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

DEPARTMENT OF MATHEMATICS

ADVANCE LEARNERS

For the Academic Year : 2017-18

BLDE ASSOCIATION'S

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

DEPARTMENT OF MATHEMATICS

SEMINAR REPORT

2017-18 (ODD SEMESTER)

BLDE Association's

S.B.Arts And K.C.P Science College, Vijayapur

DEPARTMENT OF MATHEMATICS

NOTICE:

The UG Department of Mathematics is conducting seminar for B.Sc students for the academic year 2017-18(Odd Semester)

IQAC, Co-ordinator
S.B.Arts & K.C.P.Science College
Vijayapur.

Principal,
S.B. Arts and KCP Science College
VIJAYAPUR

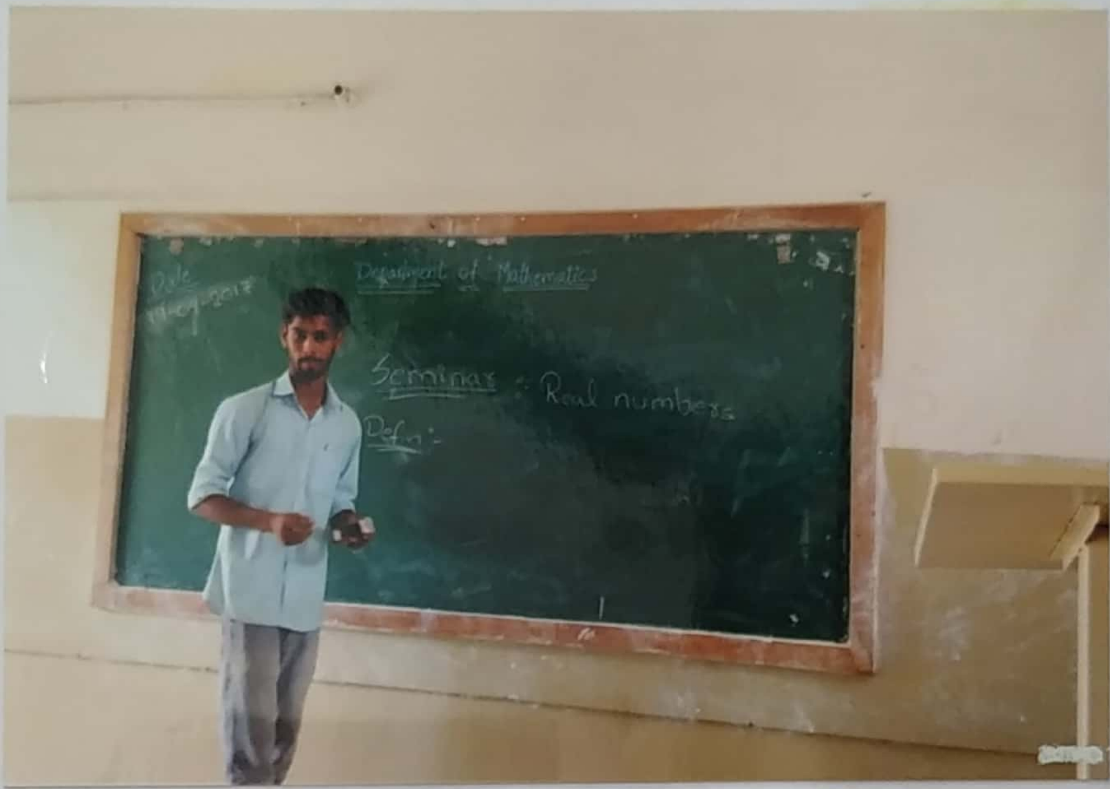
Head of Department
H. O. D:
Department of Mathematics
S. B. Arts & K. C. P. Science
College, BIJAPUR.

B.L.D.E.A's S.B.Arts & K.C.P Science College , Vijayapura

Department of Mathematics

SEMINAR – 2017-18 (ODD SEMESTER)

Sl.No	Semester	Name of the students	Topics	Date
1.	I	Akash Miragi	Real Numbers	19/09/2017
2.	III	Sushmita Mahindrakar	Properties of Jaccobians	25/09/2017
3.	V	Soumya Muttagi	Kinematics	28/09/2017



Name : Akash Miragi

Semester : I

Topic : Real Numbers

Mathematics Seminar

Topic :- Real Numbers

Prepared By :-

Name :- Akash. Miragi

Roll No :- 76

RCUB No :- S1721620

Sem : II Sem BSC

) If $a,b,c \in R$ = $a+b=a+c$ then $b=c$

Solution:- $a,b,c \in R$ and $a+b=a+c$

$b=0+b$

$b=(-a+a)+b$

$b=-a+(a+b)$

$b=-a+(a+c)$

$b=(-a+a)+c \Rightarrow b=c$

$\forall a,b,c \in R$ & $a+b=a+c \Rightarrow b=c$.

Law of Trichotomy:-

Statement:- If $a,b \in R$ then one and only one of the following three statement is true $a<b, a=b, a>b$

Proof: $a,b \in R \Rightarrow a-b \in R$

$a-b>0$, $a-b=0$, $a-b<0$

$a>b$, $a=b$, $a<b$

$\therefore a,b \in R$ one & only one of the following three statement is true.

Transitive Law:-

Statement: If $a,b,c \in R$ then $a<b$, & $b<c \Rightarrow a<b$

Proof

$a,b,c \in R$

$a<b$ & $b<c$

$a-b>0$ $b-c>0$

$[(a-b)+(b-c)]>0$

$(c-b)+(b-a)>0$

$c-a>0$ $c>a$ $\therefore a<c$

If $a>0$ & $b>0$ then prove that $a^2+b^2>2ab$

Solution:-

To prove that $a^2+b^2>2ab$

We know that, $a-b>0$

$$(a-b)^2>0$$

$$a^2+b^2-2ab>0$$

$$a^2+b^2>2ab.$$

If $a, b, c \in R$ the P.T $a^2+b^2+c^2 \geq ab+bc+ca$.

Solution:-

$a \geq b$

$a-b \geq 0$

$(a-b)^2 \geq 0$

$a^2+b^2 \geq 2ab \rightarrow (1)$

$b \geq c$

$(b-c)^2 \geq 0$

$b^2+c^2 \geq 2bc \rightarrow (2)$

$c \geq a$

$(c-a)^2 \geq 0$

$c^2+a^2-2ca \geq 0$

$c^2+a^2 \geq 2ca \rightarrow (3)$

From (1) & (2) & (3)

$$a^2+b^2+c^2+a^2+b^2+c^2 \geq 2ab+2bc+2ca$$

$$2a^2+2b^2+2c^2 \geq 2(ab+bc+ca)$$

$$(a^2+b^2+c^2) \geq ab+bc+ca.$$

If a, b, c are all +ve S.T $\frac{a+b+c}{3} > \sqrt[3]{abc}$ If $a=b=c$
$\forall a, b, c \in R^+$

Solution:- $a=b=c$

$a>0, b>0, c>0$

$a=x^3, b=y^3, c=z^3$

$x>0, y>0, z>0$

$x>0$ & $y>0 \Rightarrow (x-y)^2 >0 \Rightarrow x^2+y^2+2xy>0 \longrightarrow$ (1)

$y>0$ & $z>0 \Rightarrow (y-z)^2>0 \Rightarrow y^2+z^2+2yz>0 \longrightarrow$ (2)

$z>0$ & $x>0 \Rightarrow (z-x)^2>0 \Rightarrow z^2+x^2-2xz>0 \longrightarrow$ (3)

Adding above Equation

$x^2+y^2+y^2+z^2+z^2+x^2 \geqslant 2xy+2yz+2xz$

$2x^2+2y^2+2z^2 \geqslant 2xy+2yz+2xz$

$x^2+y^2+z^2 > xy+yz+xz$

$(x^3+y^3+z^3) = (x+y+z)(x^2+y^2+z^2-xy-yz-zx)>0$

By eq^n (1) & (2)

$x^3+y^3+z^3-3xyz>0$

$x^3+y^3+z^3>3xyz$

$x^3+y^3+z^3>3\sqrt[3]{xyz}$

$\frac{a+b+c}{3} > \sqrt[3]{xyz}$

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For any $a, b \in R$ the Prove that $\frac{a+b}{2} \geq \sqrt{ab}$

Solution:- $\forall a, b \in N$

$a = x^2 \quad b = y^2$ and $x = \sqrt{a}, y = \sqrt{b}$

$x > 0, \quad y > 0$

$(x-y)^2 > 0 \Rightarrow x^2 + y^2 - 2xy > 0$

$x^2 + y^2 > 2xy$

$\frac{x^2+y^2}{2} > \sqrt{x^2 - y^2}$

$\frac{a+b}{2} > \sqrt{ab}.$

If $a, b, c, d \in R^+$ then P.T

$a^2b + b^2c + c^2a + ab^2 + bc^2 + ca^2 \geq 6abc$

Solution:- $a > 0, b > 0, c > 0$

$a > 0, b > 0 \Rightarrow (a-b)^2 \geq 0$

$b > 0, c > 0 \Rightarrow (b-c)^2 \geq 0$

$c > 0, a > 0 \Rightarrow (c-a)^2 \geq 0$

$(a-b)^2 \geq 0$

$a^2 + b^2 - 2ab \geq 0$

$a^2 + b^2 \geq 2ab$

$(b-c)^2 \geq 0 \Rightarrow b^2 + c^2 - 2bc \geq 0.$

$(c-a)^2 \geq 0 \Rightarrow c^2 + a^2 - 2ca \geq 0$

$a(b-c)^2 \geq 0 \rightarrow (1)$

$b(c-a)^2 \geq 0 \rightarrow (2)$

$c(a-b)^2 \geq 0 \rightarrow (3)$

From equation (1) (2) & (3)

$$a(b^2+c^2-2bc)+b(c^2+a^2-2ca)+c(a^2+b^2-2ab)\geq 0$$

$$ab^2+ac^2-2abc+bc^2+ba^2-2abc+ca^2+cb^2-2abc\geq 0$$

$$ab^2+ac^2+bc^2+ba^2+ca^2+cb^2\geq 6abc.$$

* If $x, y \in \mathbb{R}$ then P.T $|x-y|\geq ||x|-|y||$

Solution:- $|x-y|=\sqrt{x^2+y^2-2xy}$

$$|x-y|=\sqrt{|x|^2+|y|^2-2|x||y|}$$

But $x<|x|$ $y<|y|$

$$|x-y|\geq\sqrt{|x|^2+|y|^2-2|x||y|}$$

$$|x-y|\geq\sqrt{(|x|-|y|)^2} \qquad (\sqrt{x^2}=|x|)$$

$$|x-y|\geq ||x|-|y||$$

Archemedian Property of Real Number.

Theorem:- State and Prove Archimedian Property of real number.

Statement: If $x, y \in R$, $x>0$ $\exists\, n \in N$ then $nx>y$

Proof: Since $y \in R$

By Trichotomy Law

$y<0$, $y=0$, $y>0$.

Case I :- If $y \leq 0$

Since $x > 0, n > 0 \Rightarrow nx > 0$

$nx > 0 \geq y$

$nx \geq y$

Case II :- If $y > 0$

Assume the result is false, than

$nx \leq y, \forall n \in N$

The set $A = \{nx / n \in N\}$ is bounded above

l.u.b of $A = u$

$nx \leq u, \forall n \in N$

$\Rightarrow (n+1)x \leq u$

$\Rightarrow nx + x \leq u$

$nx \leq u - x < u$

$u - x$ is less than u

$\therefore$ Controduction to hypothesis

$\therefore$ Our Assumption $nx < y$ is Wrong

$\therefore nx > y$.

Name : Sushmita Mahindrakar

Semester : III

Topic : Properties of Jaccobians

S. B. Arts & K. C. P Science College Vijayapur.

Mathematics Seminar

Topic : Properties of Jacobian.

Name : Sushmita Mahindrakar

Roll No : 403

RCU NO : S16 22492

Sem : 3rd Sem. BSc.

Properties of Jacobian :-

Inverse Rule : If u & v are f's of x, y then $\dfrac{\partial(u,v)}{\partial(x,y)} \times \dfrac{\partial(x,y)}{\partial(u,v)} = 1$.

Or if $J = \dfrac{\partial(u,v)}{\partial(x,y)}$, $J' = \dfrac{\partial(x,y)}{\partial(u,v)}$ then

$$J \cdot J' = 1$$

oof

If $u = f_1(x,y)$ $v = f_2(x,y)$ then we can express x, y as f's of u, v.
differentiating $u = f_1(x,y)$ $v = f_2(x,y)$ partially w.r.t. u & v.

$$u = f_1(x,y).$$

$$1 = \frac{\partial u}{\partial x} \cdot \frac{\partial x}{\partial u} + \frac{\partial u}{\partial y} \cdot \frac{\partial y}{\partial u}.$$

$$0 = \frac{\partial u}{\partial x} \frac{\partial x}{\partial v} + \frac{\partial u}{\partial y} \frac{\partial y}{\partial v}$$

$$v = f_2(x,y).$$

$$0 = \frac{\partial v}{\partial x} \frac{\partial x}{\partial u} + \frac{\partial v}{\partial y} \frac{\partial y}{\partial u}$$

$$1 = \frac{\partial v}{\partial x} \frac{\partial x}{\partial v} + \frac{\partial v}{\partial y} \cdot \frac{\partial y}{\partial v}.$$

Now,

$$\frac{\partial(u,v)}{\partial(x,y)} \times \frac{\partial(x,y)}{\partial(u,v)} =$$

$$= \begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial u}{\partial y} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial y} \end{vmatrix} \begin{vmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{vmatrix}$$

$$= \begin{vmatrix} \frac{\partial u}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial u}{\partial y}\frac{\partial y}{\partial u} & \frac{\partial u}{\partial x}\frac{\partial x}{\partial v} + \frac{\partial u}{\partial y} \\ \frac{\partial v}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial v}{\partial y}\frac{\partial y}{\partial u} & \frac{\partial v}{\partial x}\frac{\partial x}{\partial v} + \frac{\partial v}{\partial y} \end{vmatrix}$$

$$= \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$$

$$= 1 - 0$$

$$= 1.$$

$$\therefore \frac{\partial(u,v)}{\partial(x,y)} \cdot \frac{\partial(x,y)}{\partial(u,v)} = 1.$$

$$J \cdot J' = 1.$$

Example

1) If $x = u(1-v)$ & $y = u.v$ then P.T

$$\frac{\partial(x,y)}{\partial(u,v)} \cdot \frac{\partial(u,v)}{\partial(x,y)}$$

Soln $\frac{\partial(x,y)}{\partial(u,v)} = \begin{vmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{vmatrix}$

$$\begin{vmatrix} 1-v & -u \\ v & u \end{vmatrix}$$

$$= u - \cancel{uv} + \cancel{uv}$$
$$= u$$

As $x = u - uv$ & $y = uv$

$x = u - y$ $\qquad v = \dfrac{y}{u}$

$u = x + y$. $\qquad v = \dfrac{y}{x+y}$

$$\frac{\partial(u,v)}{\partial(x,y)} = \begin{vmatrix} \dfrac{\partial u}{\partial x} & \dfrac{\partial u}{\partial y} \\ \dfrac{\partial v}{\partial x} & \dfrac{\partial v}{\partial y} \end{vmatrix}$$

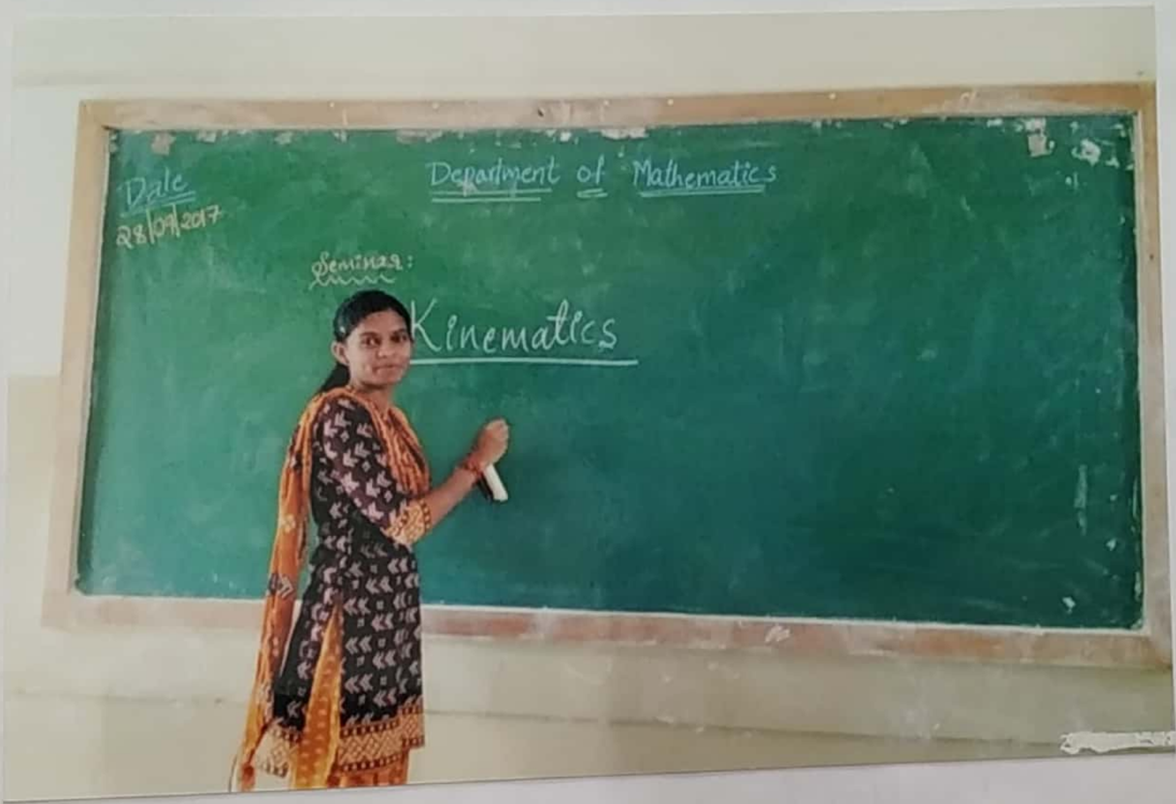
$$= \begin{vmatrix} 1 & 1 \\ \dfrac{-y}{(x+y)^2} & \dfrac{x}{(x+y)^2} \end{vmatrix}$$

$$= \frac{x}{(x+y)^2} + \frac{y}{(x+y)^2}$$

$$= \frac{\cancel{(x+y)}}{(x+y)^{\cancel{2}}}$$

$$= \frac{1}{x+y}$$

$$= \frac{1}{u}.$$



Name : Soumya Muttagi

Semester : V

Topic : Kinematics

S.B. Arts & K.C.P Science College Bijapur

Department of Mathematics

Seminar : Kinematics

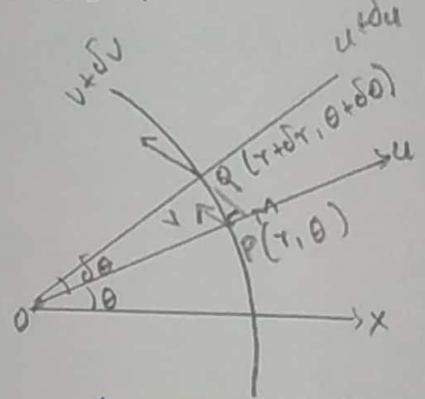
Name : Soumya . S. Mutlagi

Sem : B.Sc V Sem

Date : 28-09-2017

Reg.No : S1528125

Expression for Radial and Transverse velocities of a particle moving in a plane curve.



Let $P(r, \theta)$ and $Q(r+\delta r, \theta+\delta\theta)$ be the positions of the particle in timeo 't' and $t+\delta t$ respectively.

From right angled triangle,

Δ^{le} OQM

$$\cos\delta\theta = \frac{OM}{OQ}$$

$$OQ\cos\delta\theta = OM$$

$$OM = (r+\delta r)\cos\delta\theta \quad \text{——} \ (1)$$

$$\sin\delta\theta = \frac{QM}{OQ}$$

$$\sin\delta\theta \, OQ = QM$$

$$QM = (r+\delta r)\sin\delta\theta \quad \text{——} \ (2)$$

The radial velocity at $P = \lim_{\delta t \to 0} \frac{\text{displacement at P along OP}}{\delta t}$

$$= \lim_{\delta t \to 0} \frac{PM}{\delta t}$$

$$= \lim_{\delta t \to 0} \left[\frac{(r+\delta r)\cos\delta\theta - r}{\delta t}\right]$$

$$= \lim_{\delta t \to 0} \left[(r+\delta r)\ 1 - \frac{\delta^2\theta}{2!} + \frac{\delta^4\theta}{4!} \cdots\right] - r$$

Neglecting higher powers of $\delta\theta$, we have

$$= \lim_{\delta t \to 0} \frac{(r+\delta r)[1-r]}{\delta t}$$

$$= \lim_{\delta t \to 0} \frac{\delta r}{\delta t}$$

$$= \frac{dr}{dt}$$

Radial velocity $= \frac{dr}{dt}$

Transverse velocity at P $= \lim_{\delta t \to 0} \frac{\text{displacement at P } \perp^{er} \text{ OP}}{\delta t}$

$$= \lim_{\delta t \to 0} \frac{QM}{\delta t}$$

$$= \lim_{\delta t \to 0} \frac{(r+\delta r)\sin\delta\theta}{\delta\theta}$$

Expanding $\sin\delta\theta$ and neglecting higher powers of $\delta\theta$,

$$= \lim_{\delta t \to 0} \frac{(r+\delta r)\delta\theta}{\delta t}$$

$$= \lim_{\delta t \to 0} \frac{r\delta\theta}{\delta t} + \frac{\delta r}{\delta t}\delta\theta$$

$$= \lim_{\delta t \to 0} \frac{r\delta\theta}{\delta t}$$

$$= r\frac{d\theta}{dt}$$

Transverse velocity at P $= r\frac{d\theta}{dt}$

A point 'P'.

The radial velocity is proportional to its transverse velocity. Show that the path is an equiangular spiral.

→ Given:

Radial velocity $\propto$ Transverse velocity

$$\frac{dr}{dt} \propto r\frac{d\theta}{dt}$$

$$\frac{dr}{dt} = Kr\frac{d\theta}{dt}$$

where K is constant

$$\frac{dr}{dt} = Kr\frac{d\theta}{dt}$$

$$\frac{dr}{r} = K d\theta$$

Integrating the above equation, we get

$$\log r = K\theta + \log a$$

where $\log a$ is integrating constant

$$\log r - \log a = K\theta$$

$$\log\left(\frac{r}{a}\right) = K\theta$$

$$\frac{r}{a} = e^{K\theta}$$

$$\boxed{r = ae^{K\theta}}$$

which is eqn for equiangular spiral

show that the intrinsic equation of the path is $s = ae^{\psi} + B$, also show that the resultant velocity varies as e^{ψ}.

$\Rightarrow$ angular velocity $= K = \frac{d\psi}{dt}$

Tangential velocity $= \frac{ds}{dt} = \dot{s}$

normal velocity $= 0$

Tangential accl^n = Normal accl^n

$$v \cdot \frac{dv}{ds} = \frac{v^2}{\rho}$$

$$\frac{dv}{ds} = v \cdot \frac{d\psi}{ds}$$

$$\frac{dv}{v} = d\psi$$

on integrating we get,

$$\log v = \psi + C_1$$

$$v = e^{\psi + C_1}$$

$$v = e^{\psi} \cdot e^{C_1}$$

$$v = e^{\psi} \cdot C$$

$$v \propto e^{\psi}$$

$\therefore$ Velocity varies as e^{ψ}.

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

DEPARTMENT OF MATHEMATICS

SEMINAR REPORT: 2017-18
(Odd Semester)

The UG Department of Mathematics has conducted seminar for B.Sc students.

Name of the student	Seminar Topic
1) Akash Mirgi	Real numbers
2) Sushmita Mahindrakar	Properties of Jaccobian
3) Soumya Muttagi	Kinematics

Head of Department

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Principal

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BLDE ASSOCIATION'S

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

DEPARTMENT OF MATHEMATICS

SEMINAR REPORT

2017-18 (EVEN SEMESTER)

BLDE Association's

S.B.Arts And K.C.P Science College, Vijayapur

DEPARTMENT OF MATHEMATICS

NOTICE:

The UG Department of Mathematics is conducting seminar for B.Sc students for the academic year 2017-18(Even Semester)

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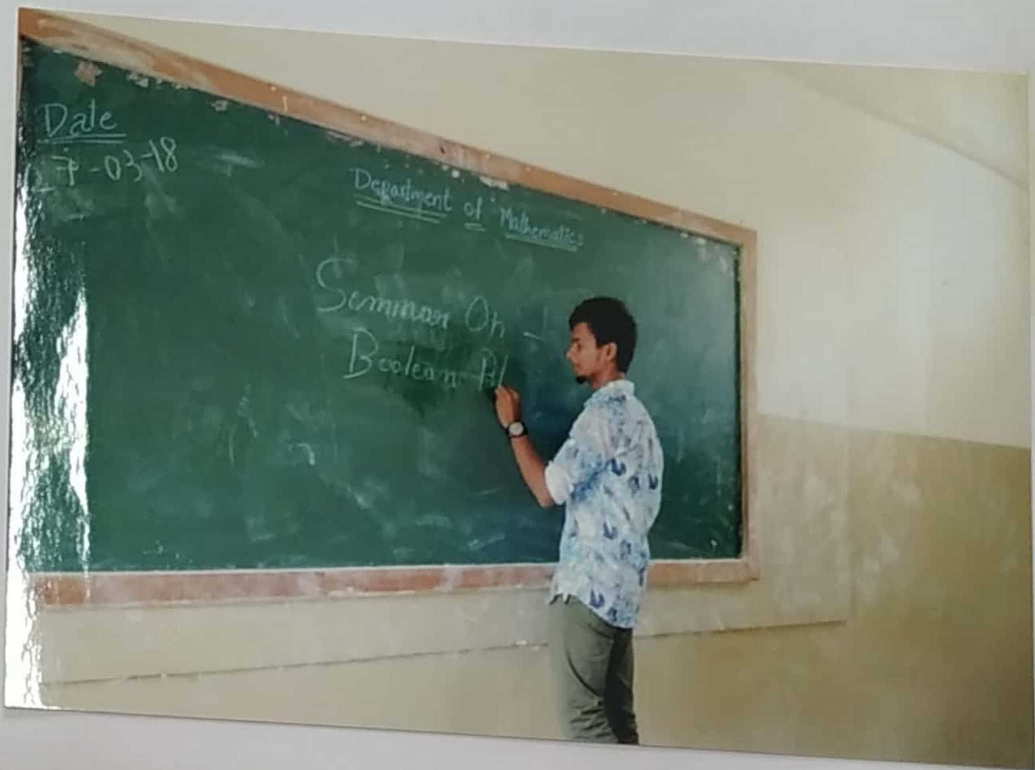
B.L.D.E.A's S.B.Arts & K.C.P Science College , Vijayapura

Department of Mathematics

SEMINAR – 2017-18 (EVEN SEMESTER)

Sl.No	Semester	Name of the students	Topics	Date
1.	II	Sandeep Ganni	Boolean Algebra	27/03/2018
2.	IV	Shruti Yadawad	Infinite Series - II	20/03/2018



Name : Sandeep. Ganni

Semester : II

Topic : Boolean Algebra

S.B. Arts & K.C.P Science college
Bijapur

Department :- Mathematics
Seminar on:- Boolean Algebra

Name:- Sandeep . Sogeeri
Std:- BSc IIIrd Sem
Roll No:- 333

SEMINAR ON BOOLEAN ALGEBRA :-

Introduction :-

In mathematical logic Boolean Algebra is a branch of algebra in which we can use values of variables are truth values true & false, usually denoted by 1 & 0 respectively

The basic laws of Boblean algebra that relate to the commutative law allowing a change in possition for addition & multiplecation the associ-ative law allowing the removal of brackets for addition & multiplication as usefull as the factoring of an expression are same

Boolean Expression :-

$A + 1 = 1$

$A + D = A$

$A . 1 = A$

$A . 0 = 0$

$A + A = A$

$A . A = A$

$\bar{A} = A$

$A + \bar{A} = 1$

$A \cdot \bar{A} = 0$

$A + B = B + A$

$A \cdot B = B \cdot A$

$\overline{A + B} = \bar{A}\bar{B}$

$\overline{A \cdot B} = \bar{A} + \bar{B}$

These are in laws in Boolean Algebra :-

Identity law

Null law

Idempotent Law

Commutative law

Inverse law

Commutative law

Associative law

Absorption law

Distrubutive law

Demorgan's law

1] **Identity law :-**

Identity is a equal relation $A = B$, such that A & B contain some variable & A & B produce the same values as each other.

2] **Null Law :-**

Null law is defined as the expression which does not consider any values is considered as Null.

3] **Idempotent law :-**

It is the property of certain operation in Boolean Algebra that it can be explained multiple times without changing the result.

4] **Commutative law :-**

It is defined as either of true laws relating to number operations of addition & Multiplication

5] **Inverse law :-**

It is type of a conditional which is opposite of another expression

6] Associative law :-

It is defined as eith[er of]
true laws relating to nor of
operations such as addition &
multiplication.

7] Distrubutive law :-

The law relating opera[tion]
of multiplication & addition.

8] Absorption law :-

It is law for identi[ty]
linking or pair of binary opera[tion]

9] Demorgan's law :-

This are pair of tra[ns]
formation rule that are both va[lid]
rules of Inference.

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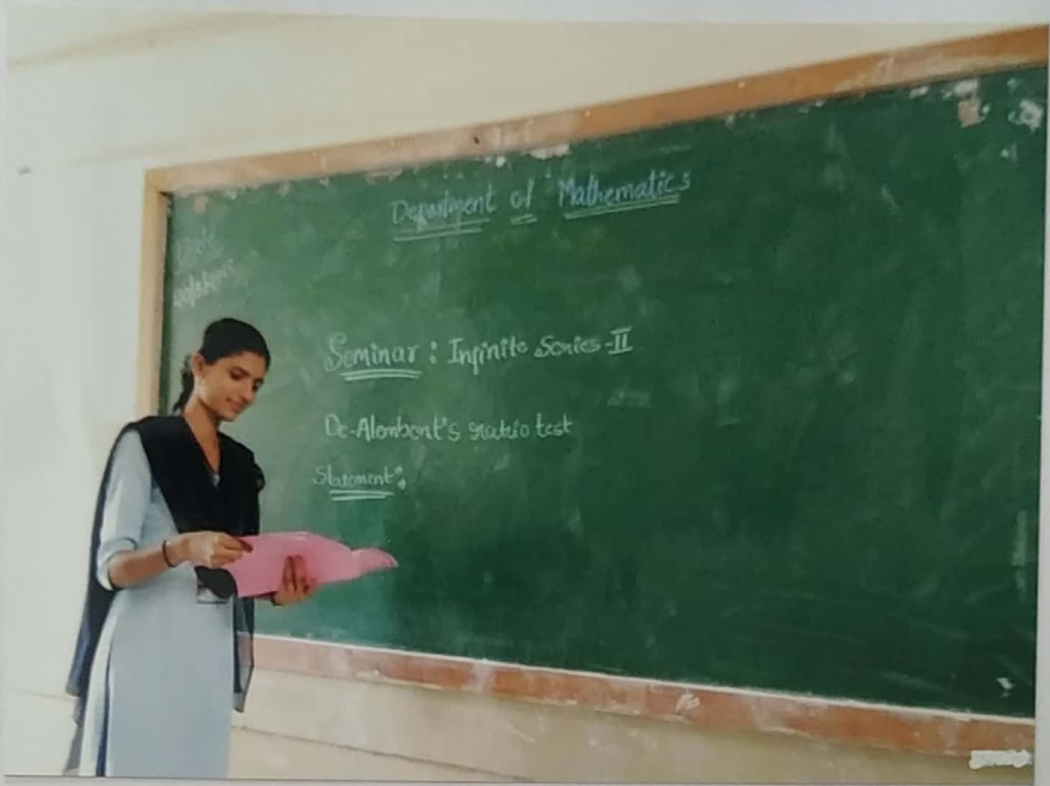

Name : Shruti . Yadawad

Semester : IV

Topic : Infinite Series - II

B.L.D.E. Assosiation

S.B. Art's and KCP Science College Vijayapur

Seminar-Topic : Infinite Series - II

Shruti. M. yadawad.
Roll No: 404 , IV Sem
R.C.U No: S1622433

Theorem :-

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Date : / /

De Alembert's Ratio Test

statement : If Σu_n be a series of positive terms and $\lim_{n\to\infty} \frac{u_{n+1}}{u_n} = l$ then

i) The series converges if $l < 1$
ii) The series diverges if $l > 1$
iii) the series test fails if $l = 1$.

proof : since $\lim_{n\to\infty} \frac{u_{n+1}}{u_n} = l$.

$\therefore$ By definition of limit

given $\varepsilon > 0$, however small, then $\exists$ integer m. such that

$$\left| \frac{u_{n+1}}{u_n} - l \right| < \varepsilon \quad \forall n > m$$

$$-\varepsilon < \frac{u_{n+1}}{u_n} - l < \varepsilon \quad \forall n > m$$

$$l - \varepsilon < \frac{u_{n+1}}{u_n} < \varepsilon + l \quad \forall n \text{ --- } ①$$

Case (i) when $l < 1$.

Choose, $\varepsilon > 0$. such that

$l < l + \varepsilon < 1$.
put $l + \varepsilon = r$ then $0 < r < 1$

from ① $\frac{u_{n+1}}{u_n} < r \quad \forall n$

Now,

Page :
Date :

$$u_n = \frac{u_n}{u_{n-1}} \cdot \frac{u_{n-1}}{u_{n-2}} \cdot \frac{u_{n-2}}{u_{n-3}} \cdots \frac{u_2}{u_1} \cdot u_1$$

$$u_n < (r.r.r.\cdots r) \cdot u_1$$

$$u_n < r^{n-1} u_1$$

If $r<1$, then by geometric series

$\sum r^{n-1}$ is converges

$\therefore \sum u_n$ is converges

Hence the series is converges if $l<1$.

Case (ii) When $l>1$.

choose $\varepsilon>0$, such that

$$l-\varepsilon = R > 1.$$

from ①, $\frac{u_{n+1}}{u_n} > R$.

Now

$$u_n = \frac{u_n}{u_{n-1}} \cdot \frac{u_{n-1}}{u_{n-2}} \cdot \frac{u_{n-2}}{u_{n-3}} \cdots \frac{u_2}{u_1} u_1.$$

$$u_n > (R.R.R.\cdots R) u_1$$

$$u_n > R^{n-1} u_1.$$

If $R>1$ then by geometric series

$\therefore \sum R^{n-1}$ is divergent

$\therefore \sum u_n$ is also divergent.

Hence the series diverges if $l > 1$.

case(iii) If $l = 1$ then series ratio test fails i.e no conclusion can be drawn, about the convergence or divergence of the series, the series may converges & it may diverges.

Practical form of De-Alembert's ratio test.

In practical ratio test is used in the following form if Σu_n is a positive term series and $\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = l$ then.

i) The series converges if $l > 1$.
ii) The series diverges if $l < 1$.
iii) the series test fails when $l = 1$.

Examples

1) Discuss the convergence of the following series.

$$1 + \frac{2!}{2^2} + \frac{3!}{3^3} + \frac{4!}{4^4} + \text{----}$$

Sol^n:

Here $u_n = \frac{n!}{n^n}$

and $u_{n+1} = \frac{(n+1)!}{(n+1)^{n+1}}$

$$\frac{u_n}{u_{n+1}} = \frac{n!}{n^n} \frac{(n+1)^{n+1}}{(n+1)n!}$$

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$$= \frac{n^{n+1}(1+1/n)^{n+1}}{n^n \cdot n(1+1/n)}$$

$$= \frac{\cancel{n^n \cdot n}(1+1/n)^n \cancel{(1+1/n)}}{\cancel{n^n \cdot n}\cancel{(1+1/n)}}$$

$$= (1+1/n)^n$$

$$\therefore \lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} (1+1/n)^n$$

$$= e > 1 \quad \because 2 < e < 3$$

$\therefore$ By De-Alembert's ratio test

Σu_n is convergent.

2) $1 + \frac{2^p}{2!} + \frac{3^p}{3!} + \frac{4^p}{4!}$ ------, $(p>0)$

Sol^n: Here $u_n = \frac{n^p}{n!}$

and

$$u_{n+1} = \frac{(n+1)^p}{(n+1)!}$$

$$= \frac{n^p(1+1/n)^p}{(n+1)n!}$$

$$\frac{u_n}{u_{n+1}} = \frac{n^p}{n!} \times \frac{(n+1)n!}{n^p(1+1/n)^p}$$

$$= \frac{n+1}{(1+1/n)^p}$$

$$\therefore \lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{n+1}{(1+1/n)^p}$$

$$= \infty > 1$$

$\therefore$ By de-Alembert's ratio test

Σu_n is convergent.

3) $\frac{1}{2} + \frac{1}{3} + \frac{1}{5} + \cdots + \frac{1}{2^{n-1}+1} + \cdots$

Sol: Here $u_n = \frac{1}{2^{n-1}+1}$

$$u_{n+1} = \frac{1}{2^{n}+1}$$

$$\frac{u_n}{u_{n+1}} = \frac{1}{2^{n-1}+1} \cdot \frac{2^n+1}{1}$$

$$= \frac{2^n(1+1/2^n)}{2^{n-1}(1+1/2^{n-1})}$$

$$= \frac{2^n(1+1/2^n)}{2^n 2^{-1}(1+1/2^{n-1})}$$

$$= \frac{2(1+1/2^n)}{(1+1/2^{n-1})}.$$

$$\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{2(1+1/2^n)}{(1+1/2^{n-1})}$$

$$= 2 > 1$$

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∴ By De-Alembert's ratio test

Σu_n is convergent.

4) $\frac{1^2 \cdot 2^2}{1!} + \frac{2^2 3^2}{2!} + \frac{3^2 4^2}{3!} + \frac{4^2 \cdot 5^2}{4!} + \cdots$

Sol^n: Here $u_n = \frac{n^2(n+1)^2}{n!}$

$$u_{n+1} = \frac{(n+1)^2(n+2)^2}{(n+1)!}$$

$$= \frac{(n+1)^2(n+2)^2}{(n+1)n!}$$

$$\frac{u_n}{u_{n+1}} = \frac{n^2(n+1)^2}{n!} \times \frac{(n+1)n!}{(n+1)^2(n+2)^2}$$

$$= \frac{n^2(n+1)}{(n+2)^2}$$

$$= \frac{n^2 \cdot n(1+1/n)}{n^2(1+2/n)^2}$$

$$\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{n(1+1/n)}{(1+2/n)^2}$$

$$= \infty > 1$$

∴ By De-Alembert's ratio test

Σu_n is convergent.

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5) $\frac{2}{1^2+1}+\frac{2^2}{2^2+1}+\frac{2^3}{3^2+1}+\text{-----}$

Solⁿ: Here $u_n = \frac{2^n}{n^2+1}$.

$u_{n+1} = \frac{2^{n+1}}{(n+1)^2+1}$.

$= \frac{2^n \cdot 2^1}{n^2(1+1/n)^2+1/n^2}$.

$\frac{u_n}{u_{n+1}} = \frac{2^n}{n^2+1} \times \frac{n^2(1+1/n)^2+1/n^2}{2^n 2^1}$.

$= \frac{n^2(1+1/n^2)+1/n^2}{2[n^2(1+1/n^2)]}$.

$= 1/2 < 1$.

∴ By De-Alembert's ratio test

Σu_n is divergent.

6) $\frac{1}{3}+\frac{8}{9}+\frac{27}{27}+\frac{64}{81}+\frac{125}{243}+\text{---}$

Solⁿ: The given series is.

$\frac{1^3}{3^1}+\frac{2^3}{3^2}+\frac{3^3}{3^3}+\frac{4^3}{3^4}+\frac{5^3}{3^5}+\text{---}$

Here $u_n = \frac{n^3}{3^n}$ and $u_{n+1} = \frac{(n+1)^3}{3^{n+1}}$

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$$\frac{u_n}{u_{n+1}} = \frac{n^3}{\cancel{3^n}} \cdot \frac{\cancel{3^n} \cdot 3}{(n+1)^3}$$

$$= \frac{n^3 3}{n^3(1+1/n)^3}$$

$$= \frac{3}{(1+1/n)^3}$$

$$\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{3}{(1+1/n)^3}.$$

$$= 3 > 1.$$

$\therefore$ By De-Alembert's ratio test.

Σu_n is convergent.

7) $\frac{2!}{3} + \frac{3!}{3^2} + \frac{4!}{3^3} + \cdots$

Sol^n Here $u_n = \frac{(n+1)!}{3^n}$

$$u_{n+1} = \frac{(n+2)!}{3^{n+1}}$$

$$= \frac{(n+1)n!}{3^n} \quad \frac{3^n 3}{(n+1)(n+2)n!}$$

$$= \frac{3}{n+2}$$

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$$\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{3}{n+1}$$

$$= \frac{3}{\infty} = 0 < 1.$$

$\therefore$ By De-Alembert's ratio test.

Σu_n is divergent.

8) $\frac{1}{5} + \frac{2!}{5^2} + \frac{3!}{5^3} + \cdots$

Sol: Here $u_n = \frac{n!}{5^n}$.

$$u_{n+1} = \frac{(n+1)!}{5^{n+1}}$$

$$\frac{u_n}{u_{n+1}} = \frac{n!}{5^n} \cdot \frac{5^n 5!}{(n+1)n!}.$$

$$= \frac{5}{(n+1)}$$

$$\lim_{n\to\infty} \frac{u_n}{u_{n+1}} = \lim_{n\to\infty} \frac{5}{(n+1)}$$

$$= \frac{5}{\infty} = 0 < 1.$$

$\therefore$ By de-Alembert's ratio test

Σu_n is divergent.

BLDE ASSOCIATION'S

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

DEPARTMENT OF MATHEMATICS

SEMINAR REPORT: 2017-18

(Even Semester)

The UG Department of Mathematics has conducted seminar for B.Sc students.

Name of the student	Seminar Topic
1) Sandeep Ganni	Boolean Algebra
2) Shruti Yadawad	Infinite series - II
3)	

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