LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : PROSIDING INTERNASIONAL

Judul Prosiding (Artikel)	:	A convergence theorem on the dunford integral			
Nama/ Jumlah Penulis	:	Solikhin, Abdul Aziz, YD Sumanto, R Heri Soelistyo Utomo			
Status Pengusul	:	penulis ke-1			
Identitas Prosiding	:	a.	Nama Prosiding	:	Journal of Physics: Conference Series
		b.	Nomor ISSN	:	Online ISSN: 1742-6596 Print ISSN: 1742-6588
		c.	Vol, No., Bln Thn	:	**1943** (2021) 012124
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		e.	DOI artikel (jika ada)	:	10.1088/1742-6596/1943/1/012124
		f.	Alamat web penerbit	:	https://iopscience.iop.org/article/10.1088/1742-6596/1943/1/012124/meta
		g.	Terindex	:	Scopus, Q4

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Total = (100%)	**28,40**	**26**	**27,20**
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Reviewer 2

Nama : R. Heru Tjahjana, S.Si., M.Si.
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Unit Kerja : FSM Undip
Bidang Ilmu : Matematika

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Semarang, 17 April 2023
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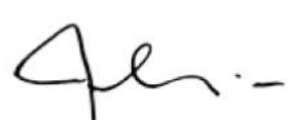

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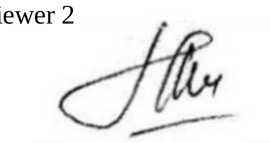

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Preface

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The 10th International Seminar on New Paradigm and Innovation on Natural Science and Its Application (10th ISNPINSA)

"Developing Innovations and Challenges in Science And Technology For Better Living"

September 24-25, 2020

PREFACE

The International Seminar on New Paradigm and Innovation of Natural Sciences and its Application (ISNPINSA) is an annual conference organized by the Faculty of Sciences and Mathematics (FSM), Diponegoro University (UNDIP), Semarang, Central Java, Indonesia. This seminar has been successfully conducted since 2011 and therefore becoming an annual event since then. This annual ISNPINSA has been intensively achieved high level improvement in strengthening the collaboration between scientists either from Indonesia or other countries, stimulating a new research partnership, and contributing to formulating policies to increase the important roles of science for the community.

The 10th ISNPINSA was held on September 24-25, 2020 with the theme of "DEVELOPING INNOVATIONS AND CHALLENGES IN SCIENCE AND TECHNOLOGY FOR BETTER LIVING". Due to the outbreak of COVID-19, the conference process was carried out virtually using licensed Zoom media. The presentations were categorized into two terms, which were plenary presentation and parallel presentation. Keynote speakers were invited to deliver their expertise and research findings at the plenary presentation and each had given 1 hour of speech. While invited speakers together with all parallel presenters delivered their presentation in parallel session with time of speech including Q&A for each of 15 minutes.

The number of participants of the seminar were 313 including 7 keynote speakers, 5 invited speakers, presenters and non-presenters coming from various institutions of various countries consist of researchers, lecturers, postgraduate and undergraduate students from various universities. There were 263 papers presented in this seminar and after the review process, there are 199 articles to be published in the present conference proceeding. All published articles remain the sole responsibility of the author for the content of the paper.

We would like to take this opportunity to extend our appreciation to all keynote speakers and invited speakers for their valuable presentation. We also would like to thank all the authors for submitting and presenting their papers to our conference, the Organizing Committee members and the supporting staff for their hard work, as well as all the Scientific& Editorial Committee and the reviewers for their constructive recommendations and critical comments helped to improve of the submitted papers. All these contributions eventually make the 10th ISNPINSA 2020 a successful and fruitful event.

The 10th ISNPINSA 2020 Organizing Committee hopes you will enjoy reading this JPCS volume.

The Chairman,
Nor Basid Adiwibawa Prasetya, S.Si., M.Sc., Ph.D

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Journal of Physics: Conference Series **1943** (2021) 011001 doi:10.1088/1742-6596/1943/1/011001

II. Invited Speaker

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2. Dr. Ibrahima Faye, *Universiti Teknologi Petronas, Malaysia*
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10th International Seminar on New Paradigm and Innovation of Natural Sciences and its Application (ISNPINSA) 2020 24-25 September 2020, Indonesia

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Open all abstracts

Preface

10th ISNPINSA

Solanum lycopersicum and *Daucus carota*: effective anticancer agents (a mini review)

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Abstract. The high cost, scarce availability, and some extraneous side effects of some pharmaceuticals have diverted the majority's mindset towards the use of nutraceuticals as both prophylactic and therapeutic alternatives. The cancer incidence in the low and middle-income countries has risen due to several factors, but notably, it has been due to poverty and the non-availability of screening centers. The non-toxic nature, high availability, and low cost of food-based nutraceuticals have been a significant advantage to its users. Solanum lycopersicum is well-known to possess excellent antioxidant, anti-inflammatory, and anticancer potential, and this has been attributed to its potent bioactive compound, lycopene. The presence of β-carotene in Daucus Carota has also contributed immensely to its antioxidant and anticancer properties. Nutraceuticals are considered suitable for anticancer drug development due to their pleiotropic actions on target sites with multiple effects. This short review has explored the dietary characteristics, bioactive components and mild anticancer effects of tomatoes and carrots.

1. Tomatoes (Solanum lycopersicum)

Tomatoes (*Solanum lycopersicum*) has sailed high to become one of the world's most recognized vegetables. It has long been in global recognition as one of the most essential vegetable with high antioxidant activity. This juicy vegetable originated from the western South America, with a wide range of different diversities of wild tomatoes recorded in Peru [1]. Tomatoes were placed in the genus Solanum as Solanum lycopersicum by Carolus Linnaeus in 1753. Two years later, but this was modified by another researcher Philip Miller (1754), who felt the need to integrate the other species of tomatoes in the genus hence he came up with a new genus, Lycopersicon [2]. Lycopersicon esculentum Mill was coined to accommodate tomatoes and its several species. The different species of Solanum are found to be present on all temperate and several tropical continents, which is attributed to their morphological and ecological diversity. Tomato is known to be the third most vital and highly nutritious vegetable cultivated in the world, and also, it battles with banana for the most consumed fruit in the world [3]. It is an edible red fruit berry with a well-seeded ovary. The fruit colour varies from green to yellow, which further projects into yellow to orange then to red based on the maturity stage. In most cases, the quality of carotenoids embedded in the fruit determines the colour of tomatoes. Carotenoids such as lycopene, chlorophylls, and β-carotene are liable for the colour of the fruit [4]. The red and orange colours of tomatoes are attributed to the quantity of the lycopene and β-carotene, respectively. The fruit's green

Convergence of the 3-point block backward differentiation formulas with off-step point for stiff ODEs

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Abstract. Development of 3-Point Block Method with one off-step point using Backward Differentiation Formula (BDF) is presented in this paper to find out the solution for stiff Ordinary Differential Equation (ODEs). By considering the Backward Differentiation Formulas (BBDF), the block method has been derived. It is well known that BBDF is used for solving stiff ODEs. The strategy for the development of this process is to compute three solution values with one off-step point concurrently to each iteration. One off-step point is added in the implicit BBDF method for better accuracy. Derivation of the formulae and consistency properties are generated in this paper. Numerically the proposed method with order five is achieved as a result. Mathematica software has been used for the derivation and consistency of the method.

1. Introduction

Many real-world problems consist of ordinary differential equations, appears in various fields. Such as modelling process of cooling, radioactive decay, chemical kinetics, biology, economics, geology, economics, physics and various aspects of engineering to approximate the solution as an alternative solver. Therefore, ODEs with first order are getting substantial attention. Stiffness of the problems are the main issue because these problems comprises of an extensively unpredictable time scale i.e., solutions of some components decomposes more faster than others [1, 2].
Our objective is to derive a multistep 3-point block method with one off-step point, which can solve stiff ODEs efficiently.
Considering the first order ODE,

$$y'(x) = f(x,y), \quad y'(a) = y_0 \tag{1}$$

having $x \in [a,b]$.
To solve the equation (1) the numerical methods are developed by types of ODEs, e.g. non-linear or linear, either stiff or non-stiff ODEs. It should be noted that by using incorrect method for a model may give slow or wrong solution. Mostly, problems having form (1) are categorized into two types. Non-stiff problem is the first type, in which the explicit methods are used along with some error control. Whereas Stiff ODEs are the second type. The word “Stiff” was firstly introduced by [3] in chemical kinetics’ problems. The solutions of stiff problems can only be found by using implicit methods because by using explicit methods it works very slowly or sometimes fails to provide an accurate solution [4]. Stiffness is described in various literature as there is not any specific definition. (1) is said to be explaining the stiff problems if,

i) The Stability region decided on the bases of step size rather than the requirement of accuracy [5];

Development of scattered radiation distribution visualization system using WebAR

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Abstract. Radiation protection education is difficult for some radiological workers to taking because they are busy with medical work. In radiation protection, understanding the behaviour of scattered radiation is important for reducing exposure. Although applications that visualize the behaviour of scattered radiation using augmented reality or virtual reality have been developed, such applications are limited by the need to download the application and the performance of the device. We have developed a system that can be used in a web browser to visualize the behaviour of scattered radiation more easily. Monte Carlo method was used to simulate the behaviour of scattered radiation during radiography using a portable X-ray machine. An augmented reality (AR) system was developed using A-Frame, an open-source web framework, and AR.js, which adds the AR function. Finally, the behaviour of scattered radiation was observed using various devices. With AR, the behaviour of scattered radiation was visualized in three dimensions. The newly developed AR system can be used with web browsers to easily learn the behaviour of scattered rays without the need for special devices.

1. Introduction

Radiological workers may have little opportunity to receive proper education on radiation protection because of their busy work schedules [1] [2]. Good knowledge of radiation protection is necessary for these workers to be able to perform their duties safely, and thus methods that help workers acquire this knowledge quickly and easily are being developed. In radiation protection, one of the important factors to understand is the behaviour of scattered radiation, which helps in reducing one's exposure to radiation [2]. However, visualization of the behaviour of scattered radiation is difficult because scattered radiation is invisible.

In the past, the spread of scattered rays was displayed in two-dimensional (2D) isolines and colour images [3]. However, the behaviour of scattered radiation is 3D, and understanding how scattered radiation actually spreads in an examination room can be difficult if only the conventional 2D methods are used. Research using technologies such as virtual reality (VR) and augmented reality (AR) has thus made it possible to observe the spread of radiation in 3D and to visualize the behaviour of scattered radiation. In a study by Matthias et al., VR was used to visualize the behaviour of scattered radiation during intraoperative imaging and fluoroscopy using a C-arm [4]. The study demonstrated how VR allowed the operator to confirm the captured image and observe the behaviour of scattered radiation

A convergence theorem on the dunford integral

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A convergence theorem on the dunford integral

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Abstract. This article discusses the convergence theorem of the Dunford integrals. We examine the sufficient conditions so that limit of the sequence of integral value whose Dunford integrable is same as limit of functions sequence. We have obtained that to guarantee a function to be Dunford integrable and its limit of functions sequence are same as value of the functions, then a sequence of Dunford integrable function is uniform convergent or weakly convergent, weakly monoton, and its limit exist. Furthermore, its weakly convergent and bounded.

1. Introduction

The Measurable function [redacted]. It [redacted] an absolute integral while Henstock-Kurzweil (Henstock) integral is not. Its means that there is a function g that is Henstock integrable and its absolute value is not Henstock integrable. In the late 1960s, McShane introduces an integral known as the McShane integral. The same as the Lebesgue integral, The McShane integral is an absolute integral. They are equivalent [1]. Some of the Lebesgue integral applications are differentiation and integration, mathematical models for probability, and convergence and limit theorems [2]. While, applications of the Henstock integral are in ordinary differential equations [3] , in financial market modelling [4], and others.

The Lebesgue integral is used to define the Dunford integral. The Dunford in[redacted]ral is defined over a weakly measurable function which the function is Banach-valued function such [redacted] belong to [redacted] [5]. Some properties of Dunford integral has been discussed by [5]. A collection of all Dunford integrable functions is linear space and seminorm space[5]. Furthermore, operators which work on space of the Dunford integrable function is linear and bounded operators [5]. It is weakly compact linear operators[5], [6].

Let function $f_1, f_2, f_3, ...$ are integrable on $[a,b]$, and suppose $f_1, f_2, f_3, ...$ converges pointwise to function f . Is f integrable on $[a,b]$ and does $\int_a^b f = \lim_{n\to\infty} \int_a^b f_n$? Any theorem that provides conditions for this question to have an affirmative answer is known as a convergence theorem. In Lebesgue integral, [redacted] best possible theorem is the dominated convergence theorem [1], [7]. In other hand, there are the [redacted] theorem, [redacted] bounded [redacted] monotone [redacted], and [redacted]. While on [redacted] Henstock integral, the controlled convergence theorem is the best theorem [7] - [9]. The hypotheses of this theorem will then be extended to establish convergence theorems for the Dunford integrals. Let $\{f_1, f_2, f_3, ...\}$ be a sequence of Dunford integrable function.

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We examine [redacted] sufficient conditions so that limit of the sequence of integral value whose Dunford integrable is same as limit of functions sequence.

2. Dunford integral

We shall now define the concept of sequence of convergence function and weakly measurable function, which will be basic in Dunford integral and some convergence theorems.

Definition 2.1 *Let* $f_1, f_2, f_3, \dots$, *be a function from* [redacted]$b]$ *to* X . *A sequence of function* $\{f_n\}$ *is convergent to function* f *if* $\{f_n(x)\}$ *is convergent to* [redacted] *there is an* [redacted]) *element* [redacted] *for every* $\varepsilon > 0$ *there is an* $n_0 = n_0(\varepsilon, x) \in \mathbb{N}$ *such that if* $n \geq n_0$ *implies*

$$\|f_n(x) - f(x)\|_X < \varepsilon .$$

So $\{f_n\}$ is convergent in $x \in [a,b]$ means $\{f_n(x)\}$ is convergent.

If [redacted] at each x belong to $[a,b]$, then $\{f_n\}$ is convergent on $[a,b]$.

Definition 2.[redacted] *weakly* [redacted] *at* [redacted]$,b]$, *if* $\{f_n(x)\}$ [redacted] , *i.e. for every* $\varepsilon > 0$ *and* $x^* \in X^*$ *there is an* $n_0 = n_0(\varepsilon, x^*, x) \in \mathbb{N}$ *such that if* $n \geq n_0$ *implies*

$|x^*$ [redacted] $)| < \varepsilon$.

And $\{$[redacted]$\}$ [redacted] *on* $[$[redacted]$,b]$, *if for every* $x \in [a,b]$ *and* $\varepsilon > 0$, $x^* \in X^*$ *there is an* $n_0 = n_0(\varepsilon, x^*, x) \in \mathbb{N}$ *such that if* $n \geq n_0$ *implies*

$$|x^* f_n(x) - x^* f(x)| < \varepsilon .$$

[redacted] *function* $\{$[redacted] *uniform* [redacted] , *if for every* $\varepsilon > 0$ *there is an* $n_0 = n_0(\varepsilon) \in \mathbb{N}$ *such that if* $n \geq n_0$ *implies*

$|x^* f_n(x) -$ [redacted]

[redacted] *every* [redacted]$,b]$ *and* [redacted]$^* \in X^*$.

Definition 2.3 *A sequence of function* $\{f_n\}$ *is called weakly increasing monotone on* $[a,b]$, *if for every* x^* *element* X^* , $\{x^*(f_n)\}$ *is increasing monotone,* [redacted]$^* f_{i+1}($[redacted]$)$ *for all* [redacted] $\in \mathbb{N}$ *and for every* [redacted] *sequence of function* $\{f_n\}$ *is called weakly descreasing monotone on* $[$[redacted]$]$, *for every* [redacted]* *element* [redacted]$^*(f_n)\}$ *is descreasing monotone,* [redacted] *e* [redacted]$^* f_i($[redacted]$^* f_{i+1}(x)$ *for all* $i \in \mathbb{N}$ *and for every* x *belong to* $[a,b]$, $x^* \in X^*$.

A sequence of weakly increasing monotone or weakly descreasing monotone are called a sequence of weakly monotone.

Measurable function can be defined by simple functions. As follows.

Definition 2.4 *A function* $f:[a,b] \to X$ *is called measurable, if there is a simple sequence of functions* $\{f$ [redacted] li[redacted] $\| f_k ($[redacted]$) \|_X = 0$,

for every x belong to $[a,b]$.

Definition 2.5 *A functions* f *is called weakly measurable, if for each* x^* *element* X^* *we have* $x^*(f)$ *is measurable*.

The Dunford integral can be defined on basic measurable function. It is related to Lebesgue integral.

Definition 2.6 *Let* f *is weakly measurable. If* $x^*(f):[a,b]\to R$ *is Lebesgue integrable for each* x^* *element* X^**, then function* f *is said to be Dunford integrable.*

The Dunford integral $(D_L)\int_A f$ of f over measurable set $A\subset[a,b]$ is defined by vector $x^{**}_{(f,A)}$ element [redacted]

[redacted]$^*) = \int x^*($[redacted]

for all [redacted]* element X^*.

The set of all function f which it is the Dunford integrable denoted by $D_L[a,b]$.

We have shown that $D_L[a,b]$ is hold the additive and homogenous properties.

Definition 2.7 *A function* $f:[a,b]\to R$ *is called McShane integrable on* $[a,b]$*, if there exists real number* $M_C \in R$ *such that for every* $\varepsilon > 0$ *there exists a positive function* δ *and if* $\mathcal{M} = \{(D,x)\}$ *McShane partitions* δ*-fine on* $[a,b]$ *implies*

$$\left| \sum_{x\in[a,b]} f(x)\alpha(D) - M_C \right| < \varepsilon .$$

The McShane integral and the Lebesgue integral are equivalent.. By Definition 2.6, we obtained that f is Dunford integrable iff $x^*(f)$ is Lebesgue integrable for all x^* element X^*. Therefore, we can say f is Dunford integrable iff $x^*(f)$ is McShane integrable for all x^* element X^*.

3. Convergence theorems

Now we consider [redacted] convergence theorems for Dunford integrals. Let X is a complete normed space which X^* is dual [redacted] X [redacted] X^{**} [redacted] seon [redacted] X. Lets $[a,b]\subset R$ is closed interval, and functions $f, f_n:[a,b]\to X$ $\forall n\in$ □ . If $f_n \in D_L[a,b], \forall n \in$ □ and $\{f_n\}$ is weakly convergent to f on $A\subset[a,b]$, we showed some condititions which cause $f\in D_L[a,b]$ and

$$x^{**}_{(f,A)} = \lim_{n\to\infty} x^{**}_{(f_n,A)} .$$

The following is a convergence theorems on the Dunford integrals.

Theorem 3.1 (Uniformly convergence theorem) *Lets* $f, f_n:[a,b]\to X$ *and* $f_n\in D_L[a,b]$ *for every* n*. If* $\{f_n\}$ *is weakly uniform convergent to* f *on* $A\subset[a,b]$*, then* $f\in D_L[a,b]$ *and*

$$x^{**}_{(f,A)} = \lim_{n\to\infty} x^{**}_{(f_n,A)} .$$

Proof: Let arbitrary $A \subset [a,b]$. Sequence $\{f_n\}$ is weakly uniform convergent to f on $A \subset [a,b]$. This means, for every $\varepsilon > 0$ there exists nature number $n_0 = n_0(\varepsilon)$ such that if $n \geq n_0$ we have

$$\left|x^* f_n(x) - \text{[redacted]}\right| < \frac{\text{[redacted]}}{5\alpha(\text{[redacted]}) + 1}$$

[redacted] almost [redacted] element [[redacted],b] and [redacted]*element X^*.

Functions $f_n \in D_L[a,b]$, $\forall n \in$, i.e. for $\varepsilon > 0$, $x^* \in X^*$, and $A \subset [a,b]$ then $x^*(f_n)$ is Lebesgue integrable (is equivalent McShane integrable) on A. So that, there exists $\delta_n > 0$ on $[a,b]$ and if $\mathcal{D}_1 = \{(D_1, x)\}$ and $\mathcal{D}_2 = \{(D_2, x)\}$ are McShane partitions δ_n-fine on A then

$$\left|\mathcal{D}_1 \sum_{x \in \text{[redacted]}} \text{[redacted]})\alpha(D_1) - \text{[redacted]}_{,A)}(\text{[redacted]}^*)\right| < \frac{\varepsilon}{5}$$

and

$$\left|\text{[redacted]} \sum_{\text{[redacted]} \in A} \text{[redacted]}^* f_n(\text{[redacted]})\alpha(D_1) - \mathcal{D}_2 \sum_{\text{[redacted]}} \text{[redacted]})\alpha(D_2)\right| < \frac{\varepsilon}{5}.$$

So that, if $\mathcal{D}_1 = \{(D_1, x)\}$ and $\mathcal{D}_2 = \{(D_2, x)\}$ are McShane partitions δ_n-fine on A we obtained

$$\left|\mathcal{D}_1 \sum_{\text{[redacted]} \in A} x^* f(\text{[redacted]}) - \mathcal{D}_2 \sum_{\text{[redacted]} \in A} \text{[redacted]}^* f(\text{[redacted]})\alpha(D_2)\right|$$

$$\leq \left|\text{[redacted]}_{\text{[redacted]} \in A}{}^* f(\text{[redacted]}) - \mathcal{D}_1 \sum_{\text{[redacted]} \in A} \text{[redacted]}^* f_n(\text{[redacted]}\right|$$

$$+ \left|\mathcal{D}_1 \sum_{\text{[redacted]} \in A} \text{[redacted]}^* f_n(\text{[redacted]})\alpha(D) - \text{[redacted]}_{\text{[redacted]} \in A}{}^* f_n(\text{[redacted]})\alpha(D_2)\right|$$

$$+ \left|\mathcal{D}_2 \sum_{\text{[redacted]} \in A} \text{[redacted]}^* f_n(\text{[redacted]})\alpha(\text{[redacted]}_{\text{[redacted]} \in A}{}^* f(\text{[redacted]}\right|$$

$$< \varepsilon.$$

Its means [redacted]$^*(f)$ is [redacted] and for every [redacted] $\subset [a,$[redacted]] closed interval there exists [redacted] element [redacted]** so

$$\text{[redacted]}^{**}_{(f,\text{[redacted]})}(x^*) = (L)\int_{\text{[redacted]}} \text{[redacted]}$$

So [redacted] $\in D_L[$[redacted]$,b]$.

[redacted] function [redacted] $\in D_L[$[redacted]$,b]$, i.e. for each $x^* \in X^*$ and $A \subset [a,b]$, then [redacted] Lebesgue [redacted] (McShane integrable) [redacted] A. This means [redacted] $\varepsilon > 0$ there exixst positive function δ' on A so that if $\mathcal{D}_3 = \{(D_3, x)\}$ is McShane partition δ'-fine on A we have

$$\left|\mathcal{D}_3 \sum_{\text{[redacted]}} \text{[redacted]})\alpha(D_3) - \text{[redacted]}^{**}_{(f,}\text{[redacted]}^*)\right| < \frac{\varepsilon}{5}.$$

Take $\delta^*($[redacted]$) = \text{Min}\{\delta_n($[redacted]$)\}$ for almost all $x \in [a,b]$. We obtained positive functions δ^* on $[a,b]$. If $\mathcal{D}_4 = \{(D_4, x)\}$ is McShane partition δ'-fine on A then

$$\left|x^{**}_{(f_n,A)}\left(x^*\right)-x^*_{(}\right.$$ [redacted] $$\left|{}^{**}_{f_n,A)}\left(\;\right)-\mathcal{D}_4\sum{}^* f_n\left(\right.\right.$$ [redacted]

$$+\left|\mathcal{D}_4\sum_{\in A}{}^* f_n(\;)\alpha(D_4)-\mathcal{D}_4\sum_{\in A}{}^* f(\;)\alpha(D_4)\right|$$

$$+\Big|$$ [redacted] $$)\alpha(D_4)-{}^{**}_{(f,}$$ [redacted]

$$<\frac{\varepsilon}{5}+\frac{\varepsilon}{5\alpha(A)+}\mathcal{D}^*\sum_{x\in A}\alpha(D)+\frac{\varepsilon}{5}$$

$$<\varepsilon\,.$$

In other word[redacted]

$$_{,A)}\left(\;\right)=\text{li}\;{}^{**}_{(f_n,A)}\left(\;\right),$$

for every $x^*\in X^*$. □

Theorem 3.2 (Monotone congvergence theorem) *Lets* $f, f_n:[a,b]\to X$ *and* $f_n\in D_L[a,b],\forall n\in\mathbb{N}$. *if*

(i) $\{f_n\}$ *weakly monotone on* A,

(ii) $\{f_n\}$ *weakly convergent to* f *on* A, *and*

(iii) $\lim_{n\to\infty} x^{**}_{(f_n,A)}\left(x^*\right)$, $\forall x^*\in X^*$ *exists and finite.*

Then $f\in D_L[a,b]$ *and*

$$x^{**}_{(f,A)}=\lim_{n\to\infty} x^{**}_{(f_n,A)}$$

for every $A\subset[a,b]$ *closed interval.*

Proof: we showed [redacted]r sequence of increasing monotone. Lets arbitrary $\varepsilon>0$ and closed interval $A\subset[a,b]$. $\{f_n\}$ is [redacted] on [redacted]$\subset[a,b]$, i.e. for every $\varepsilon>0$, $x^*\in X^*$ and $x\in[a,b]$, there is a nature number $m_0=m_0\left(\varepsilon,x^*,x\right)$ such that if $n\geq m_0$ we have

$$\left|x^* f_n(x)-x^* f(x)\right|<\frac{\varepsilon}{5\alpha(A)+5}\,.$$

Functions $f_n\in D_L[a,b]$, $\forall n\in\mathbb{N}$, i.e. for every $\varepsilon>0$, $x^*\in X^*$, and $A\subset[a,b]$ then $x^*(f_n)$ is McSahne integrable on A. So that, there exists $\delta_n>0$ on $[a,b]$ and if $\mathcal{D}=\{(D,x)\}$ is McShane partitions δ_n-fine on A we have

$$\left|\mathcal{D}\sum_{\in A}\right.$$ [redacted] $$_{,A)}\Big($$ [redacted] $$)\alpha(D)-(L)\int$$ [redacted] $$\frac{}{3}\,.$$

Sequence of weakly increasing monotone $\{f$[redacted] on A. Its means for each $x^*\in X^*$ sequence $\left\{x^*(f_n)\right\}$ is increasing monotone on A. Its means [redacted]$_{+1}(\;)$ for every [redacted] belong to $A\subset[a,b]$. Furthermore, since $f_n\in D_L[a,b]$, for each x^* element X^* and $A\subset[a,b]$ we have $x^*(f_n)$ is Lebesgue integrable o[redacted]A such that

[redacted]$_{,A)}\big($[redacted]$\big)$.

Therefore

[redacted] $^{**}_{(f_n,A)}(x^*) = ($ [redacted] $)\int_A x^*($ [redacted] $) \le (L)\int_A$ [redacted] $_{+1}) =$ [redacted] $^{**}_{(f_{n+1},A)}(x^*)$.

Its means $\{($ [redacted] $\}$ is [redacted] sequence [redacted] increasing monoton on A. We known $\lim_{n\to\infty} x^{**}_{(f_n,A)}(x^*)$ for each $x^* \in X^*$ exists and finite, then $\left\{(L)\int_A x^* f_n\right\}$ is convergent takes to L such that

$$\lim_{n\to\infty} x^{**}_{(f_n,A)}(x^*) = \lim_{n\to\infty} (L)\int_A x^*(f_n) = L.$$

So, for $\varepsilon > 0$ in above, there is a $n_0 = n_0(\varepsilon, x^*) \in$ □ such that if $n \ge n_0$ we have

$$\left|(L)\int_A x^* f_n - L\right| < \frac{\varepsilon}{5}.$$

Takes $m^* = m^*(\varepsilon, x^*, x) = \max\{n_0, m_0\}$

We construct positive fun[redacted]ion by

$\delta(x) = \delta_{m^*}($ [redacted] almost [redacted] $\in [a,b]$ [redacted] x^* [redacted] X^*.

Therefore, if $\mathcal{D} = \{(D,x)\}$ McShane partition $\delta-$fine on A we obtained

$\Big|$ [redacted] $^*(f)($ [redacted] $) - L\Big| \le \Big|\mathcal{D}\sum$ [redacted] $^*(f)($ [redacted] $) - \mathcal{D}\sum$ [redacted] $^*(f_{m^*})($ [redacted] $\Big|$

$+\Big|$ [redacted] $^*(f_{m^*})($ [redacted] $)\alpha(D) - ($ [redacted] $)\int$ [redacted] $^*(f_{m^*})\Big| + \Big|(L)\int$ [redacted] $) - L\Big|$

$\le \mathcal{D}\sum\Big|$ [redacted] $^*(f)($ [redacted] $) - x^*($ [redacted]

$< \varepsilon$.

Its means $x^* f$ is McShane integrable, so its Lebesgue integrable on A and there exists [redacted] $_{,A)} \in$ [redacted] ** such that

[redacted] $_{,A)}($ [redacted] $^*) = (L)\int$ [redacted]

In other word, $f \in D_L[$ [redacted] $]$ and [redacted] $^{**}_{(f,}$ [redacted] $_{)}(x^*) =$ [redacted] $^{**}_{(f,}$ [redacted] $^*) = \lim_{n\to\infty}$ [redacted] $^{**}_{f_n,}$ [redacted] $^*)$

for every $x^* \in X^*$. □

Theorem 3.3 (Fatou's Lemma) *Lets $f, f_n : [a,b] \to X$ and $f_n \in D_L[a,b], \forall n \in$ □. If for every $A \subset [a,b]$ closed interval, $\{f_n\}$ is weakly convergent on A and $x^* f_n(x) \ge 0$ almost everywhere on A for all n and $x^* \in X^*$, then $f \in D_L[a,b]$ and*

$$x^{**}_{(f,A)}(x^*) \le \liminf_{n\to\infty} x^{**}_{(f_n,A)}(x^*).$$

Proof: Lets arbitrary closed interval $A \subset [a,b]$. For all nature number n and x^* element X^* we defined $h_n : A \subset [a,b] \to X$ by

$$x^* h_n(x) = \inf_{l \ge n}\{x^* f_l(x)\} \text{ for every } x \in A \subset [a,b].$$

We obtained $\{x^* h_n\}$ is increasing monotone on A for every $x^* \in X^*$, i.e. $\{h_n\}$ is weakly increasing monotone on A.
For all $n \in \mathbb{N}$ we [redacted]tained

$x^* h_n($ [redacted] $^* f_n($ [redacted]

[redacted] almost [redacted] element [redacted]. We known $x^*(f_n)(x) \geq 0$ almost everywhere, then $x^* g_n(x) \geq 0$ almost everywhere on A.
Therefore, we [redacted]e

li [redacted] $^*(h_n) \leq$ li [redacted] $^*(f_n)$ $\Leftrightarrow$ li [redacted] $) \leq \lim_{n\to\infty}$ [redacted]

We known $\{$[redacted]$^* h_n\}$ is increasing monotone and $\{x^* f_n\}$ is convergent to $x^*(f)$ for each $x^* \in X^*$, then $\{x^* h_n\}$ is convergent to $x^*(f)$ for each $x^* \in X^*$. Its means $\{h_n\}$ is weakly convergent to f. Since $\lim_{n\to\infty}(L)\int x^* h_n$ exists, by Monotone Convergence Theorem we obtained $f \in D_L[$[redacted]$]$ and if [redacted]

we have

[redacted] $) = \lim_{n\to\infty}$ [redacted] $_{(h_n,A)}(x^*) \leq \liminf_{n\to\infty} x^{**}_{(f_n,A)}(x^*)$,

for each $x^* \in X^*$. □

Fatou Lemma results Lebesgue Dominated Convergence Theorem. As follow.

Theorem 3.4 *Lets* $f, h, f_n : [a,b] \to X$ *and* $h, f_n \in D_L[a,b]$, $\forall n \in \mathbb{N}$. *If*

(i) $\{f_n\}$ *is weakly convergent to* f *on* $[a,b]$,

[redacted] $^* f_n($ [redacted] $^* h($[redacted]$)$ $\forall n \in N$, [redacted] *, *and* [redacted] $,b]$

we have $f \in$ [redacted]$[a,b]$ *and*

[redacted] $_{,A)}($[redacted]$) =$ li [redacted] $_{(f_n,A)}($[redacted]$)$

for every $A \subset [a,b]$ *closed interval.*

Proof: Let $A \subset [a,b]$ arbitrary closed interval.
Sequence $\{f_n\}$ is weakly convergent to function f [redacted]. for every $\varepsilon > 0$, $x \in [$[redacted]$]$, and [redacted] * there is an $n_0 = n_0(\varepsilon, x^*, x) \in \mathbb{N}$ such that if $n \geq n_0$ we have

$|x^*($[redacted]$) - x^*($[redacted]$)| < \varepsilon$

or

[redacted]$^*(f_n)($[redacted]$) - \varepsilon < x^*($[redacted]$^*(f_n)($[redacted]$) + \varepsilon$.

We known that

$|$[redacted]$)| \leq x^*($[redacted]$)$

We obtained

$-$[redacted]$^*(h)($[redacted]$) \leq x^*($[redacted]$)$

Therefore

[redacted]$^* h($[redacted]$^* f_n(x) = x^*($[redacted]$) \geq 0$.

Sequence $\{x^*($[redacted]$)\}$ is convergent to function $x^*($[redacted]$)$ on $[$[redacted]$]$ for every $x^* \in$ [redacted]*, then $\{$[redacted]$- f_n)\}$ is convergent to function [redacted]$^*(h-f)$ on $[a,b]$. Its means $\{h - f_n\}$ is weakly convergent to function

$h-f$ on $[a,b]$. In the next result, the sequence $\left\{(L)\int_A x^*(h-f_n)\right\}$ is bounded for all $n\in\mathbb{N}$ and x^* element X^*.

By Fatou's Lemma, we get $h-f\in D_L[a,b]$ and

[redacted] $) \le \liminf_{n\to\infty}$ [redacted] (x^*).

We are known $-x^*$ [redacted] $) \le x^*$ [redacted] $) \le x^*$ [redacted] every [redacted] $\subset [a,$ [redacted] $]$, $x^*\in X^*$ [redacted] $\in D_L[a,b]$, then $f\in D_L[a,b]$ and

$$\begin{aligned}
0 &\le x^{**}_{(h,A)}(x^*) - x^{**}_{(f,A)}(x^*)\\
&\le \liminf_{n\to\infty} x^{**}_{(h-f_n,A)}(x^*)\\
&= \liminf_{n\to\infty}\left\{(L)\int_A x^*h + (L)\int_A x^*(-f_n)\right\}\\
&= (L)\int_A x^*h \;-\; \limsup_{n\to\infty}(L)\int_A x^*(f_n)\\
&= x^{**}_{(h,A)}(x^*) - \limsup_{n\to\infty} x^{**}_{(f_n,A)}(x^*)
\end{aligned}$$

We get

[redacted]

In other hand, [redacted] $x^*h(x)+x^*f_n(x)\ge 0$. We have $\liminf$ [redacted] (x^*).

Therefore,

[redacted] $) = \lim_{n\to\infty}$ [redacted] (x^*). □

From Lebesgue Dominated Convergen Theorems, its implies theorems in below.

Theorem 3.5 (Bounded Convergence Theorem) *Lets* $f, f_n:[a,b]\to X$ *and* $f_n\in D_L[a,b], \forall n\in\mathbb{N}$ *If for every* $A\subset[a,b]$ *closed interval,* $\{f$ [redacted] f *on* [redacted] *there exist real number* $M>$ [redacted] $(f_n)($ [redacted] $)|\le M$ $\forall n\in\mathbb{N}$, [redacted], *and* [redacted] $\in A$, [redacted] $\in D_L[a,b]$ *and we have*

$$x^{**}_{(f,A)} = \lim_{n\to\infty} x^{**}_{(f_n,A)}.$$

Proof: Let's arbitrary closed interval $A\subset[a,b]$. We take $x^*h(x)=M>0$, $M\in R$ for every $x\in A$. We known $\{f_n\}$ is weakly convergent to f on A and $|$ [redacted] $)=M$ $\forall n\in\mathbb{N}$, [redacted], and [redacted] $\in A$, by Theorem 3.4 we get $f\in D_L[a,b]$ and

$$x^{**}_{(f,A)} = \lim_{n\to\infty} x^{**}_{(f_n,A)}. \quad \square$$

4. Conclusion

We have obtained that to guarantee a function which is Dunford integrable and its limit of functions sequence are same as the value of the functions, then a sequence of Dunford integrable function is uniformly convergent or weakly convergent, weakly monotone, and its limit exist. Furthermore, its weakly convergent and bounded.

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