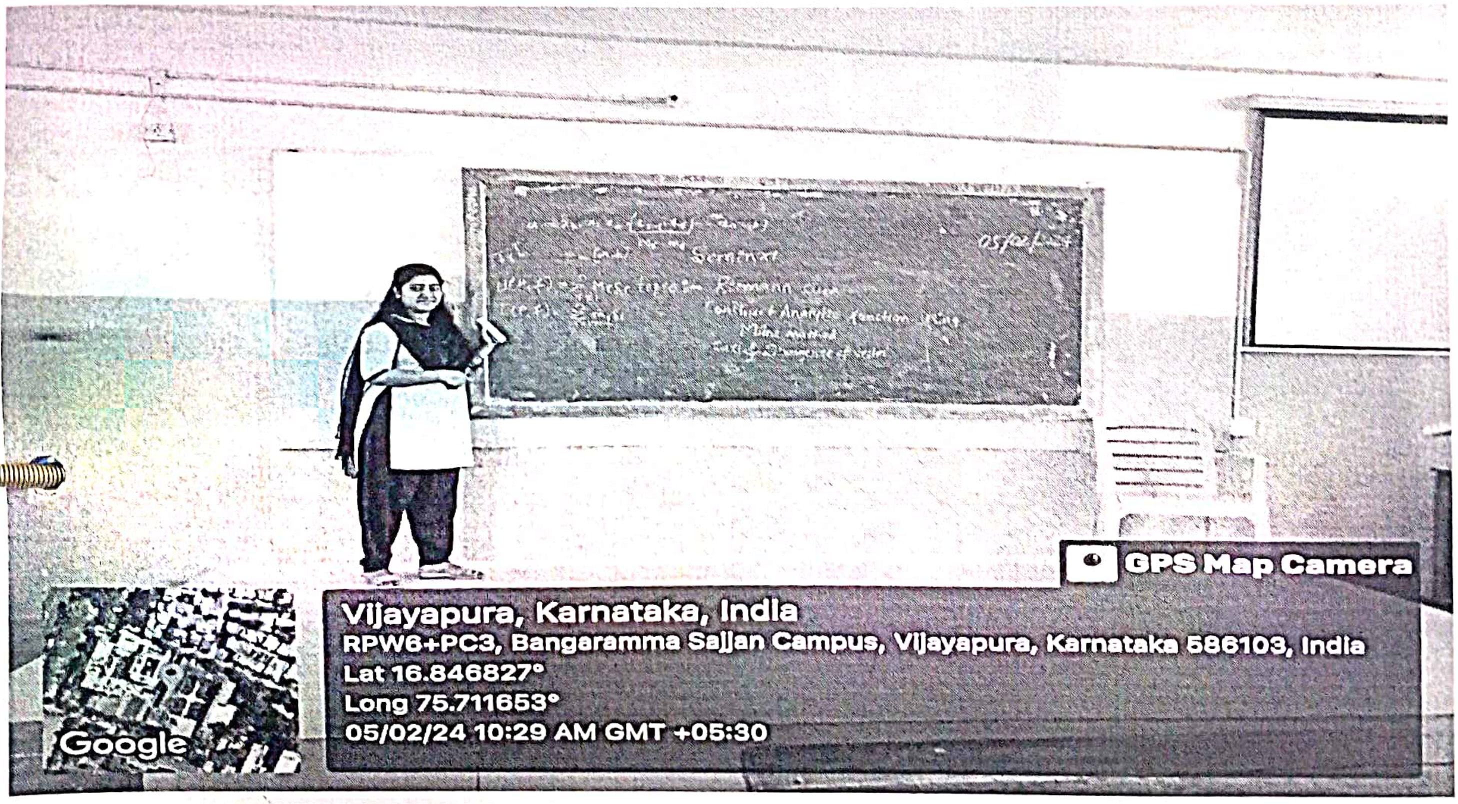
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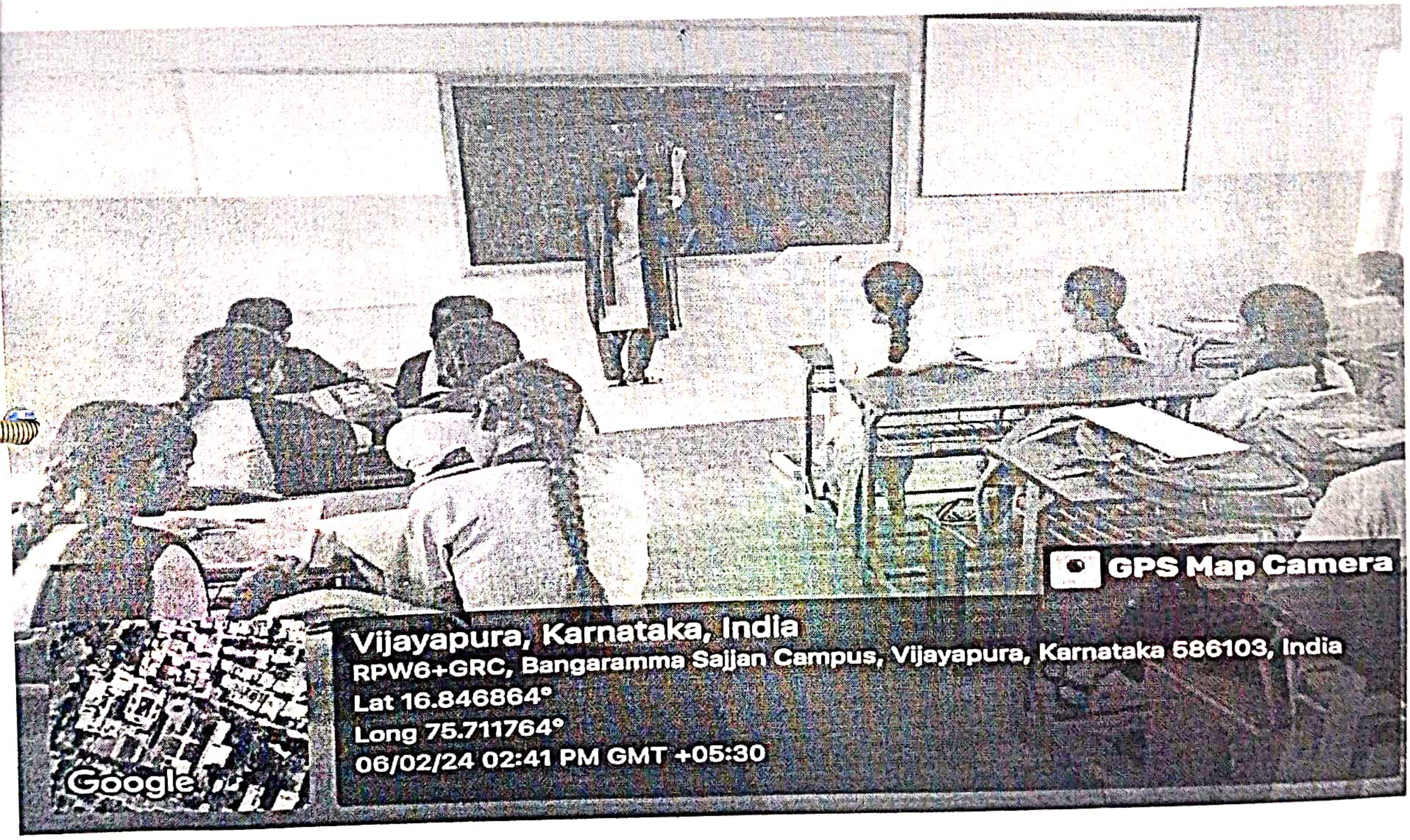
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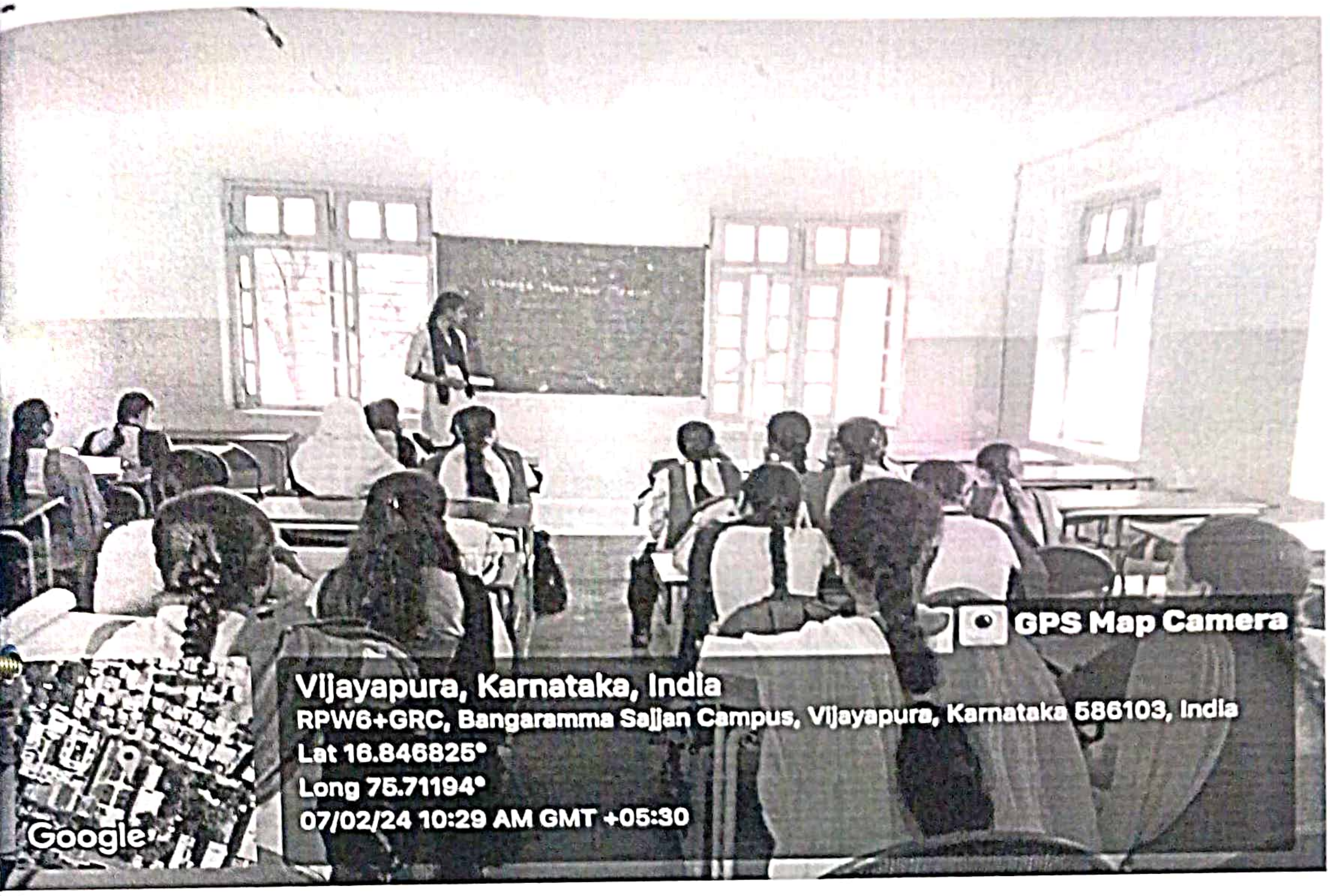
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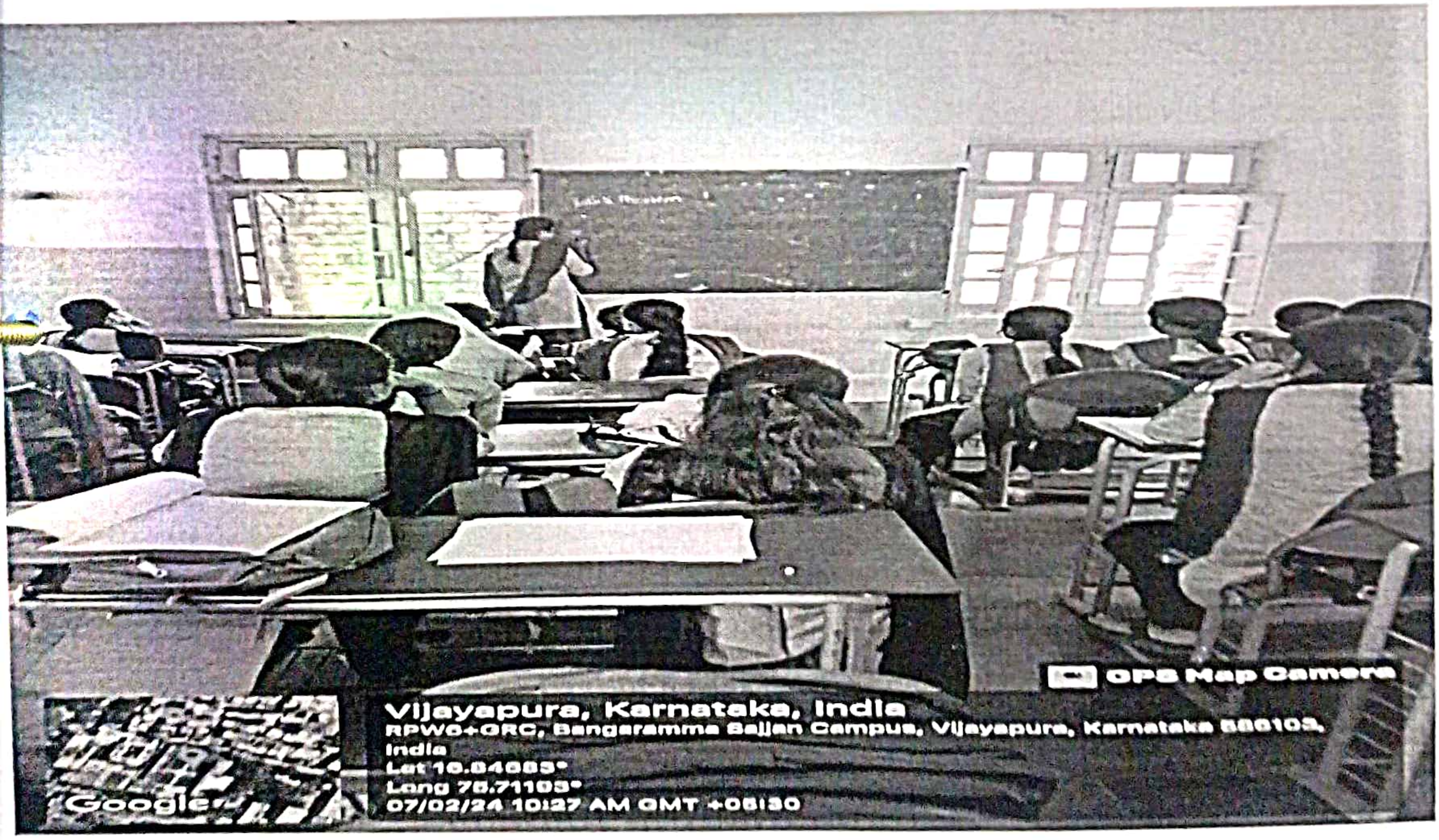
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B. L. D. E. ASSOCIATION'S

S. B. ARTS AND K. C. P. SCIENCE COLLEGE VIJAYAPUR

DEPARTMENT OF MATHEMATICS

Date: 09/02/2024

Seminar Attendence sheet

Sl. NO	UUCMS. NO	NAME OF THE STUDENTS	B.SC	Signature
1	U15KM23S0191	Ambika Sankh	I	A.J.S.
2	U15KM23S0067	Aishwarya	I	A.B.M
3	U15KM23S0071	Danamma Bidari	I	D.M.Bidari
4	U15KM23S0132	Anita Ankalagi	I	A.G.Ankalagi
5	U15KM23S0157	Priya Madar	I	Priya.
6	U15KM23S0209	Rukmini Darveshi	I	[illegible]
7	U15KM23S0213	Bhagyashree	I	Bhagya.
8	U15KM23S0243	Bhagyashree	I	B.S.C
9	U15KM23S0302	Kaveri Hullur	I	K.H.S.
11	U15KM23S0367	Priyanka	I	PSH
12	U15KM23S0366	Sneha Katti	I	S.S.katti
13	U15KM22S0001	Kaveri Melinakeri	III	[illegible]
14	U15KM22S0005	Sakshi Ajur	III	Ajur
15	U15KM22S0009	Suma Hitnalli	III	SSH
16	U15KM22S0022	Bhagyashree	III	[illegible]
17	U15KM22S0026	Sushmita	III	S.G.Jangamshetti
18	U15KM22S0060	Mahadevi B Patil	III	Patil
19	U15KM22S0098	Sangeeta Kirasur	III	[illegible]
20	U15KM22S0102	Swati Chavhan	III	[illegible]
21	U15KM22S0128	Bhagyashree	III	[illegible]
22	U15KM22S0130	Abhishek Rathod	III	[illegible]
23	U15KM22S0137	Ningaraddy	III	Pattedar.
24	U15KM22S0153	Jayashree	III	Bagali
25	U15KM22S0162	Akshata Badagi	III	A.R.Badagi
26	U15KM22S0165	Arpita Sajjan	III	Sajju
27	U15KM22S0167	Shivaleela	III	S.R.N.
28	U15KM22S0179	Asharani Bhali	III	Asharani
29	U15KM22S0180	Bhoomika	III	Bhoomika

30	U15KM22S0221	Abdul Yadagiri	III	AHY..
31	U15KM22S0224	Sahana Sajjan	III	Sajjan.
32	U15KM22S0294	Danamma Poojari	III	Daj
33	U15KM22S0305	Pooja Ashok Katti	III	PKatti
34	U15KM22S0311	Amruta Shiroor	III	AR.
35	U15KM22S0312	Revati Nesur	III	R.R.Nesur
36	U15JU22S0058	Prema Bagalkot	III	Prema.
37	U15KM21S0001	Krupa Biradar	V	KB
38	U15KM21S0026	Sabale Diksheeta	V	S.Wbale
39	U15KM21S0043	Nikita Biradar	V	Nikhit.
40	U15KM21S0097	Bhuvaneshwari	V	Bhu.
41	U15KM21S0163	Prajwal Aihole	V	Prjwal
42	U15KM21S0289	Annaray Bhavikatti	V	Annaray.S.B
43	U15KM21S0315	Prema S	V	Prema
44	U15KM21S0339	Bhagyanidhi	V	HBij
45	U15KM21S0366	Savita Bilijadar	V	SMBal
46	U15KM21S0370	Kashibai Pujari	V	KP.
47	U15KM21S0372	Spoorti Siddapur	V	Spoorti
48	U15KM21S0384	Shruti Pujari	V	S.B.Pujari
49	U15KM21S0389	Nagaveni Harawal	V	NHarawal
50	U15KM21S0390	Aishwarya	V	Ail
51	U15KM21S0396	Vidya Biradar	V	Vid
52	U15KM21S0412	Vishal Sarur	V	Vam
53	U15KM21S0471	Madhubaratagi	V	M.M.R.
54	U15KM21S0506	Ragini Dwivedi	V	Ragin
55	U15KM21S0562	Tejashwini	V	Om.
56	U15MY21S0086	Pooja	V	RBE

HOD
Department of Mathematics
S.B. Arts & K.C.P. Science College
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IQAC, Co-ordinator
S.B.Arts & K.C.P.Science College,
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Principal,
S.B.Arts & KCP. Sc. College,
Vijayapur.

Name :- Kumar Biradar

Subject :- Mathematics

UUCMS NO :- U15KM2350017

Topic :- Integrable function

Sem :- II nd sem

Theorem:-

Statement: If f and g are integrable function on $[a,b]$, then we have to prove $fg \in R[a,b]$.

Proof:

Let f and g are two integrable function on $[a,b]$ there exist a positive real number 'M' such that, $|f(x)| \leq M$,

$$|g(x)| \leq M \quad \forall x \in [a,b]$$

$$|fg(x)| = |f(x)\, g(x)|$$
$$= |f(x)|\,|g(x)|$$
$$\leq M M$$
$$\leq M^2$$

This shows that fg is bounded.

Let $f \in R[a,b]$ and $g \in R[a,b]$ $\exists$ a partitions P_1 and P_2 of $[a,b]$.

$$\left.\begin{aligned} U(P_1,f) - L(P_1,f) &< \frac{\epsilon}{2M} \\ U(P_2,g) - L(P_2,g) &< \frac{\epsilon}{2M} \end{aligned}\right\} \quad (1)$$

$$P = P_1 \cup P_2$$

$$\left.\begin{aligned} U(P,f) - L(P,f) &< \frac{\epsilon}{2M} \\ U(P,g) - L(P,g) &< \frac{\epsilon}{2M} \end{aligned}\right\} \quad (2)$$

Let M_r and m_r are the function of fg.

Let M_r and m_r are the supremum and Infimum of function fg on I_r.

M_r' and m_r' are the supremum and Infimum of function 'f' on I_r.

M_r'' and m_r'' are the supremum and Infimum of function 'g' on I_r.

Consider,

$$|fg(x) - fg(y)| = |f(x)g(x) - f(y)g(y)|$$
$$= |f(x)g(x) - f(y)g(x) + f(y)g(x) - f(y)g(y)|$$
$$= |g(x)(f(x) - f(y)) + f(y)(g(x) - g(y))|$$

$$|fg(x) - fg(y)| \le |g(x)(f(x) - f(y))| + |f(y)(g(x) - g(y))|$$
$$\le |g(x)||f(x) - f(y)| + |f(y)||g(x) - g(y)|$$
$$\le M|f(x) - f(y)| + M|g(x) - g(y)|$$

$$M_r - m_r \le M(M_r' - m_r') + M(M_r'' - m_r'')$$

Multiply δ_r and Σ on both side.

$$\sum_{r=1}^{n}(M_r - m_r)\delta_r \le M\sum_{r=1}^{n}(M_r' - m_r')\delta_r + M\sum_{r=1}^{n}(M_r'' - m_r'')\delta_r$$

$$\sum_{r=1}^{n} M_r\delta_r - \sum_{r=1}^{n} m_r\delta_r \le M\left(\sum_{r=1}^{n} M_r'\delta_r - \sum_{r=1}^{n} m_r'\delta_r\right)$$
$$+ M\left(\sum_{r=1}^{n} M_r''\delta_r - \sum_{r=1}^{n} m_r''\delta_r\right)$$

$$U(P,fg) - L(P,fg) \le M(U(P,f) - L(P,f))$$
$$+ M(U(P,g) - L(P,g))$$

from ②

$$U(P,fg) - L(P,fg) \le \cancel{M}\frac{\epsilon}{2\cancel{M}} + \cancel{M}.\frac{\epsilon}{2\cancel{M}} \Rightarrow \frac{\cancel{2}\epsilon}{\cancel{2}}$$

$U(P, fg) - L(P, fg) < \epsilon$

Hence $fg \in R[a,b]$.

Theorem:-

Statement: If f and g are two functions both bounded and integrable on $[a,b]$ and there exist a number 't' > 0, such that $|g(x)| > t$, $\forall x \in [a,b]$ then we have to prove f/g is bounded and integrable on $[a,b]$.

Proof:

Let f and g are bounded function on $[a,b]$. $\exists$ a positive real number k. such that,

$|f(x)| \leq k$, $|g(x)| \leq k$, $|g(x)| \geq t$, $\frac{1}{|g(x)|} \leq \frac{1}{t}$

$$\left|\frac{f}{g}(x)\right| = \left|\frac{f(x)}{g(x)}\right| \leq \frac{k}{t}$$

This shown that f/g is bounded.

Let $f \in R[a,b]$ and $g \in R[a,b]$. $\exists$ a partition P_1 and P_2 of $[a,b]$.

$$\left.\begin{aligned} U(P_1, f) - L(P_1, f) &< t^2 \frac{\epsilon}{2k} \\ U(P_2, g) - L(P_2, g) &< t^2 \frac{\epsilon}{2k} \end{aligned}\right\} ①$$

$P = P_1 \cup P_2$

$$\left.\begin{aligned} U(P, f) - L(P, f) &< t^2 \frac{\epsilon}{2k} \\ U(P, g) - L(P, g) &< t^2 \frac{\epsilon}{2k} \end{aligned}\right\} ②$$

Let M_r and m_r are the supremum and infimum of f/g on I_r.

Let M_r' and m_r' are the supremum and infimum of f on I_r.

Let M_r'' and m_r'' are the supremum and infimum of g on I_r.

Consider, $\alpha, \beta \in I_r$.

$$\left|\frac{f(\beta)}{g(\beta)} - \frac{f(\alpha)}{g(\alpha)}\right| = \left|\frac{f(\beta)g(\alpha) - f(\alpha)g(\beta)}{g(\alpha)g(\beta)}\right|$$

$$= \frac{f(\beta)g(\alpha) - f(\alpha)g(\beta) - f(\alpha)g(\alpha) + f(\alpha)g(\alpha)}{g(\alpha)g(\beta)}$$

$$= \frac{g(\alpha)(f(\beta)-f(\alpha)) - f(\alpha)(g(\beta)-g(\alpha))}{g(\alpha).g(\beta).}$$

$$= \left|\frac{g(\alpha)(f(\beta)-f(\alpha))}{g(\alpha)g(\beta)}\right| + \left|\frac{f(\alpha)[g(\beta)-g(\alpha))}{g(\alpha)g(\beta)}\right|$$

$$= \frac{|g(\alpha)|\,|f(\beta)-f(\alpha)|}{|g(\alpha)|\,|g(\beta)|} + \frac{|f(\alpha)|\,|g(\beta)-g(\alpha)|}{|g(\alpha)|\,|g(\beta)|}$$

$$\left|\frac{f(\beta)}{g(\beta)} - \frac{f(\alpha)}{g(\alpha)}\right| \leq \frac{k\,|f(\beta)-f(\alpha)|}{t^2} + \frac{k\,|g(\beta)-g(\alpha)|}{t^2}$$

$$M_r - m_r \leq \frac{k}{t^2}(M_r' - m_r') + \frac{k}{t^2}(M_r'' - m_r'')$$

Multiply δ_r and taking Σ on both side.

$$\sum_{r=1}^{n}(M_r - m_r)\delta_r \leq \frac{k}{t^2}\sum_{r=1}^{n}(M_r' - m_r')\delta_r + \frac{k}{t^2}\sum_{r=1}^{n}(M_r'' - m_r'')\delta_r$$

$$\sum_{r=1}^{n} M_r\delta_r - \sum_{r=1}^{n} m_r\delta_r \leq \frac{k}{t^2}\left(\sum_{r=1}^{n} M_r'\delta_r - \sum m_r'\delta_r\right) + \frac{k}{t^2}\left(\sum_{r=1}^{n} M_r''\delta_r - \sum_{r=1}^{n} m_r''\delta_r\right)$$

$$U(P, f/g) - L(P, f/g) \le \frac{K}{t^2}(U(P,f) - L(P,f))$$

$$+ \frac{K}{t^2}(U(P,g) - L(P,g))$$

From eq^n ②

$$U(P, f/g) - L(P, f/g) \le \frac{\cancel{K}}{\cancel{t^2}}\left(\cancel{t^2}\frac{\epsilon}{2\cancel{K}}\right) + \frac{\cancel{K}}{\cancel{t^2}}\left(\cancel{t^2}\frac{\epsilon}{2\cancel{K}}\right)$$

$$U(P, f/g) - L(P, f/g) \le \frac{\epsilon}{2} + \frac{\epsilon}{2}$$

$$U(P, f/g) - L(P, f/g) \le \frac{\cancel{2}\epsilon}{\cancel{2}}$$

$$U(P, f/g) - L(P, f/g) \le \epsilon$$

Hence $f/g \in R[a,b]$ //

Name :- Sahana Mallappagol

UUCMS NO :- U15KM2280125

Subject :- Mathematics

Topic :- Echelon form of matrix

Sem :- IV sem

Echelon Form of Matrix :-

A matrix a is said to be in Echelon from if

i) all the non-zero rows if any precede the zero rows

ii) the Number of zero's Preceding the first non-zero Element is a row is less than the Succeding rows

iii) the first non-zero Element in a row is unity

or

A non zero matrix A is said to be in a row Echelon form if the following conditions Satisfies

i) all the zero rows are below non-zero rows

ii) the first non zero entry in any non zero row is one.

iii) Any $M \times N$ (where $M \geq 2$ and $N \geq 2$) Matrix is said to be in Row Echelon form.

Example

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 0 & 1 & 2 & 3 & 4 \\ 0 & 0 & 1 & 2 & 3 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Column Echelon Form of Matrix

i) Any $M \times N$ (where $M \geq 2$ and $N \geq 2$) Matrix is said to be in Column Echelon Form if all the following 3 conditions are true

a) All the zero values must preceed any Non-zero values for all the Columns

b) All the Non-zero values must preceed any zero values for all the Rows / co-vectors

c) First Row / co-vector must have one and only one Non zero value. Any succeeding Rows have Atleast as many Non-zero values as the Previous Row / co-vector and Atmost one Non-zero values more than the previous Row / co-vectors

Hence, the Columns Echelon Matrix have all the zero values concentrated at the top and Right Corner of the matrix while the Non-zero values are concentrated at the Bottom and Left corner of the matrix.

Examples of Reduction of Echelon Form of Matrix

(1) Reduce the following matrix to its Echelon Form. $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$

Let $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$

Apply $R_2 \leftrightarrow R_1$

$$\begin{bmatrix} 2 & 3 & -1 \\ 4 & 1 & -1 \\ -2 & 1 & 5 \end{bmatrix}$$

$R_2 = R_2 - 2R_1 \qquad R_3 = R_3 + R_1$

$$\begin{bmatrix} 2 & 3 & -1 \\ 0 & -5 & 1 \\ 0 & 4 & 4 \end{bmatrix}$$

$R_3 = 1/4\, R_3$

$$\begin{bmatrix} 2 & 3 & -1 \\ 0 & -5 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

$R_3 = 5R_3 + R_2$

$$\begin{bmatrix} 2 & 3 & -1 \\ 0 & -5 & 1 \\ 0 & 0 & 6 \end{bmatrix}$$

$R_1 = R_1/2 \quad R_2 = R_2/-5 \quad R_3 = R_3/6$

$$\begin{bmatrix} 1 & 3/2 & -1/2 \\ 0 & 1 & -1/5 \\ 0 & 0 & 1 \end{bmatrix}$$

clearly this is the Echelon form of the matrix

A Number of non zero is 3.

(2) Reduce the following matrix to Echelon Form $A = \begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{bmatrix}$

$R_3 = R_3 - 2R_1 \quad R_4 = R_4 - 4R_1$

$$\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 0 & -11 & 5 & -3 \\ 0 & -11 & 5 & -3 \end{bmatrix}$$

$R_4 = R_4 - R_3 \quad R_3 = R_3 + R_2$

$$\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$R_2 = R_2/11$

$$\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 1 & -5/11 & 3/11 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Clearly this is the Echelon form of the matrix A.

Number of non zero row is 2

③ Reduce the following matrix to its Echelon form and also $A = \begin{bmatrix} 8 & 2 & 1 & 5 \\ 2 & 1 & 0 & 1 \\ 3 & 0 & 1 & 3 \\ 5 & 1 & 1 & 4 \end{bmatrix}$

Given $A = \begin{bmatrix} 8 & 2 & 1 & 5 \\ 2 & 1 & 0 & 1 \\ 3 & 0 & 1 & 3 \\ 5 & 1 & 1 & 4 \end{bmatrix}$

$C_1 \leftrightarrow C_3$

$$\begin{bmatrix} 1 & 2 & 8 & 6 \\ 0 & 1 & 2 & 1 \\ 1 & 0 & 3 & 3 \\ 1 & 1 & 5 & 4 \end{bmatrix}$$

$R_3 \to R_3 - R_1 \qquad R_4 \to R_4 - R_1$

$$\begin{bmatrix} 1 & 2 & 8 & 6 \\ 0 & 1 & 2 & 1 \\ 0 & -2 & -5 & -3 \\ 0 & -1 & -3 & -2 \end{bmatrix}$$

$R_3 \to R_3 + 2R_2 \qquad R_4 = R_4 + R_2$

$$\begin{bmatrix} 1 & 2 & 8 & 6 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & -1 & -1 \\ 0 & 0 & -1 & -1 \end{bmatrix}$$

$R_4 \to R_4 - R_3$

$$\begin{bmatrix} 1 & 2 & 8 & 6 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & -1 & -1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$R_3 \to \dfrac{R_3}{-1}$

$$\begin{bmatrix} 1 & 2 & 8 & 6 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Clearly this is the Echelon form of the matrix A

$\therefore$ Number of non zero rows are 3

BLDEA'S

S B Arts and KCP Science College Vijayapur

Seminar on: Numerical Analysis

Name: Bhagyanidhi Budihal

Sub : Mathematics (II) (B div)

Class: BSc VI sem

UUCMS NO: U15KM21S0339

Seen

1) Find a real root of Eqn $x^3 - 2x - 5 = 0$ by the method of false position correct to 3 decimal places

let $f(x) = x^3 - 2x - 5$ then

$f(0) = -5$, $f(1) = -6$, $f(2) = -1$, $f(3) = 16$

$\therefore$ the root lies in $(2, 3)$ & it may observed that value of $f(x)$ at $x = 2$ being -1 is nearer to zero compared to $f(3) = 16$, so that we expect root lies in right neighbourhood of 2

Now $f(2.1) = 0.061 > 0$

$\therefore$ the roots lies b/n 2 & 2.1

I appro^n^

here $a = 2$ $\quad b = 2.1$

$f(a) = -1$ $\quad f(b) = 0.061$

$$x_1 = \frac{a\,f(b) - b\,f(a)}{f(b) - f(a)} = \frac{2(0.061) - 2.1(-1)}{0.061 + 1} = 2.0942$$

Now,

$$f(2.0942) = 9.18447 - 4.1884 - 5$$
$$= -0.0039 < 0$$

$\therefore$ the root lies b/n 2.0942 & 2.1

II appro^n^

$$x_2 = \frac{2.0942(0.061) - 2.1(-0.0039)}{0.061 + 0.0039} = 2.094$$

Comparing x_1 & x_2 we observe that the values are same upto 3 decimal places

hence approximate root is 2.094

2) Solve by Gauss- Jordon Method

$2x + 5y + 7z = 52$

$2x + y - z = 0$

$x + y + z = 9$

The given system of eqn can be written in the form of $AX = B$

$$\begin{bmatrix} 2 & 5 & 7 \\ 2 & 1 & -1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 52 \\ 0 \\ 9 \end{bmatrix}$$

consider the augumented matrix $[A:B]$

$$[A:B] = \left[\begin{array}{ccc:c} 2 & 5 & 7 & 52 \\ 2 & 1 & -1 & 0 \\ 1 & 1 & 1 & 9 \end{array}\right]$$

$R_1 \leftrightarrow R_3$

$$\sim \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 2 & 1 & -1 & 0 \\ 2 & 5 & 7 & 52 \end{array}\right]$$

$R_2 \rightarrow R_2 - 2R_1$ & $R_3 \rightarrow R_3 - 2R_1$

$$\sim \left[\begin{array}{ccc:c} 1 & 1 & 1 & 9 \\ 0 & -1 & -3 & -18 \\ 0 & 3 & 5 & 34 \end{array}\right]$$

$R_1 \rightarrow R_1 + R_2$ & $R_3 \rightarrow R_3 + 3R_2$

$$\sim \left[\begin{array}{ccc:c} 1 & 0 & -2 & -9 \\ 0 & -1 & -3 & -18 \\ 0 & 0 & -4 & -20 \end{array}\right]$$

$R_3 \rightarrow (-1/4) R_3$

$$[A \vdots B] \sim \begin{bmatrix} 1 & 0 & 2 & \vdots & -9 \\ 0 & -1 & -3 & \vdots & -18 \\ 0 & 0 & 1 & \vdots & 5 \end{bmatrix}$$

$R_1 \rightarrow R_1 + 2R_3$

$R_2 \rightarrow R_2 + 3R_3$

$$[A \vdots B] \sim \begin{bmatrix} 1 & 0 & 0 & \vdots & 1 \\ 0 & -1 & 0 & \vdots & -3 \\ 0 & 0 & 1 & \vdots & 5 \end{bmatrix}$$

$x = 1, \quad y = 3, \quad z = 5$

Hence the required solution is

$x = 2, \quad y = 3, \quad z = 5.$

3) Find the Polynomial by using Newton forward interpolation formula.

x:	0	1	2	3
$f(x)$:	1	2	1	10

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$
0	1			
		1		
1	2		-2	
		-1		12
2	1		10	
		9		
3	10			

3) wkt Newton forward interpolation formula

$$f(x) = f(a) + u.\frac{\Delta f(a)}{1!} + u(u-1)\frac{\Delta^2 f(a)}{2!} + \cdots \frac{u(u-1)(u-2)\cdots(u-n+1)\Delta^n f(a)}{n!}$$

here, $h=1$

$x = a+hu$

$u = \frac{x-a}{h} \Rightarrow \frac{x-0}{1} = x \quad [a=0]$

$\boxed{u=x}$

$$f(x) = f(0) + \frac{x\Delta f(0)}{1} + \frac{x(x-1)\Delta^2 f(0)}{2} + \frac{x(x-1)(x-2)\Delta^3 f(0)}{6}$$

$$= 1 + x(1) + \frac{x(x-1)}{2}(-2) + \frac{x(x-1)(x-2)}{6}(12)$$

$$= 1+x-(x^2-x) + x(x^2-2x-x+2)2$$

$$= 1+x-x^2+x+2x(x^2-3x+2)$$

$$= 1+x-x^2+x+2x^3-6x^2+4x$$

$$f(x) = 2x^3-7x^2+6x+1$$

Which is required polynomial.

44) find $f'(1.5)$ from given table

x: 0.0 0.5 1.0 1.5 2.0

y: 0.3989 0.3521 0.2420 0.1295 0.0540

consider diff table

x	y	$\nabla f(x_n)$	$\nabla^2 f(x_n)$	$\nabla^3 f(x_n)$	$\nabla^4 f(x_n)$
0.0	0.3989				
		-0.0468			
0.5	0.3521		-0.0633		
		-0.1101		0.0609	
1.0	0.2420		-0.0024		-0.0215
		-0.1125		0.0394	
1.5	0.1295		0.037		
		-0.0755			
2.0	0.0540				

here $h = 0.5$ $x = 1.5$ $x_n = 1.5$ $P = \dfrac{1.5-1.5}{0.5} = 0$

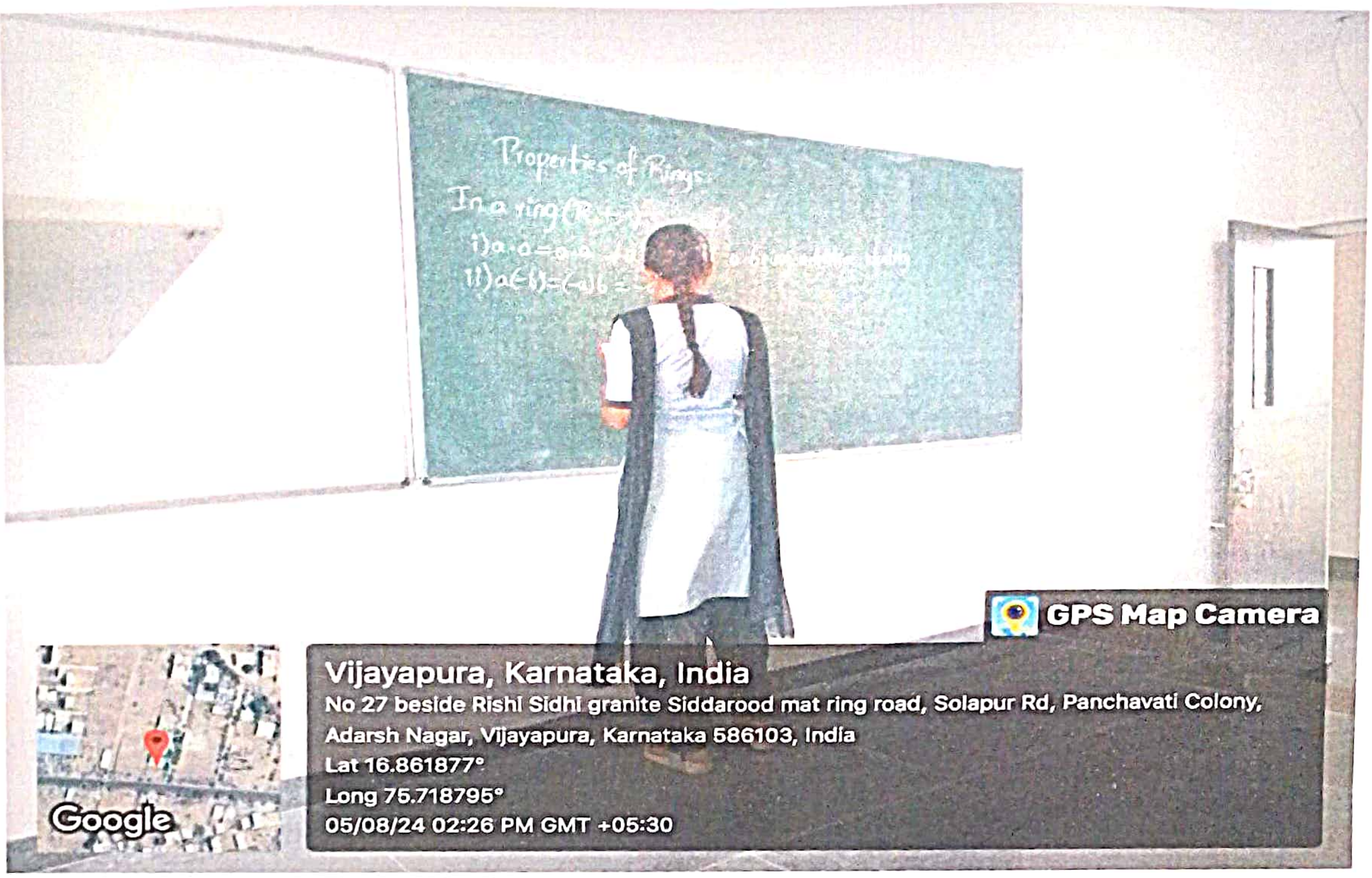
$$f'(x_n) = \frac{1}{h}\left[\nabla f(x_n) + \frac{1}{2}\nabla^2 f(x_n) + \frac{1}{3}\nabla^3 f(x_n)\right]$$

$$f'(1.5) = \frac{1}{0.5}\left[-0.1125 + \frac{1}{2}(-0.0024) + \frac{1}{3}(0.0609)\right]$$

$$= \frac{1}{0.5}\left[-0.1125 - 0.0012 + 0.0203\right]$$

$$= \frac{1}{0.5}\left[-0.0934\right]$$

$$f'(1.5) = -0.1868$$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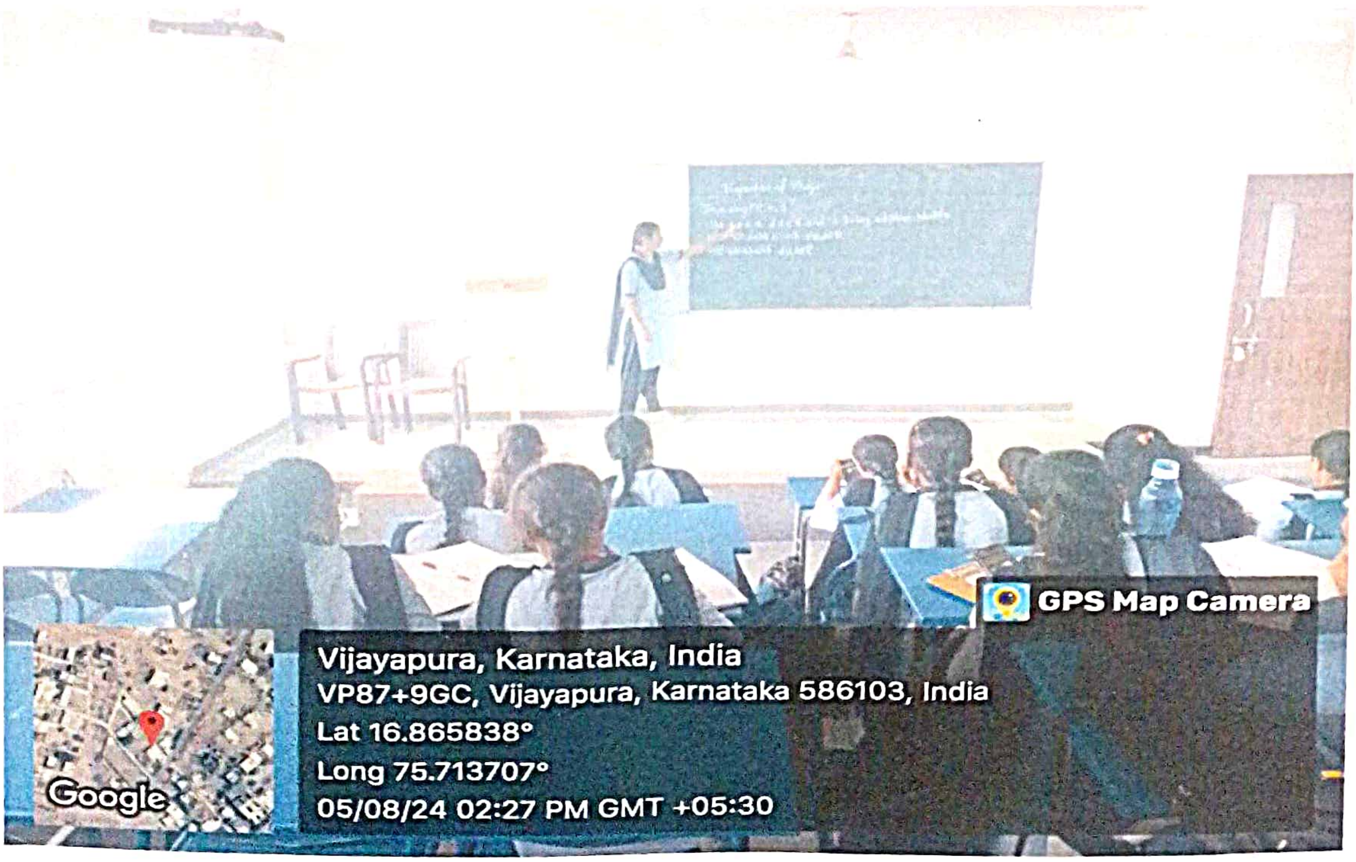
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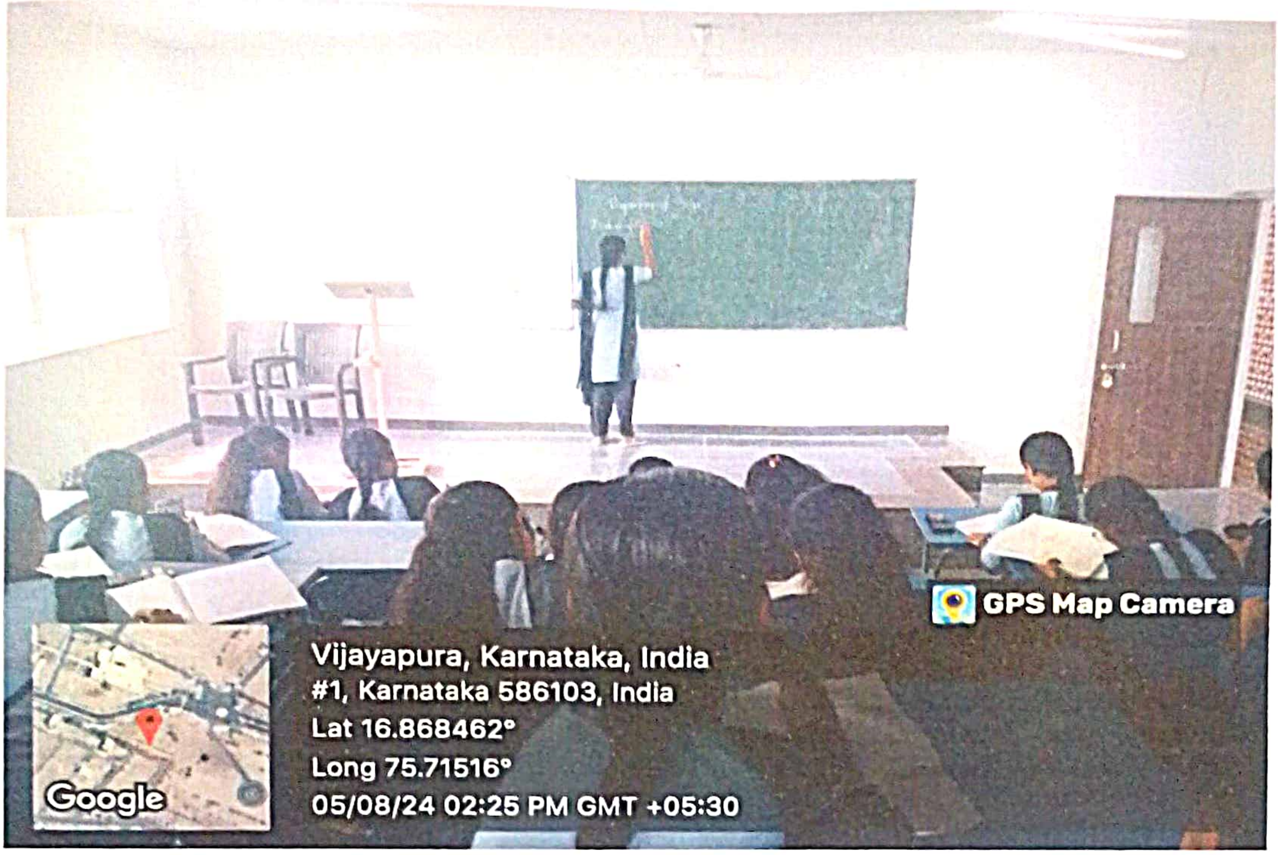
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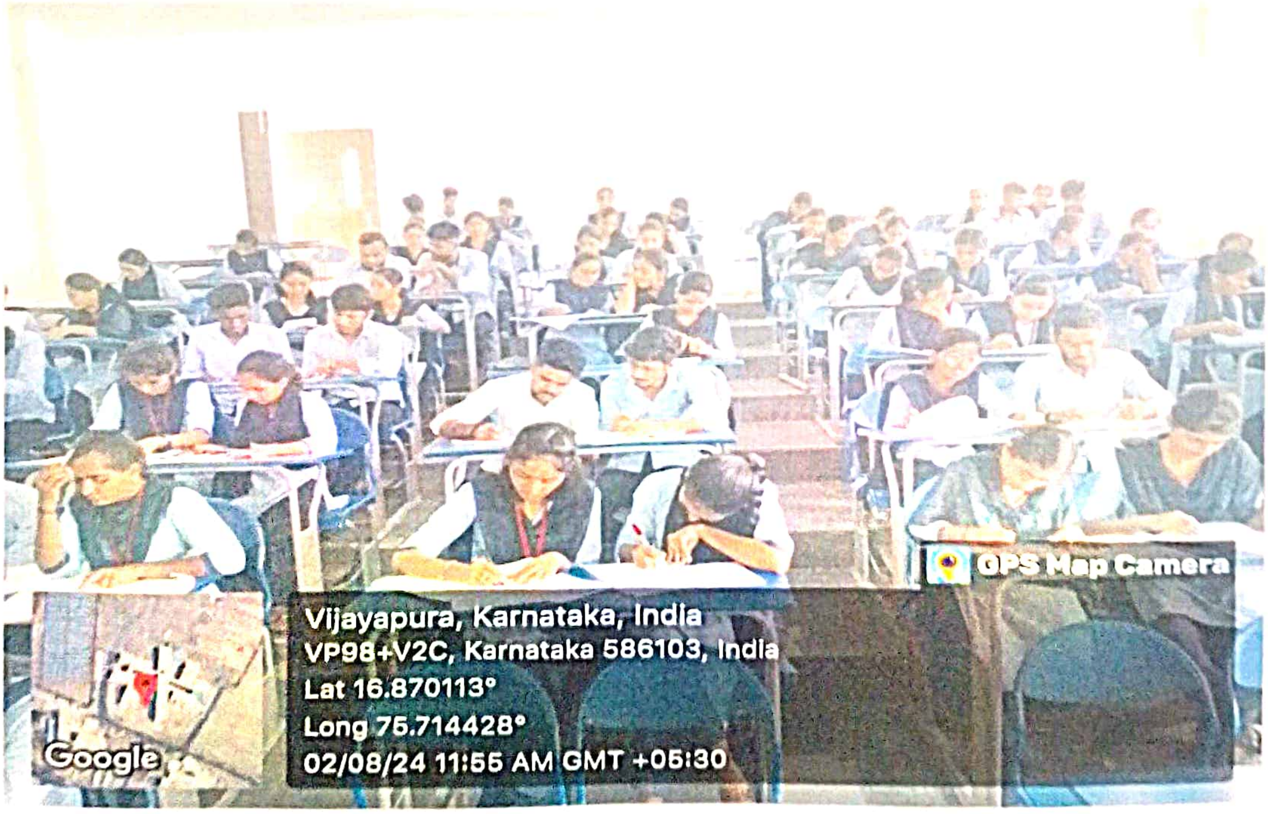
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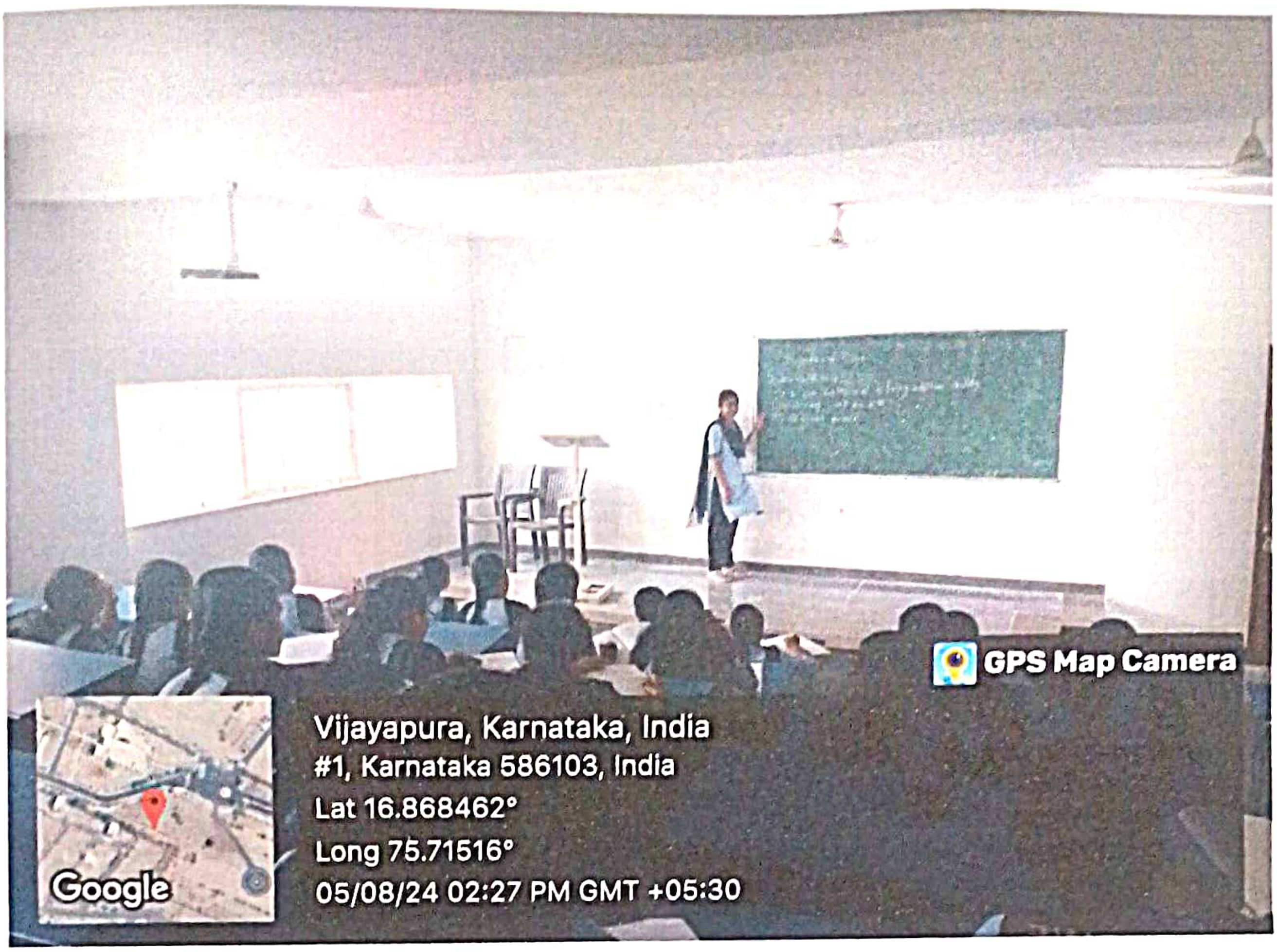
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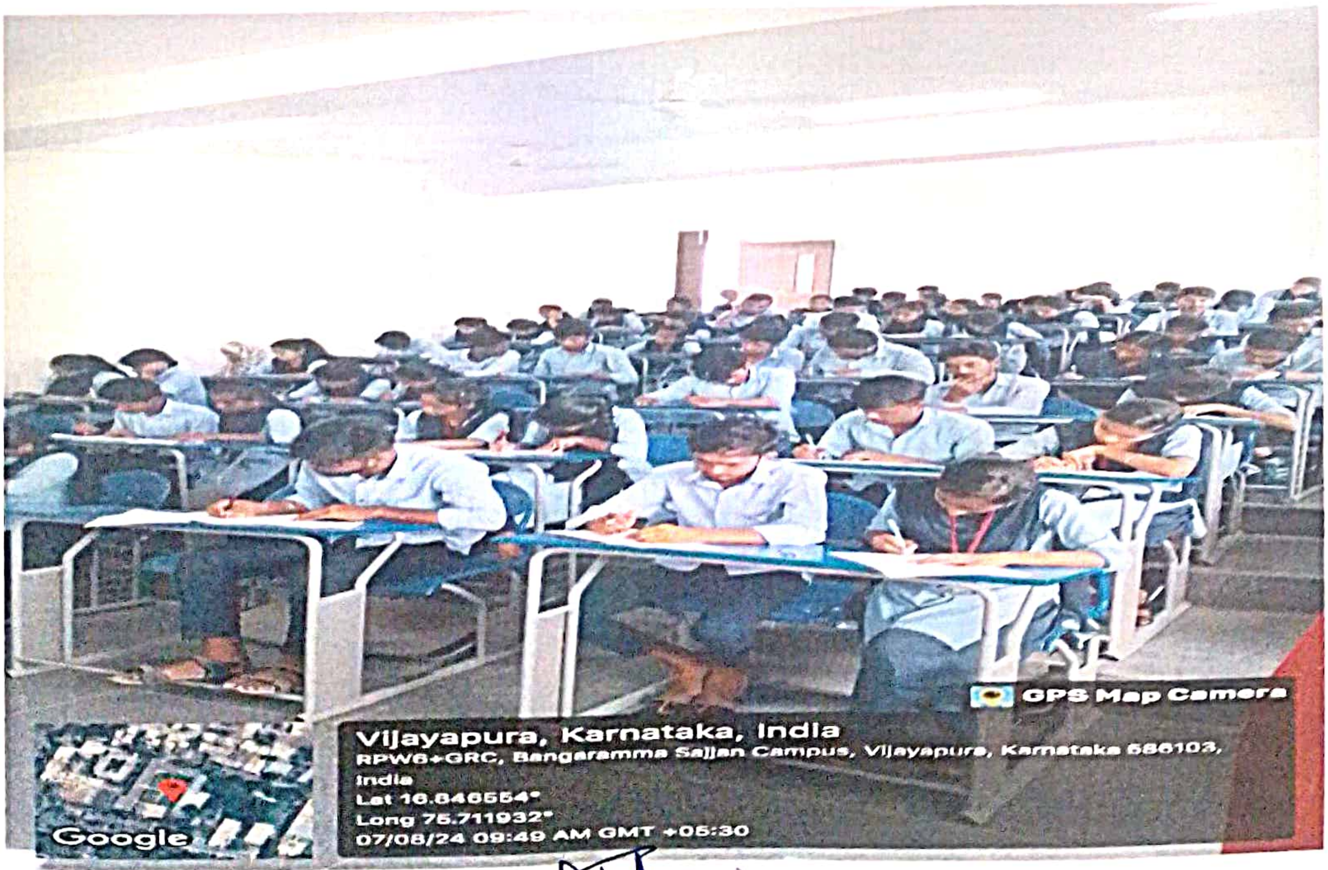
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12.	U15KM23S0209	Rukmini Darveshi	II	[illegible]
13.	U15KM23S0211	Pallavi Mathapati	II	[illegible]
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24.	U15KM23S0358	Lakshmi Patil	II	Patil
25.	U15KM23S0359	Satish Pujari	II	Pujari
26.	U15KM23S0379	Tabassum Benni	II	Tabassum B.
27.	U15KM22S0259	Swati Bisanal	IV	S. Bisanal
28.	U15KM22S0273	Rashmi	IV	[illegible]
29.	U15KM22S0294	Danamma Poojari	IV	Poojari
30.	U15KM22S0305	Pooja Ashok Katti	IV	[illegible]
31.	U15KM22S0311	Amruta Shiroor	IV	[illegible]
32.	U15KM22S0312	Revati Nesur	IV	Amruta S
33.	U15JU22S0058	Prema Bagalkot	IV	[illegible]
34.	U15KM22S0221	Abdul Yadagiri	IV	[illegible]

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36.	U15KM22S0224	Sahana Sajjan	IV	
37.	U15KM22S0225	Sheetal Kadamani	IV	Sheetal
38.	U15KM22S0192	Shubhangi Biradar	IV	
39.	U15KM22S0180	Bhoomika Kondaguli	IV	
40.	U15KM22S0180	Bhoomika Kondaguli	IV	
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42.	U15KM22S0164	Laxmi Biradar	IV	
43.	U15KM22S0165	Arpita Sajjan	IV	
44.	U15KM22S0167	Shivaleela Nalatawad	IV	
45.	U15KM22S0162	Akshata Badagi	IV	A.R.Badagi
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47.	U15KM22S0153	Jayashree	IV	
48.	U15KM22S0158	Shweta Hunasagi	IV	
49.	U15KM22S0137	Ningaraddy	IV	
50.	U15KM22S0125	Sahana Mallappagol	IV	
51.	U15KM22S0115	Preeti Keshav	IV	Preeti
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53.	U15KM22S0102	Swati Chavhan	IV	Swati
54.	U15KM22S0022	Bhagyashree Mathapati	IV	
55.	U15KM22S0024	Madhumati Kalagond	IV	
56.	U15KM22S0001	Kaveri Melinakeri	IV	
57.	U15KM22S0009	Suma Hitnalli	IV	
58.	U15KM21S0001	Krupa Mahadev Biradar	VI	
59.	U15KM21S0011	Aishwarya S Ghanure	VI	Aishwarya
60.	U15KM21S0023	Uma Shivanand Padanad	VI	U.S.P
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64.	U15KM21S0098	Apoorva Awati	VI	
65.	U15KM21S0130	Nikhita Siddeshwar Vijapur	VI	N.S.Vijapur
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67.	U15KM21S0221	Hariprasad Kulkarni	VI	HRK
68.	U15KM21S0232	Shameem Iqbal Pendari	VI	
69.	U15KM21S0285	Pranoti Pralhad Kulkarni	VI	Pranoti
70.	U15KM21S0289	Annaray Bhavikatti	VI	Annaroy.s.B
71.	U15KM21S0295	Abhishek Kolakar	VI	A.M.Kolkar
72.	U15KM21S0315	Prema S	VI	P.S.M
73.	U15KM21S0339	Bhagyanidhi Budihal	VI	
74.	U15KM21S0359	Pooja Mallappa Patil	VI	P.M.Patil
75.	U15KM21S0362	Kavyashree M Kaladagi	VI	K.M.Kaladagi
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77.	U15KM21S0370	Kashibai Pujari	VI	KIP
78.	U15KM21S0372	Spoorti Shivappa Siddapur	VI	Spoorti

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80.	U15KM21S0389	Nagaveni Harawal	VI	
81.	U15KM21S0390	Aishwarya Paragond	VI	
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86.	U15KM21S0013	Akshata Iranna Ingaleshwar	VI	Akshata
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88.	U15KM21S0086	Priyanka Shanmukh Galave	VI	
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93.	U15KM21S0163	Prajwal Aihole	VI	Prajwal
94.	U15KM21S0173	Aishwarya Umarani	VI	
95.	U15KM21S0177	Prema Sidagouda Patil	VI	P.Patil
96.	U15KM21S0201	Jyoti Jiddagi	VI	
97.	U15KM21S0222	Ashok Teli	VI	
98.	U15KM21S0284	Rashmi	VI	Rashmi
99.	U15KM21S0288	Sadhana Subhashagoud Patil	VI	
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102.	U15KM21S0379	Rekha	VI	
103.	U15KM21S0383	Sneha Sasanur	VI	Sneha
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