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Some Applications of Closed Setsin Second Wave Covid-19 Infections Parameters

[1]Dr Monika DasharathGorkhe, [2]Dr. Minirani S, [3]Dr. A.KRISHNARAJU, [4]Devendra Singh, [5]RAHUL KAR, [6]Dr.Makarand Upadhyaya, [7]A.PANDI, [8]S.Balamuralitharan*

[1]Assistant Professor, Dr D Y Patil Institute of Management Studies (DYPIMS), Maharashtra Pune -411018

[2]Associate Professor, Department of BSH, MPSTME, SVKM's NMIMS Deemed to university, Mumbai- 400056

[3]PROFESSOR, Department of Mechanical and Automation Engineering PSN College of Engineering and Technology TIRUNELVELI - 627152

[4]Department of Biotechnology, Motilal Nehru National Institute of Technology, Allahabad-211004, India

[5]Department of mathematics,KalyaniMahavidyalaya, Kalyani, Nadia, India
Email: rkar997@gmail.com

[6]Associate Professor-Marketing, University of Bahrain, Department of Management & Marketing, College of Business Administration, Bahrain- 32038
E-mail: makarandjaipur@gmail.com

[7]ASSISTANT PROFESSOR, DEPARTMENT OF MATHEMATICS, RATHINAM TECHNICAL CAMPUS, POLLACHI MAIN ROAD, EACHANARI, COIMBATORE-21. TAMILNADU, INDIA.

[8]Department of Mathematics, College of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur-603 203, Chengalpattu District, Tamilnadu, INDIA.

*Corresponding Author Email: balamurs@srmist.edu.in

Abstract: We connected current pandemic second wave COVID-19 infections parameters with algebraic structure. This parameter estimation compare to closed set in Nano topological spaces under the structure of COVID-19.In thisarticle, we introduce a (i,j)*-Ω-cld in BTPS. This sets lies between $\tau_{i,j}$-cld and the class of (i,j)*-g-cld.

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1. INTRODUCTION

This paper deals the parameters of COVID-19 equation models ([1]- [4]) connected to closed sets. In this regard, we compare the sg-closed sets, gs-closed sets, ω closed sets and αgs-closed sets to COVID-19 infection models. It is a connection for this infection model analysis to (i,j)*-Ω-cld in BTPS. This paper was fully analyzed the pure mathematics under the connection of closed sets in Nano topological spaces.

Recently,Several authors such as Bhattacharya and Lahiri, Arya and Nour, Sheik John and Rajamani and Viswanathan introduced sg-closed sets, gs-closed sets, ω-closed sets and αgs-closed sets respectively ([5]-[21]). In myarticle, we introduce a (i,j)*-Ω-cld in BTPS. This sets lies between $\tau_{i,j}$-cld and the class of (i,j)*-g-cld.

2. PRELIMINARIES

Throughout this paper(X, τ_i, τ_j) (briefly, X)willdenote BTPS.

Definition 2.1

Let $H \subseteq X$. Then H is said to be $\tau_{i,j}$-open [12] if $H = P \cup Q$where $P \in \tau_i$ and $Q \in \tau_j$.

The complement of $\tau_{i,j}$-open set is called $\tau_{i,j}$-cld.

Definition 2.2 [12]

Let $H \subseteq X$. Then

(i) the $\tau_{i,j}$-closure of H, denoted by $\tau_{i,j}$-cl(H), is defined as $\cap\{F : H \subseteq F$ and F is $\tau_{i,j}$-cld$\}$.

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(ii) the $\tau_{i,j}$-interior of H, denoted by $\tau_{i,j}$-int(H), is defined as $\cup$ {F : F $\subseteq$ H and F is $\tau_{i,j}$-open}.

Definition 2.3

A subset H $\subseteq$ X is called:

(i) (i,j)*-semi-open set [11] if H $\subseteq$ $\tau_{i,j}$-cl($\tau_{i,j}$-int(H));
(ii) (i,j)*-preopen set [11] if H $\subseteq$ $\tau_{i,j}$-int($\tau_{i,j}$-cl(H));
(iii) (i,j)*-α -open set [8] if H $\subseteq$ $\tau_{i,j}$-int($\tau_{i,j}$-cl($\tau_{i,j}$-int(H)));
(iv) (i,j)*-β-open set [13] (= (i,j)*-semi-preopen [13]) if H $\subseteq$ $\tau_{i,j}$-cl($\tau_{i,j}$-int($\tau_{i,j}$-cl(H)));
(v) regular (i,j)*-open set [11] if H = $\tau_{i,j}$-int($\tau_{i,j}$-cl(H)).

The complements of the above mentioned open sets are called their respective clos ed sets.

Definition 2.4

A H$\subseteq$ X is called

(i) (i,j)*-generalized closed (briefly, (i,j)*-g-cld) set [16] if $\tau_{i,j}$-cl(H) $\subseteq$ U whenever H $\subseteq$ U and U is $\tau_{i,j}$-open in X.

(ii) (i,j)*-semi-generalized closed (briefly, (i,j)*-sg-cld) set [11] if (i,j)*-scl(H) $\subseteq$ U whenever H $\subseteq$ U and U is (i,j)*-semi-open in X.

(iii) (i,j)*-generalized semi-closed (briefly, (i,j)*-gs-cld) set [11] if (i,j)*-scl(H) $\subseteq$ U whenever H $\subseteq$ U and U is $\tau_{i,j}$-open in X.

(iv) (i,j)*-α -generalized closed (briefly, (i,j)*-α g-cld) set [15] if (i,j)*-α cl(H) $\subseteq$ U whenever H $\subseteq$ U and U is $\tau_{i,j}$-open in X.

(v) (i,j)*-generalized semi-preclosed (briefly, (i,j)*-gsp-cld) set [15] if (i,j)*-spcl(H) $\subseteq$ U whenever H $\subseteq$ U and U is $\tau_{i,j}$-open in X.

(vi) (i,j)*-ĝ-closed set ((i,j)*-ω -cld)) [5] if $\tau_{i,j}$-cl(H) $\subseteq$ U whenever H $\subseteq$ U and U is (i,j)*-semi-open in X.

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(vii) (i,j)*-αgs-cld set [15] if (i,j)*-α cl(H) $\subseteq$ U whenever H $\subseteq$ U and U is (i,j)*-semi-open in X.

(viii) (i,j)*-g*s-cld set [11] if (i,j)*-scl(H) $\subseteq$ U whenever H $\subseteq$ U and U is (i,j)*-gs-open in X.

The complements of the above mentioned closed sets are called their respective op en sets.

Definition 2.5 [16]

A subset H of a BTPS X is said to be (i,j)*-locally closed if H = U $\cap$ F, where U is $\tau_{i,j}$-open and F is $\tau_{i,j}$-cld in X.

Remark 2.6

(1) Every $\tau_{i,j}$-open set is (i,j)*-g*s-open [16].

(2) Every (i,j)*-semi-open set is (i,j)*-g*s-open [11].

(3) Every (i,j)*-g*s-open set is (i,j)*-sg-open [16].

(4) Every (i,j)*-semi-cld set is (i,j)*-gs-cld [16].

(5) Every $\tau_{i,j}$-cld set is (i,j)*-gs-cld [16].

3. (i,j)*-Ω-CLD SETS IN BTPS

We introduce the following definition.

Definition 3.1

A subset H of a BTPS X is called a (i,j)*-Ω-cld set if $\tau_{i,j}$-cl(H) $\subseteq$ U whenever H $\subseteq$ U and U is (i,j)*-gs-open in X.

Proposition 3.2

Every $\tau_{i,j}$-cld set is (i,j)*-Ω-cld.

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Proof

If H is any $\tau_{i,j}$-cld set in X and G is any (i,j)*-gs-open set containing H, then $G \supseteq H = \tau_{i,j}$-cl(H). Hence H is (i,j)*-Ω-cld.

The converse of Proposition 3.2 need not be true as seen from the following example.

Example 3.3

Let X = {p, q, r}, τ_i = {ϕ, X, {p, q}} and τ_j = {ϕ, X}. Then the sets in {ϕ, {p, q}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {r}} are called $\tau_{i,j}$-closed. Then (i,j)*-Ω-C(X) = {ϕ, {r}, {p, r}, {q, r}, X}. Here, H = {p, r} is (i,j)*-Ω-cld set but not $\tau_{i,j}$-cld.

Proposition 3.4

Every (i,j)*-Ω-cld set is (i,j)*-g*s-cld.

Proof

If H is a (i,j)*-Ω-cld subset of X and G is any (i,j)*-gs-open set containing H, then $G \supseteq \tau_{i,j}$-cl(H) $\supseteq$ (i,j)*-scl(H). Hence H is (i,j)*-g*s-cld in X.

The converse of Proposition 3.4 need not be true as seen from the following example.

Example 3.5

In Example 3.3, Here, (i,j)*G*SC(X) = {ϕ, {p}, {r}, {p, r}, X}. Here, H = {r} is (i,j)*-g*s-cld but not (i,j)*-Ω-cld set in X.

Proposition 3.6

Every (i,j)*-Ω-cld set is (i,j)*-ω-cld.

Proof

Suppose that $H \subseteq G$ and G is (i,j)*-semi-open in X. Since every (i,j)*-semi-open set is (i,j)*-gs-open and H is (i,j)*-Ω-cld, therefore $\tau_{i,j}$-cl(H) $\subseteq$ G. Hence H is (i,j)*-ω-cld in X.

The converse of Proposition 3.6 need not be true as seen from the following example.

Example 3.7

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Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X, {q, r}}. Then the sets in {ϕ, {p}, {q, r}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {p}, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-Ω-C(X) = {ϕ, {p}, {q, r}, X} and (i,j)*-ωC(X) = P(X). Here, H = {p, r} is (i,j)*-ω-cld but not (i,j)*-Ω-cld set in X.

Proposition 3.8

Every (i,j)*-g*s-cld set is (i,j)*-sg-cld.

Proof

Suppose that H ⊆ G and G is (i,j)*-semi-open in X. Since every (i,j)*-semi-open set is (i,j)*-gs-open and H is (i,j)*-g*s-cld, therefore (i,j)*-scl(H) ⊆ G. Hence H is (i,j)*-sg-cld in X.

The converse of Proposition 3.8 need not be true as seen from the following example.

Example 3.9

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X, {q, r}}. Then the sets in {ϕ, {p}, {q, r}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {p}, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-G*SC(X) = {ϕ, {p}, {q, r}, X} and (i,j)*-SGC(X) = P(X). Here, H = {p, q} is (i,j)*-sg-cld but not (i,j)*-g*s-cld set in X.

Proposition 3.10

Every (i,j)*-ω-cld set is (i,j)*-αgs-cld.

Proof

If H is a (i,j)*-ω-cld subset of X and G is any (i,j)*-semi-open set containing H, then G ⊇ $\tau_{i,j}$-cl(H) ⊇ (i,j)*-α cl(H). Hence H is (i,j)*-αgs-cld in X.

The converse of Proposition 3.10 need not be true as seen from the following example.

Example 3.11

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X}. Then the sets in {ϕ, {p}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-ωC(X) = {ϕ, {q, r}, X} and (i,j)*-αGS

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C(X) = {ϕ, {q}, {r}, {q, r}, X}. Here, H = {q} is (i,j)*-αgs-cld but not (i,j)*-ω-cld set in X.

Proposition 3.12

Every (i,j)*-Ω-cld set is (i,j)*-g-cld.

Proof

If H is a (i,j)*-Ω-closed subset of X and G is any open set containing H, since every $\tau_{i,j}$-open set is (i,j)*-gs-open, we have G ⊇ $\tau_{i,j}$-cl(H). Hence H is (i,j)*-g-cld in X.

The converse of Proposition 3.12 need not be true as seen from the following example.

Example 3.13

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X, {q, r}}. Then the sets in {ϕ, {p}, {q, r}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {p}, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-Ω-C(X) = {ϕ, {p}, {q, r}, X} and (i,j)*-GC(X) = P(X). Here, H = {p, q} is (i,j)*-g-cld but not (i,j)*-Ω-cld set in X.

Proposition 3.14

Every (i,j)*-Ω-cld set is (i,j)*-αgs-cld.

Proof

If H is a (i,j)*-Ω-closed subset of X and G is any (i,j)*-semi-open set containing H, since every (i,j)*-semi-open set is (i,j)*-gs-open, we have G ⊇ $\tau_{i,j}$-cl(H) ⊇ (i,j)*-α cl(H). Hence H is (i,j)*-αgs-cld in X.

The converse of Proposition 3.14 need not be true as seen from the following example.

Example 3.15

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X, {q, r}}. Then the sets in {ϕ, {p}, {q, r}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {p}, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*- Ω-C(X) = {ϕ, {p}, {q, r}, X} and (i,j)*-αGSC(X) = P(X). Here, H = {p, r} is (i,j)*-αgs-cld but not (i,j)*-Ω-cld set in X.

Proposition 3.16

Every (i,j)*-Ω-cld set is (i,j)*-α g-cld.

Proof

If H is a (i,j)*-Ω-cld subset of X and G is any $\tau_{i,j}$-open set containing H, since every $\tau_{i,j}$-open set is (i,j)*-gs-open, we have G $\supseteq$ $\tau_{i,j}$-cl(H) $\supseteq$ (i,j)*-α cl(H). Hence H is (i,j)*-α g-cld in X.

The converse of Proposition 3.16 need not be true as seen from the following example.

Example 3.17

Let X = {p, q, r}, τ_i = {ϕ, X, {r}} and τ_j = {ϕ, X, {p, q}}. Then the sets in {ϕ, {r}, {p, q}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {r}, {p, q}} are called $\tau_{i,j}$-closed. Then (i,j)*- Ω-C(X) = {ϕ, {r}, {p, q}, X} and (i,j)*-αgC(X) = P(X). Here, H = {p, r} is (i,j)*-α g-cld but not (i,j)*-Ω-cld set in X.

Proposition 3.18

Every (i,j)*- Ω-cld set is (i,j)*-gs-cld.

Proof

If H is a (i,j)*-Ω-cld subset of X and G is any $\tau_{i,j}$-open set containing H, since every $\tau_{i,j}$-open set is (i,j)*-gs-open, we have G $\supseteq$ $\tau_{i,j}$-cl(H) $\supseteq$ (i,j)*-scl(H). Hence H is (i,j)*-gs-cld in X.

The converse of Proposition 3.18 need not be true as seen from the following example.

Example 3.19

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X}. Then the sets in {ϕ, {p}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-Ω-C(X) = {ϕ, {q, r}, X} and (i,j)*-GSC(X) = {ϕ, {q}, {r}, {p, q}, {p, r}, {q, r}, X}. Here, H = {r} is (i,j)*-gs-closed but not (i,j)*-Ω-cld set in X.

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Proposition 3.20

Every (i,j)*-Ω-cld set is (i,j)*-gsp-cld.

Proof

If H is a (i,j)*-Ω-cld subset of X and G is any $\tau_{i,j}$-open set containing H, every $\tau_{i,j}$-open set is (i,j)*-gs-open, we have G ⊇ $\tau_{i,j}$-cl(H) ⊇ (i,j)*-spcl(H). Hence H is (i,j)*-gsp-cld in X.

The converse of Proposition 3.20 need not be true as seen from the following exam ple.

Example 3.21

In Example 3.19, Here, (i,j)*-GSP C(X) = {ϕ, {q}, {r}, {p, q}, {p, r}, {q, r}, X}. Here, H = {r} is (i,j)*-gsp-cld but not (i,j)*-Ω-cld set in X.

Remark 3.22

The following example shows that (i,j)*-Ω-cld sets are independent of (i,j)*-α-cld sets and (i,j)*-semi-cld sets.

Example 3.23

Let X = {p, q, r}, τ_i = {ϕ, X, {p, q}} and τ_j = {ϕ, X}. Then the sets in {ϕ, {p, q}, X} are called $\tau_{i,j}$-open and the sets in {ϕ, X, {r}} are called $\tau_{i,j}$-closed. Then(i,j)*-Ω-C(X) = {ϕ, {r}, {p, r}, {q, r}, X} and (i,j)*-α C(X) = (i,j)*-S C(X) = {ϕ, {r}, X}. Here, H = {p, r} is (i,j)*-Ω-cld but it is neither (i,j)*-α-cld nor (i,j)*-semi-cld in X.

Example 3.24

Let X = {p, q, r}, τ_i = {ϕ, X, {p}} and τ_j = {ϕ, X}. Then the sets in {ϕ, {p}, X} ar e called $\tau_{i,j}$-open and the sets in {ϕ, X, {q, r}} are called $\tau_{i,j}$-closed. Then (i,j)*-Ω-C(X) = {ϕ, {q, r}, X} and (i,j)*-α C(X) = (i,j)*-S C(X) = {ϕ, {q}, {r}, {q, r}, X}. Here, H = {q} is (i,j)*-α-cld as well as (i,j)*-semi-cld in X but it is not (i,j)*-Ω-cld in X.

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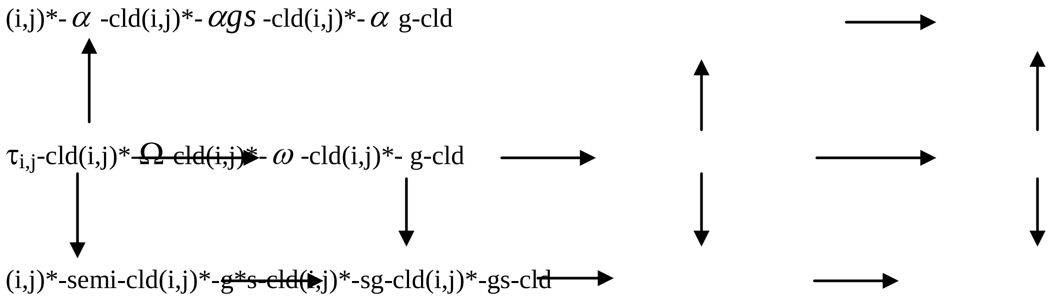
Remark 3.25



None of the above implications is reversible as shown in the remaining examples and in th e related papers [15,16].

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