

CHANDIDAS MAHAVIDYALAYA

Department of Mathematics

Notice

Date: 21-06-2021

It is hereby informed to all the students of Dept. of Mathematics that a departmental seminar (Topic: Riemann Integration) will be held on 27th June 2021 at 11:00am onwards in the online mode through google-meet platform.

Speaker	Designation	Title	Target audience
Dr. Sabina Eyasmin	Assistant Professor & Head, Dept. of Mathematics, Chandidas Mahavidyalaya	Riemann Integration	Sem-III, IV, V, VI

The link of the meeting will be sent in your e-mail/whatsapp during the given time. All the students are requested to attend the seminar.



(Dr. Sabina Eyasmin)

Department of Mathematics

Chandidas Mahavidyalaya

Departmental Seminar/ Webinar

Session 2020-2021

A seminar is a crucial meeting in teaching-learning process, in which students can learn about certain topics. This would help the learners to get more information on the particular seminar topic. The Department of Mathematics, Chandidas Mahavidyalaya, often organizes seminar/ webinar/ special lecture for encouraging the under-graduate students in their studies and for increasing the conceptual depth on various topics in Mathematics. The details of such a seminar are given as follows:

Date: 27-06-2021

Mode: Online

Venue: Through google-meet platform

Present Members:

Faculties:

1. Dr. Sabina Eyasmin (HOD)
2. Bipattaran Raj
3. Bhaskar Ghosh
4. Arghya Ghosh

Students:

1. Sinjina Dewan
2. Soumya Saha
3. Saifur Rahaman Khan
4. Kaji Sahid Ahammed
5. Sakline Mustak
6. Saqline Rahaman
7. Mir Md Asif
8. Sk Saiyed Anwer
9. Promod Ranjan Saha
10. Sangita Nag
11. Sivananda Karmakar
12. Sourav Debanshi
13. Sk. Amit
14. Indrajit Sarkar
15. Somnath Chatterjee

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Department of Mathematics

Session : 2020-2021

Report on

Departmental Webinar on Riemann Integration

(Organized by Department of Mathematics, Chandidas Mahavidyalaya)

1	Topic of the Webinar	Riemann Integration
2	Sub Category	Research aspect & Skill development
3	Date	27-06-2021 (27 th June 2021)
4	Time	7:00pm – 8:00pm
5	Venue	Google-meet platform (online mode)
6	Name of the Resource Person(s)	Dr. Sabina Eyasmin, Assistant Professor & Head, Dept. of Mathematics, Chandidas Mahavidyalaya
7	No. of participants	18 (15 students + 3 faculties)
8	A brief discussion	The aim of the lecture was to create a concrete concept of “Riemann Integration” for the students. All the students, who were present in the seminar, participated actively through the conversation and discussion with the speaker. It is noteworthy to mention that there were so many graphical or pictorial demonstrations of several definitions and theorems in Riemann integration, which will definitely stimulate the study of the present students and fulfil the purpose of the seminar.
9	Outcomes	<ul style="list-style-type: none">• The students were able to visualize the whole thing that how the Riemann integrability can be described geometrically.• Active conversation and discussion between the speaker and the students assist students to clear their doubts.• During the webinar the students were voluntarily asking their queries about Riemann integration to the speaker.• Various graphical or pictorial demonstrations of several concepts in Riemann integration have promoted their study.• At the end of the webinar, few students requested to learn more advanced notions of Riemann integration, such as Riemann-Stieltjes integration, Lebesgue integration etc., which reflects the interest of research among those students.



(Dr. Sabina Eyasmin)

Coordinator

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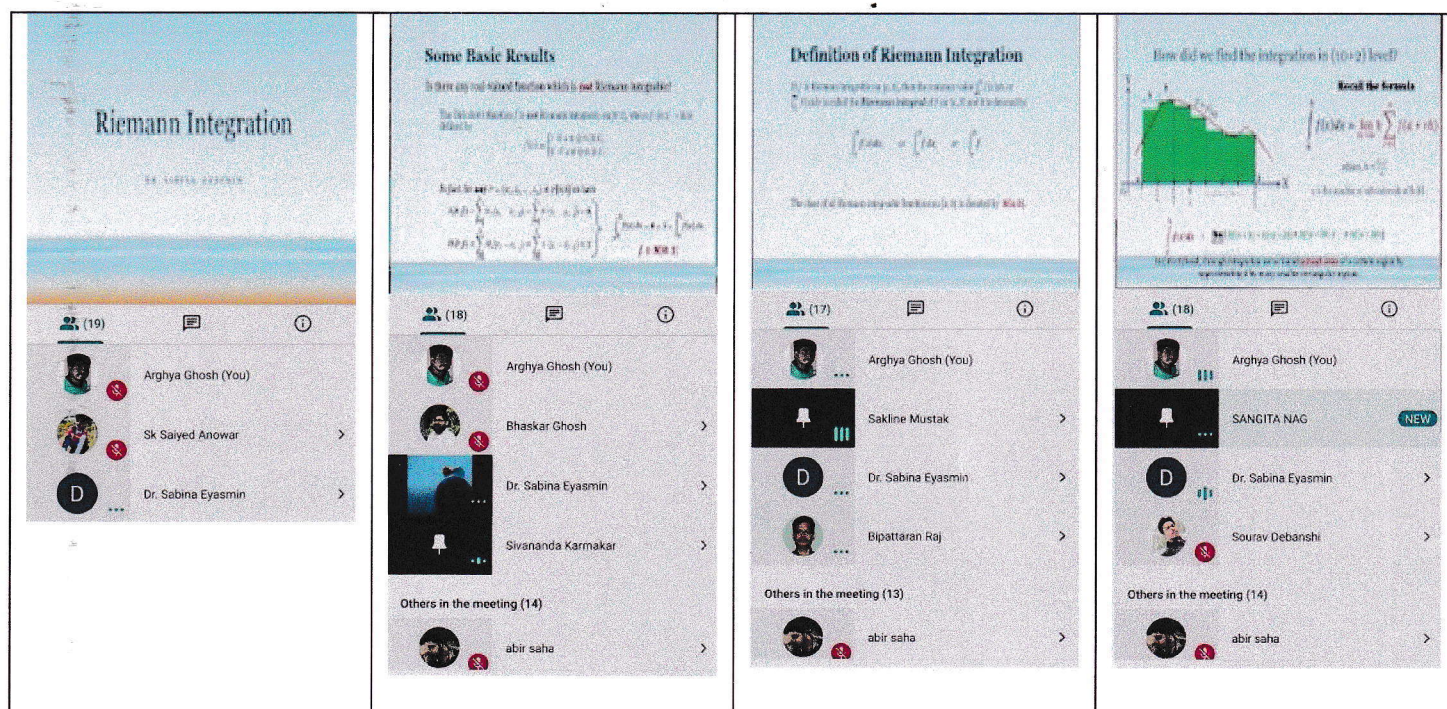
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Details of Webinar:

Speaker/ Resource Person	Designation	Title
Dr. Sabina Eyasmin	Assistant Professor, Head, Dept. of Mathematics, Chandidas Mahavidyalaya	Riemann Integration

Some Screen-shorts



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Department of Mathematics

Details of Webinar:

Speaker/ Resource Person	Designation	Title
Dr. Sabina Eyasmin	Assistant Professor, Head, Dept. of Mathematics, Chandidas Mahavidyalaya	Riemann Integration

Some samples of the slides

Riemann Integration

DR. SABINA EYASMIN

What is the geometrical meaning of integration?

$f(x)dx = \text{Area}$

The usual motivation to find the integration of a function f on $[a, b]$ is to find the area of the region bounded by f .

Development of the Theory of Integrations

In this lecture, we are usually concerned to Riemann Integration.

Georg Friedrich Bernhard Riemann

How did we find the integration in (10+2) level?

Recall the formula

$$\int_a^b f(x)dx = \lim_{n \rightarrow \infty} h \sum_{i=1}^n f(a + r_i h)$$

where, $h = \frac{b-a}{n}$
 a is the number of sub-intervals of $[a, b]$

In (10+2) level, through integration we've found actual area of a certain region by approximating it by many smaller rectangular regions.

Introduction to Riemann Integration

Let us consider the map $f: [a, b] \rightarrow \mathbb{R}$. Consider a partition $P = \{a = x_0 < x_1 < x_2 < \dots < x_n = b\}$ of $[a, b]$. Then, P supplies a sub-intervals of $[a, b]$ such as $[x_0, x_1], [x_1, x_2], [x_2, x_3], \dots, [x_{n-1}, x_n]$. For each $i = 1, 2, \dots, n$, let $M_i = \sup_{x \in [x_{i-1}, x_i]} f(x)$.

Define lower Darboux sum $L(P, f)$ and upper Darboux sum $U(P, f)$ by

$$L(P, f) = \sum_{i=1}^n m_i (x_i - x_{i-1})$$

$$U(P, f) = \sum_{i=1}^n M_i (x_i - x_{i-1})$$

Introduction to Riemann Integration

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Define lower Darboux sum $L(P, f)$ and upper Darboux sum $U(P, f)$ by

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$$U(P, f) = \sum_{i=1}^n M_i (x_i - x_{i-1})$$

Definition of Riemann Integration

Define lower integral $\int_a^b f(x)dx$ and upper integral $\int_a^b f(x)dx$ by

$$\int_a^b f(x)dx = \sup \{L(P, f) : P \in \mathcal{P}(a, b)\}$$

$$\int_a^b f(x)dx = \inf \{U(P, f) : P \in \mathcal{P}(a, b)\}$$

The function f is said to be Riemann integrable on $[a, b]$ if

$$\int_a^b f(x)dx = \int_a^b f(x)dx$$

Definition of Riemann Integration

If f is Riemann integrable on $[a, b]$, then the common value $\int_a^b f(x)dx$ or $\int_a^b f(x)dx$ is called the Riemann integral of f on $[a, b]$ and it is denoted by

$$\int_a^b f(x)dx, \text{ or } \int_a^b f, \text{ or } \int f$$

The class of all Riemann integrable functions on $[a, b]$ is denoted by $\mathcal{R}(a, b)$.

Some Basic Results

Is there any real-valued function which is not Riemann integrable?

The Dirichlet's function f is not Riemann integrable on $[0, 1]$, where $f(x) = 1$ if $x \in \mathbb{Q} \cap [0, 1]$ and $f(x) = 0$ if $x \in \mathbb{R} \setminus \mathbb{Q} \cap [0, 1]$.

In fact, for any $P = \{x_0, x_1, \dots, x_n\} \in \mathcal{P}(a, b)$ we have

$$U(P, f) = \sum_{i=1}^n M_i (x_i - x_{i-1}) = \sum_{i=1}^n 1 \cdot (x_i - x_{i-1}) = b - a$$

$$L(P, f) = \sum_{i=1}^n m_i (x_i - x_{i-1}) = \sum_{i=1}^n 0 \cdot (x_i - x_{i-1}) = 0$$

$\int_a^b f(x)dx = b - a = 1$ and $\int_a^b f(x)dx = 0$

The Riemann Sum $S(P, f)$

The Riemann sum for f corresponding to the partition $P = \{x_0, x_1, \dots, x_n\}$ of $[a, b]$ is defined as

$$S(P, f) = \sum_{i=1}^n f(\xi_i) (x_i - x_{i-1})$$

where $\xi_i \in [x_{i-1}, x_i]$, $1 \leq i \leq n$.

Clearly, for any $P \in \mathcal{P}(a, b)$ the following relation holds

$$L(P, f) \leq S(P, f) \leq U(P, f)$$

Theorem: For the function $f: [a, b] \rightarrow \mathbb{R}$ and $P \in \mathcal{P}(a, b)$, the limit $\lim_{\|P\| \rightarrow 0} S(P, f)$ exists, then the limit is unique and f is Riemann integrable.

Some Basic Results

Theorem: Let a function $f: [a, b] \rightarrow \mathbb{R}$ be bounded on $[a, b]$. Then f is Riemann integrable on $[a, b]$ and only if for each $\epsilon > 0$ there exists a partition P of $[a, b]$ such that

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

Some Basic Results

Theorem: If $f: [a, b] \rightarrow \mathbb{R}$ is continuous on $[a, b]$, then the function $F: [a, b] \rightarrow \mathbb{R}$ defined by

$$F(x) = \int_a^x f(t)dt$$

is an anti-derivative of f on $[a, b]$.

A function $\phi: [a, b] \rightarrow \mathbb{R}$ is said to be an anti-derivative or primitive of $f: [a, b] \rightarrow \mathbb{R}$ if $\phi'(x) = f(x)$ for all $x \in [a, b]$.

Theorem: If $f: [a, b] \rightarrow \mathbb{R}$ is continuous on $[a, b]$ and $\phi: [a, b] \rightarrow \mathbb{R}$ is an anti-derivative of f on $[a, b]$, then

$$\int_a^b f(x)dx = \phi(b) - \phi(a)$$

Fundamental theorem of Integral Calculus

If $f \in \mathcal{R}(a, b)$ and f possesses an anti-derivative $\phi: [a, b] \rightarrow \mathbb{R}$, then

$$\int_a^b f(x)dx = \phi(b) - \phi(a)$$

As an extension of the fundamental theorem of integral calculus, we come to the following theorem with extra conditions.

Theorem: If $f \in \mathcal{R}(a, b)$ and there exists a continuous function $\phi: [a, b] \rightarrow \mathbb{R}$ such that $\phi'(x) = f(x)$ for all $x \in [a, b]$, then

$$\int_a^b f(x)dx = \phi(b) - \phi(a)$$

Integration by parts

Theorem: Let $f, g \in \mathcal{R}(a, b) \rightarrow \mathbb{R}$ be both differentiable on $[a, b]$ and $f', g' \in \mathcal{R}(a, b)$. Then

$$\int_a^b f(x)g'(x)dx = f(x)g(x) - \int_a^b f'(x)g(x)dx = f(x)g(x) - \int_a^b f(x)g'(x)dx$$

Integration by substitution

Theorem: Let $f \in \mathcal{R}(a, b)$ and $\phi: [a, b] \rightarrow [c, d]$ be a function with $\phi'(x) = g(x)$ for all $x \in [a, b]$. Let $f \circ \phi \in \mathcal{R}(a, b)$ and $\phi'(x) \neq 0$ for all $x \in [a, b]$. Then

$$\int_a^b f(\phi(x))g(x)dx = \int_{\phi(a)}^{\phi(b)} f(u)du$$

Theorem: Let $\phi: [a, b] \rightarrow \mathbb{R}$ be a function and ϕ' be continuous with $\phi'(x) \neq 0$ on $[a, b]$. Let $f \circ \phi \in \mathcal{R}(a, b)$ and ϕ be a function for real-valued continuous on $\phi([a, b])$. Then

$$\int_a^b f(\phi(x))g(x)dx = \int_{\phi(a)}^{\phi(b)} f(u)du$$

Date: 27th June 2021

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