GOD DOES NOT PUT SIGNATURE
NUNCUPATIVE OR EPISCOPAL: A BRAHMAN AND ANTI BRAHMAN MODEL FOR GOD

ABSTRACT: In quantum physics, in order to quantize a gauge theory, like for example Yang-Mills theory, Chern-Simons or BF model, one method is to perform a gauge fixing. This is done in the BRST and Batalin-Vilkovisky formulation. Another is to factor out the symmetry by dispensing with vector potentials altogether (they’re not physically observable anyway) and work directly with Wilson loops, We HERE as in an earlier paper drawn heavily upon the fact that in a Bank, when it is said Assets=Liabilities, it means that the result of the entire transactional ties of the day is zero. Zero is not “nothing”. It is the cancellation of assets and Liabilities. First and the foremost we assume that God does not put signature. And Brahman=Ant Brahman, In other words, we assume that Christ=Anti Christ. All have Gods and Demons in them. Due to disturbance in the Gratification-Deprivation balance In other words, “Prakruti Kshobha”, i.e.coming to the fore what easily comes to you. Be it belligerence, cantankerousness, tempestuousness, termagnance, bellingsgatishness, astute truculence, serenading whimsicality, blitzy conviction, epynymous radicality, anagonistic dispensation aggressive iconoclasm, asymmetric retribution, anachronistic disposition, it we assume arises attributable or ascribable to disturbance of the already unconservative Gratification-Deprivation Complex of the individual. This point to be clarified. Gratification-Deprivation complex of individual is unconservative, but whereas it is conservative. Almost all perfom gratification producing and deprivation producing actions and we just maintain a General Ledger of all the actions of the people in this world broadly classified as one generating gratification and the other deprivation generating. The world seething and sizzling with murder, mayhem, plunder, pillage, cataclysm, clepsydra, calypss, nemesis, apocalyse, Armageddon, insurgencies, intransigence and insurrections, bears ample testimony and impeccable observatory to the fact some packets are the ones that create problems, and the individual So we have a varied system here. The B_AB combination, spacetime, mass energy, Tamás (staticity)-Rajas (dynamism), and the allocation or deployment of functions to people who come alloyed with gratification deprivation creating activities. This we assume can be measured by ASCII characters and stored in mind which leads to repetitive storage and replication of thinking which only aggravates and exacerbates it. Thus we have everyone performing gratification and deprivation producing actions and like in a Bank Ledger we post each such actions including thinking. All emotions come under both the categories enuretic freneticness, ensorcelled frenzy, entropic entrepotishness, temaracious recklessness, Thunderstorm thermistoriness, Gerry mandering gossanderlines, dopey dopplegangerliness and so on ad infinitum We however have no claims for Neurons DNA that brings out all the thoughts. Some neuroscience research has been able to detect the thought process. With this resume we, bring out the Model of God, for God, and probably by God.
INTRODUCTION:

Following are excerpts I posted on Face Book. There cannot be more apt introduction for this paper.

DIALOGUE WITH THE CONFLICTING SELF:

Modern psychology has elaborated a rich repository and receptacle to account for the perceptual field and variations of the objects in the perceptual field. There is form--background; depth--length--theme--potentials, profiles,--unity of object; fringe-center; text-context, thesis-antithesis, transitive states and substantive parts. But the philosophical problem is not fully realised. one can raise the question whether these categories belong to the perceptual field raised. As immanent and contiguous to it. This we shall call it simply "monism". The other question is whether the objects in this perceptual field, refer itself to the subjective synthesis operating on subject matter of perception. this we shall call it "dualism". it would be wrong to take the objection to the dualist interpretation that perception does not occur does not occur through a judgmental intellectual synthesis; one can certainly conceive passively sensible synthesis of an entirely different sort, operating on the material inside the perceptual field. In this context it is pertinent to point out that Husserl never depreciated "dualism". But there still exists a doubt. What is that? The question is that is dualism established between the 'matter of the perceptual field' and the ego. Here when we say 'ego' it is presynthesis of ego. unsynthesised 'ego' but one more point to be made is that true dualism lies elsewhere that is to say that it lies between (eb) the effects of the 'structure other' and the absence of the effect; that is to say what would have been the perception (eb) if there were 'no others' we must understand that other is not one structure in the field of perception. For example it must be noted that it is the structure which conditions the entire field and its functioning. It renders possible the constitution and application of preceding categories. So, it is not the ego, but the 'other' which renders the perception as possible; here 'other' is also object in the field (when we say 'other' mean the dualistic object') or it is also possible that the 'other' dualistic thing could be the subject in the field. in defining the other as the possible entity of the dualistic world, we are in fact making the 'apriori' organization of every field, and that is in accordance with the categories; we make it a structure which allows it the functioning with its categorization of duality namely 'subject' and the object then you are first making a phenomenological distinction, and when questioned you go back to the ontologicalism of 'duality' that probably is wrong. Real dualism must appear in the absence of the 'other' subject and 'object' has to exist. May be the oneness might occur at a single point, but in essence the dualism must persist does it allow us to understand this duality? Or does it also conceal itself like a coy bride........................these are some of the questions that arise when one talks of dualism and also the divinity of both 'subject' and the 'object'. Can the divinity be two? Can there be cocreationlike equities in fin there definitely is a sense of compunction, contrition, hesitation, regret, remorse, compunction or contrition to the acknowledgement of the fact that there is a personal relation to destiny. Louis de Broglie said that the events have already happened and it shall disclose to the people based on their level of consciousness. So there is destiny to start with! Say i am undergoing some seemingly insurmountable problem, which has hurt my sensibilities, susceptibilities and sentimentalities that I refuse to accept that that event was waiting for me to happen. In fact this is the statement of stoic philosophy which is referred to almost as bookish or abstract. Wound is there; it had to happen to me. So i was wounded. Stoics tell us that the wound existed before me; i was born to embody it. It is the question of consummation, consolidation, concretion, con substantiation, that of this, that creates an "event" in us; thus you have become a quasi cause for this wound. for instance my feeling to become an actor made me to behave with such perfectionism everywhere, that people's expectations rose and when i did not come to them i fell; thus the 'wound' was witing for me and "i' was waiting for the wound! One fellow professor used to say like you are searching for ideas, ideas also searching for you. Thus the wound possesses in itself a nature which is 'impersonal and preindividual' in character, beyond general and particular, the collective and the private. It is the question of becoming universalistic and holistic in your outlook. Unless this fate had not befallen you, the "grand design" would not have taken place in its entire entirety. it had to happen. And the concomitant ramifications and pernicious pr positive implications. Everything is in order because the fate befell you. It is not as if the wound had to get something that is best from me or that i am a chosen from god to face the event. As said earlier "the grand design" would have been altered. And it cannot alter. You got to play your part and go; there is just no other way. The legacy must go on. Yee shall be torch bearer and yee shall hand over the torch to somebody. This is the name of the game in totalistic and holistic way.
When it comes to ethics, I would say it makes no sense. It means to say that you are unworthy of the fate that has befallen you. To feel that what happened to you was unwarranted and unauntonous, it telling the world that you are aggressively iconoclastic, veritably resentful, and volitionally resentient. What is immoral is to invoke the name of god, because some event has happened to you. Cursing him is immoral. Realize that it is all "grand design" and you are playing a part. Resignation, renunciation, revocation is only one form of resensitement. willing the event is primarily to release the eternal truth; in fact you cannot release an event despite the fact everyone tries all ways and means they pray god; they prostrate for others destitution, poverty,penuary,misery, they do black magic. But releasing an event is something like an "action at a distance" which only super natural power can do.

Here we are face to face with volitional intuition and repetitive transmutation. Like a premeditated skirmisher, one quarrels with one self, with others with god, and finally leaves this world in despair. Now look at this sentence which was quoted by I think Bousquet "if there is a failure of will", "I will substitute a longing for death" for that shall be apotheosis, a perpetual and progressive glorification of the will

The internal or external have some value if they are in contact. Otherwise isolated internality and externality ceases to be! To become! To being! The internal or external, depth or height, have biological value only through this topological surface of contact. Even biologically it is necessary to understand that deepest is the skin. The skin at its disposal a vital and properly superficial potential energy. i told you earlier, that surface is created by the actions and passions of others but still they say "surface energy" does it not look strange! And just as events doesn’t occupy the surface bit rather frequent it, superficial energy is not localized at the surface. The "superficial energy" is bound to its formation, reformation, revitalization, rejuvenation, resurrection. The living lives at the limit of itself; the characteristic polarity of consciousness, in fact the very polarization is consciousness, is at the level of membrane. it is here life exists in an essential manner; as an aspect of dynamic topology; which itself maintains and manages by the meta stability by which it exists; the entire content of internal space is in contact with the external space topologically; it is in contact at the limits of living; the entire mass of living matter contained in the internal space is actively present to the outside world at the limits of life; it is at this level of polarized membrane internal past and external future face one another..........................................................surface is the locus of sense

What is an event? Or for that matter an ideal event? An event is a singularity or rather a set of singularities or steady singular points characterizing a mathematical curve, a physical state of affairs, a psychological person or a moral person. Singularities are turing points and points of inflection: they are bottle necks, foyers and centers; they are points of fusion; condensation and boiling; points of tears and joy; sickness and health; hope and anxiety; they are so to say “sensitive” points; such singularities should not be confused or confounded, aggravated or exacerbated with personality of a system expressing itself; or the individuality and idiosyncrasies of a system which is designated with a proposition. They should also not be fused with the generalizational concept or universalistic axiomatic predications and postulation alcovishness, or the dipsomaniac flageolet dirge of a concept. Possible a concept could be signified by a figurative representation or a schematic configuration. "Singularity is essentially, pre individual, and has no personalized bias in it, nor for that matter a prejuduce or procircumspection of a conceptual scheme. It is in this sense we can define a “singularity” as being neither affirmative nor non affirmative. It can be positive or negative; it can create or destroy. On the other hand it must be noted that singularity is different both in its thematic discursive from the run of the mill day to day musings and mundane drooling. There are in that sense “extra-ordinary”

Each singularity is a source and resource, the origin, reason and raison d’etre of a mathematical series, it could be any series any type, and that is interpolated or extrapolated to the structural location of the destination of another singularity. This according to this standpoint, there are different, multifarious, myriad, series in a structure. In the eventuality of the fact that we conduct an unbiased and prudent examination of the series belonging to different “singularities” we can come to indubitable conclusion that the "singularity" of one system is different from the "other system" in the subterranean realm and ceratoid dualism of comparison and contrast

EPR experiment derived that there exists a communications between two particles. We go a further step to say that there exists a channel of communication however slovenly, inept, clumpy, between the two singularities. It is also possible the communication exchange could be one of belligerence,
cankanterousness, tempestuousness, astutely truculent, with ensorcelled frenzy. That does not matter. All we are telling is that singularities communicate with each other.

Now, how do find the reaction of systems to these singularities. You do the same thing a boss does for you. "Problematize" the events and see how you behave. I will resort to "pressure tactics", "intimidation of deriding report", or "cut in the increment" to make you undergo trials, travails and tribulations. I am happy to see if you improve your work; but may or may not be sad if you succumb to it and hang yourself! We do the same thing with systems. systems show conducive response, felicitous reciprocation or behave erratically with inner roil, eponymous radicalism without and with blitzy conviction say like a solipsist nature of bellicose and blustering particles, or for that matter coruscation, trepidiational motion in fluid flows, or seemingly perfidious incendiaries in gormandizing fellow elementary particles, abnormal ebullitions, surcharges calumniations and unwarranted (you think so but the system does not!) unrighteous fulminations.

So the point that is made here is "like we problematize the "events" to understand the human behaviour we have to "problematize" the events of systems to understand their behaviour.

This statement is made in connection to the fact that there shall be creation or destruction of particles or complete obliteration of the system (blackhole evaporation) or obfuscation of results. Some systems are like "inside traders" they will not put signature atoll!! How do you find they did it! Anyway, there are possibilities of a CIA finding out as they recently did! So we can do the same thing with systems to. this is accentuation, corroborational,fortificational,foamentory note to explain the various coefficients we have used in the model as also the dissipations called for

In the bank example we have clarified that various systems are individually conservative, and their conservativeness extends holistically too.that one law is universal does not mean there is complete adjudication of nonexistence of totality or global or holistic figure. Total always exists and "individual" systems always exist, if we don’t bring Kant in to picture! For the time being let us not! Equations would become more eneuretic and frenzied.

Kant shows that sum total of all possibilities excludes all but originary predicates ,and in this way constitutes completely determined concept of an individual being for only in this case concept-things thing completely determined in and through itself and known as the representation of an individual.

What is this great manifest duality about idea and image? The duality is present in the goal, to bring consummation of the two sorts of images and bring it full resemblance. If copies or icons are well founded, it is because of the fact because they are endowed with very good resemblance. Idea? Idea goes from one thing to another which comprehends the relations and proportions constitutes internal resonance. So resemblance is a measure of pretensions! It is both internal and spiritual! The copy resembles something only to the degree that it resembles the idea of that thing. Take for example rajnikanth and shatrughan sinha. The copy truly resembles something to such an extent that it is modeled on an idea. It is the superior identity of the idea which founds the good pretensions of the copies because it bases on internal or derived resemblance. Consider now other species of images like simulacra. Pretension is one thing that brings out striving power in you to bring in similarities of characteristics it conceals dissimilarity. And that is an internal unbalance. So this happens to everyone to become like the other. This is the first degree of actualization. This world belongs to you. it is filled with individual self and individual motivations... philosophy merges with ontology; ontology merges with univocity of being; analogy has always a theological vision; not a philosophical vision; one becomes adapted to the forms of god; self and world; the univocity of being does not mean that there is one and the same being: on the contrary, beings are multiple and different they are always produced by disjunctive synthesis; and they themselves are disintegrated and disjoint and divergent; membra disjuncta.the univocity of being signifies that that being is a voice that is said and it is said in one and the same "consciousness".

Everything about which consciousness is spoken about. being is the same for everything for which it is said like gravity; it occurs therefore as an unique event for everything; for everything for which it happens; eventum tantum; it is the ultimate form for all of the forms; and all these forms are disjointed; it brings about resonance and ramification of its disjunction; the univocity of being merges with the positive use of the disjunctive synthesis, and this is the highest affirmation of its univocity like gravity; it is the eternal resurrection or a return itself, the affirmation of all chance in a single moment, the unique cast for all throws; a simple rejoinder for Einstein’s god does not play dice; one being, one
consciousness, for all forms and all times single instance for all that exists single phantom for all the living single voice for every hum of voices; or a single silence for all the silences; a single vacuum for all the vaccuumes; consciousness should not be said without occurring; if consciousness is one unique event in which all the events communicate with each other; univocity refers both to what occurs to what it is said. The attributable to all states of bodies and states of affairs and the expressible of every proposition. So univocity of consciousness means the identity of the noematic attribute and that which is expressed linguistically and senseful; ly. Univocity means that it does not allow consciousness to be subsisting in a quasi state and but expresses in all pervading reality;

You see! You have to accept that the world that has-been created is to see itself! That is not me talking that am Spencer brown! If that impresses you! To do that it has to cut itself in to two halves one to see and the other to be seen! So why i referred you to the statement is that consciousness is above all the dualism of subject and object! Here appears the principle of generalization and particularization which contradicts each other but which are same. Again you are being abstract! No! Please reflect, introspect on which i said! Yee shall realize! Whenever you perform any action and mind you even thinking is also an action wave’s rise over the membrane of mind! Like waves on ocean! There is underlying unity there! That is the millionth time i am hearing that! Just because you have heard it before it should not become cliché my son! Truth is always truth! Mind leads to incessant multiplication and division of one unity and the unification of innumerable many! There is no beginning! There is no end! There is no duration! There is no space! No time! Hawking says “all Space time is within yourself. And you see that outside! It is all your imagination, product of your fecund imagination! Do not laugh! Do you not find the obvious similarities between yoga and a schizophrenia or Zen follower? You see this in practical sense implies the social and physical reality is disturbing! So you want to withdraw! And all these are methodologies that are proposed! No! No! I think you are wrong! Scientific studies end and there begins the study of self! It has happened to you and still you resort to self abnegations said the person who studies the subject is itself governed by the same laws and hence he just cannot study the truth! Yeah! That i have been propounding since long although it is still not articulately in my mind...

IN THE ORDER OF ANTIBRAHMAN:

Notes on 19th March 2012 in Dairy:

First listen?

You are not telling! And you say ‘listen’!

Anti Brahman is like a fat cat of Wall Street!

What does he do?

He scares you! He teaches you the association! He leaves Supari mafia, crime syndicates, hoodlum mugger aggregates, raucous, ribaldry congregates, lewd luciferian cavalcades after you!

And association?

He teaches you!

He is a Teacher also!

Yes!

That is why all space time is illusion! It is in your Head not outside!

What is outside?

A dream! A reflection! Outside!

Police keep quiet?
A within the speed vehicle in city limits can kill you by “chance”! Some hundred people can walk with you! Where ever you go you shall be given second glance; looked down like a criminal; It is all the figment of fecund imagination!

No! The truth has to be found!

Yes!

Why?

Have you not heard of Saturn responsible for “Governmental Problems” according to astrologers?

Chill runs down my spine!

Ha! Ha! Not me! I was scared of life not death!

Again the two Self; two consciousnesses!

Consciousness has no direction!

Even jeering loutish elements?

You fool! You never learn!

And Brahman?

He also does not put signature! He gives “Energy” instead of ‘money’!

Whom does he give?

To the persons who bring you glory?

Only glory?

No! Even trails, tribulations, travails, tormentations, anecdote of life would become the aphorism of thought! Rocky razzmatazz turn in to autumn sonata; portentous voice of doom and calamity!

That means Brahman operates like Anti Brahman!

Yes!

You! Entropic enter pot, obscurantist scatoma, marginal scholium, didactic dilly, Yiddish Schlmatlz.get out! Get out!

But I am your “Self”!

Oh! God! Tomorrow I must go to Church and confess; go to temple and pray; Utch; Ugh!; Oh!

“How I become Selfless”?

Whom shall I have a dialogue of conflict with?

Without quarrel life is difficult!

“Consciousness” is Maya!

Space time is Maya?

Yes!
Even the dream state and dreamless state?

Yes!

What is the truth?

Illusion!

Both Truth and Illusion!

Both! How....

Like Brahman and Anti Brahman!

Then you should have included that in the Model!

Yes!

That is what they call Wagner’s friend’s paradox!

OK!

Reductionist method?

I have proved the reductionist method is one that makes you get all wrong?

Where?

In “Theory of Every Thing”!

Ask Alex!

What is this word? AntiBrahman? Anti Christ? Why do we bring it in the mathematical paper? It is like an antiparticle that should balance the process of Brahman. Lest there shall be jeopardy and jettison of the locus and focus of essence, sense and expression, propositional subsistence and substantive corporeality. When we read Klossowski’s work, we find that it is built on an astonishing and still essentially predicational parallelism, between body and language, or we can also say the sentinel and bastion is on the thematic and potential reflection of one in the other. Klossowski’s thinks that the reasoning has a theological essence and the form of disjunctive syllogism together with interfacial interference and syncopated justices. There is also disjunctive articulation in the principal frontier of diurnal dynamics and hypostatized signification. Biologists, for example teach us that the development proceeds by fits and starts; a CHUNK of a limb is determined to be the right paw. On the same account, reasoning proceeds by fits and starts; it is the same energy that propels both Brahman and Anti Brahman. It is the same bomb that gives nuclear reactors for electricity and the detrimental ramifications and pernicious implications need not to be cited at all. Reasoning hesitates and bifurcates at every level. How with zest I wrote equal to zero in elementary standard. And the result looked perfectly alright. But the very equation, and in fact every equation speaks of conservation. Including that of Brahman and Anti Brahman. So any delineation and dissemination of language by means of language proceeds by hesitation, bifurcation and trepidation.

In another aspect and respect, it is our epoch that has discovered theology. One no longer needs to believe in God; we seek rather the “structure” of primordial determinate apriori and differential posteori. Theology is now the science of nonexistent entities, despite CERN scientists of having found “Higgs boson” which gives mass to the matter. It is in this sense that Nietzsche’s prediction of God and grammar is realized. It is here “language” is fully developed and mathematics realized, but this time it is a recognized link. Willed, acted out, pantomimed, and “hesitated”. It is fully developed and placed
under the service of “Anti Brahman”. Like Dionysus crucified. Now, for example the function of sight is disintegration, division, and multiplication. Whereas the function of ear is bringing out the resonance and hearing those resonances. Klossowski’s entire work moved towards the dissolution of self. When there is no “Self”, you don’t have any quarrel, for self is contradictory in nature. Lucretius established that we can come to the implications of naturalism pluralism linked with multiple affirmations. It is this that is connected with the diverse and disjunctive syllogisms. Intermediaries do the job. And the coordinator is just not in the picture. Like a spider weaves its web and withdraws, Anti Brahman does it. And perhaps Brahman. For they are both sides of the same coin
What is of paramount importance here is that the statement that the. Theories of Knowledge have the discrepancy and inadequacy of the contemporaneity of subject and object. They must assume that there shall be annihilation of perception of the subject when object perceives. Look at this lovely paragraph from Kierkegaard (little revised by me): Then suddenly there is a knock; the subject breaks away from the object, divesting it a part and parcel of its color, substance, theme, and potentiality. There is aggrandizement in the scheme of things, and the whole range of objects crumbles in becoming me, each object transferring its quality to the subject. The light becomes the eye and is no longer existent (Why doth a dead man see?); it simply is the stimulation of the retina. The smell becomes the nostril-and the world declares odorless; The song in the trees, the torrent of darkness among the gusty trees are disavowed; with the moon tossed upon the cloudy seas, the night was that of a timpani, with the road of the purple moor; The subject is disqualified object; My nose is all that remains of the odors; My hand refutes the thing it holds; Thus the problem of consciousness is born out of anachronism. There exists the simultaneous existence of the subject and the object whose existence they themselves define, by their own stability, from which they rest as they are(some write up mine)

If the nature is nonlinear, and thinking is linear, speaking is linear, and then the very act of speaking and interaction must create a bias as a participant. The concept of witness consciousness is destroyed here. Does Klossowski’s thought mean to say that speaking prevents us from thinking nasty things? No! It cannot be! What he says is in fact that pure knowledge that produces an impure silence is a provocation of mind by the body; similarly, the impure language which produces a pure silence is the revocation of the body by mind. As Sade’s heroes say it is not the bodies which are present that excite the libertine, but the great idea that is not there. Language in its wide ranging manifestations becomes forces giving thereby to the disintegrated body and the dissolved self access to a silence which is that of innocence’s it means there is purity of responsibility and purity of innocence. Le Baphiomet says: either the words are recalled but their senses become obscure; or the sense appears when the memory of the words disappears.

In the profound, the nature of dilemma is still theological Octave is a Professor of Theology. Le Baphiomet is in its entirety is a theological model, which opposes the system of God, and is therefore Anti Brahman. So these terms are of fundamental disjunction. In the order of Brahman, in the order of existence, bodies give to minds or impose on them, catapult them to two phenomenological properties: identity and immortality, personality and resurrect ability, incommunicability and integrity. What is incommunicability? It is the principle according to which individual would not be attributable to several individuals and being of the individual to be a self identical person (Antoine)

1. The order of Brahman includes the following elements:
2. The identity of Brahman as the ultimate terra firma
3. The identities of human bodies or in general bodies as the bastion
4. The identity of the world as the principal frontier of bipolar counter actualities and variant and virtuous action.

5. The identity of bodies as the sentinel of depth-length, theme –potentialities, profiles and unity of perspectives, fringe-centre, text-context, the tic and non the tic

But this order of Brahman is constructed against the order of Anti Brahman, an order, this order of Anti Brahman subsists in the Brahman (See the Model) and weakens him, dissipates him little by little. We shall here do not make any assumptions of co creations which some Vedas and scriptures do. It is at this point that the story of Baphiomet begins: in the service of Brahman, the great master of Templars has as its mission, the sorting out of spirits and preventing their mixing together while waiting for the day of resurrection. The return of God, Christ, Brahman. We will not further elaborate upon the Theories of Knowledge, especially that of Beingness and Nothingness which has been vehemently and trenchantly criticized and has on the other hand received accolades and plaudits; There exits transitive states and substantive sub states of determinate orientation. Thus we shall refer Brahman and Anti Brahman are the two sides of the same coin. What was virtue yesterday is vice today; and what is vice today is virtue tomorrow; the cycle never ends..................................

In the model below we use the contemporaneous existence of subject and object and create a consolidated forty eight storey structure

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**BRAHMAN AND ANTIBRAHMAN:**

**MODULE NUMBERED ONE**

**NOTATION :**

\[ G_1 \] : CATEGORY ONE OF ANTIBRAHMAN (THERE ARE LOT OF ANTIBRAHMANS AND COCNOIMITANT ACTIVITY THEREOF. CLASSIFICATION IS BASEDON EACH INDIVIDUAL ACTION WHICH IS GRATIFICATION OR DEPRIVATION PRODUCING)

\[ G_2 \] : CATEGORY TWO OF ANTIBRAHMAN

\[ G_3 \] : CATEGORY THREE OF ANTIBRAHMAN

\[ T_1 \] : CATEGORY ONE OF BRAHMAN (HERE WE TAKE IN TO CONSIDERATION GRATIFICATION PRODUCING ACTIVITIES INCLUDING SPEECH, HOW WE TALK, HOW WE LISTEN, HOW THER WOULD BE TRANSMISSION THERE ARE LOT OF NEUROSCIENTIFIC MATHEMATICAL MODELS)

\[ T_2 \] : CATEGORY TWO OF BRAHMAN

\[ T_3 \] : CATEGORY THREE OF BRAHMAN

**GRATIFICATION AND DEPRIVATION** (WE MAKE AN EXPPLICIT ASSUMPTION THAT GRATIFICATION INCREASES BY ARITHMETIC PROGRESSION AND DEPRIVATION INCREASES BYGEOMETRIC PROGRESSION IN MIND WHEREIN COMPUTER LIKE
SENTENCES ARE WRITTEN ABOUT THE SITUATION. MORE THE NUMBER OF SENTENCES MORE ANGRY YOU GET AND FINALLY PATHOLOGICAL STATE ARISES.

MEASUREMENT IS BY SIMPLE ASCII CHARACTERS BYTES)

MODULE NUMBERED TWO:

G_{16} : CATEGORY ONE OF DEPRIVATION
G_{17} : CATEGORY TWO OF DEPRIVATION
G_{18} : CATEGORY THREE OF DEPRIVATION
T_{16} : CATEGORY ONE OF GRATIFICATION
T_{17} : CATEGORY TWO OF GRATIFICATION
T_{18} : CATEGORY THREE OF GRATIFICATION

SPACE TIME:

MODULE NUMBERED THREE:

G_{20} : CATEGORY ONE OF TIME
G_{21} : CATEGORY TWO OF TIME
G_{22} : CATEGORY THREE OF TIME
T_{20} : CATEGORY ONE OF SPACE (JUST THE DIVISION LIKE SILENT ZONE, CHILDRENS ZONE-DRIVE SLOWLY, ONE HEARS PEOPLE TELLING “AREA” IS, “NOT ALRIGHT”)
T_{21} : CATEGORY TWO OF SPACE
T_{22} : CATEGORY THREE OF SPACE

MASS AND ENERGY

MODULE NUMBERED FOUR:

==G_{24} : CATEGORY ONE OF ENERGY
G_{25} : CATEGORY TWO OF ENERGY
G_{26} : CATEGORY THREE OF ENERGY
T_{24} : CATEGORY ONE OF MATTER
T_{25} : CATEGORY TWO OF MATTER
$T_{26} : \text{CATEGORY THREE OF MATTER}$

**RAJAS(DYNAMISM)-TAMAS(STATICITY) SYSTEM:**

**MODULE NUMBERED FIVE:**

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CATEGORY ONE OF TAMAS( WE MEASURE HERE THE STATICITY OF PEOPLE UNLESS EXTERNALLY OR EXOGENOUSLY FORCED FOR ACTIVITY-QUANTUM OF WORK DONE)

CATEGORY TWO OF TAMAS

CATEGORY THREE OF TAMAS

$G_{28} : \text{CATEGORY ONE OF TAMAS}$

$G_{29} : \text{CATEGORY TWO OF TAMAS}$

$G_{30} : \text{CATEGORY THREE OF TAMAS}$

$T_{28} : \text{CATEGORY ONE OF RAJAS}$

$T_{29} : \text{CATEGORY TWO OF RAJAS}$

$T_{30} : \text{CATEGORY THREE OF RAJAS}$

==========================================================================

CATEGORY ONE OF GRATIFICATION PRODUCING ACTIONS AND CATEGORY TWO OF DEPRIVATION PRODUCING ACTIONS:

**MODULE NUMBERED SIX:**

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CATEGORY ONE OF DEPRIVATION PRODUCING ACTIONS(NOTED LIKE IN A BANK LEDGER BY THE QUANTITY OF DEPRIVATION WHICH IS STORED IN BYTES AND MEASURED BY ASCII)

CATEGORY TWO OF DEPRIVATION PRODUCING ACTIONS

CATEGORY THREE OF DEPRIVATION PRODUCING ACTIONS

$G_{32} : \text{CATEGORY ONE OF DEPRIVATION PRODUCING ACTIONS}$

$G_{33} : \text{CATEGORY TWO OF DEPRIVATION PRODUCING ACTIONS}$

$G_{34} : \text{CATEGORY THREE OF DEPRIVATION PRODUCING ACTIONS}$

$T_{32} : \text{CATEGORY ONE OF GRATIFICATION PRODUCING ACTIONS}$

$T_{33} : \text{CATEGORY TWO OF GRATIFICATION PRODUCING ACTIONS}$

$T_{34} : \text{CATEGORY THREE OF GRATIFICATION PRODUCING ACTIONS}$

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……………………………………………. AND SO ON TILL (N-1) AND NTH CATEGORY OF GRATIFICATION PRODUCING AND DEPRIVATION PRODUCING ACTIONS SUCH A CLASSIFICATION IS DONE BASED ON THE PEOPLE THEMSELVES WHO PERFORM IT. IN FACT EVERY ONE PERFORM GRATIFICATION DEPRIVATION PRODUCING ACTIONS AND A SEPARATE ACCOUNT IS THEREOF MAINTAINED LIKE A BANK ACCOUNT. WE SHALL NOT TALK OF NEURON DNA ATLEAST NOT AS YET.

==========================================================================
(N-1),(N-2),(N-3) AND NTH CATEGORY OF GRATIFICATION PRODUCING AND DEPRIVATION PRODUCING ACTIONS: ALMOST ALL PEOPLE PERFORM GRATIFICATION PRODUCING AND DEPRIVATION ACTIONS AND WE WRITE A GENERAL THEORY OF ALL THOSE ACTIONS IN THE FORM OF GENERAL LEDGER IN A BANK:

MODULE BEARING NUMBER 7(SEVEN)

==========================================================================

\(G_{(N-1)}\) : (N-1)TH CATEGORY ONE OF GRATIFICATION PRODUCING ACTIONS

\(G_{(N-2)}\) : CATEGORY BEARING NUMBER (N-2) OF GRATIFICATION PRODUCING ACTIONS

\(G_{(N)}\) : CATEGORY BEARING NUMBER (N) OF GRATIFICATION PRODUCING ACTIONS

\(T_{(N-1)}\) : CATEGORY (N-1) OF DEPRIVATION PRODUCING ACTIONS

\(T_{(N-2)}\) : CATEGORY BEARING (N-2) OF DEPRIVATION BEARING ACTIONS

\(T_{(N)}\) : CATEGORY BEARING N OF DEPRIVATION ACTIONS

==========================================================================

=====:

\(a_{13}^{(1)},a_{14}^{(1)},a_{15}^{(1)},b_{13}^{(1)},b_{14}^{(1)},b_{15}^{(1)},a_{16}^{(2)},a_{17}^{(2)},a_{18}^{(2)}\)

\(b_{19}^{(2)},b_{20}^{(2)},b_{21}^{(2)},a_{20}^{(3)},a_{21}^{(3)},a_{22}^{(3)},b_{22}^{(3)},b_{23}^{(3)},b_{24}^{(3)}\)

\(a_{24}^{(4)},a_{25}^{(4)},a_{26}^{(4)},b_{24}^{(4)},b_{25}^{(4)},b_{26}^{(4)},b_{27}^{(5)},b_{28}^{(5)},b_{29}^{(5)},b_{30}^{(5)}\)

\(a_{28}^{(5)},a_{29}^{(5)},a_{30}^{(5)},a_{32}^{(6)},a_{33}^{(6)},a_{34}^{(6)},b_{32}^{(6)},b_{33}^{(6)},b_{34}^{(6)}\)

are Accentuation coefficients

\(a_{13}^{(1)},a_{14}^{(1)},a_{15}^{(1)},b_{13}^{(1)},b_{14}^{(1)},b_{15}^{(1)},a_{16}^{(2)},a_{17}^{(2)},a_{18}^{(2)}\)

\(b_{19}^{(2)},b_{20}^{(2)},b_{21}^{(2)},a_{20}^{(3)},a_{21}^{(3)},a_{22}^{(3)},b_{22}^{(3)},b_{23}^{(3)},b_{24}^{(3)}\)

\(a_{24}^{(4)},a_{25}^{(4)},a_{26}^{(4)},b_{24}^{(4)},b_{25}^{(4)},b_{26}^{(4)},b_{27}^{(5)},b_{28}^{(5)},b_{29}^{(5)},b_{30}^{(5)}\)

\(a_{28}^{(5)},a_{29}^{(5)},a_{30}^{(5)},a_{32}^{(6)},a_{33}^{(6)},a_{34}^{(6)},b_{32}^{(6)},b_{33}^{(6)},b_{34}^{(6)}\)

are Dissipation coefficients

BRAHMAN AND ANTIBRAHMAN:

MODULE NUMBERED ONE

45
The differential system of this model is now (Module Numbered one)

\[ \frac{dG_{13}}{dt} = (a_{13})^{(1)} G_{14} - \left[ (a'_{13})^{(1)} + (a''_{13})^{(1)} (T_{14}, t) \right] G_{13} \]

\[ \frac{dG_{14}}{dt} = (a_{14})^{(1)} G_{13} - \left[ (a'_{14})^{(1)} + (a''_{14})^{(1)} (T_{14}, t) \right] G_{14} \]

\[ \frac{dG_{15}}{dt} = (a_{15})^{(1)} G_{14} - \left[ (a'_{15})^{(1)} + (a''_{15})^{(1)} (T_{14}, t) \right] G_{15} \]

\[ \frac{dT_{13}}{dt} = (b_{13})^{(1)} T_{14} - \left[ (b'_{13})^{(1)} - (b''_{13})^{(1)} (G, t) \right] T_{13} \]

\[ \frac{dT_{14}}{dt} = (b_{14})^{(1)} T_{13} - \left[ (b'_{14})^{(1)} - (b''_{14})^{(1)} (G, t) \right] T_{14} \]

\[ \frac{dT_{15}}{dt} = (b_{15})^{(1)} T_{14} - \left[ (b'_{15})^{(1)} - (b''_{15})^{(1)} (G, t) \right] T_{15} \]

\[ + (a''_{13})^{(1)} (T_{14}, t) = \text{First augmentation factor} \]

\[ - (b''_{13})^{(1)} (G, t) = \text{First detritions factor} \]

---

**GRATIFICATION AND DEPRIVATION:** (WE MAKE AN EXPLICIT ASSUMPTION THAT GRATIFICATION INCREASES BY ARITHMETIC PROGRESSION AND DEPRIVATION INCREASES BY GEOMETRIC PROGRESSION IN MIND WHEREIN COMPUTER LIKE SENTENCES ARE WRITTEN ABOUT THE SITUATION. MORE THE NUMBER OF SENTENCES MORE ANGREY YOU GET AND FINALLY PATHOLOGICAL STATE ARISES: MEASUREMENT IS BY SIMPLE ASCII CHARACTERS BYTES)

---

**MODULE NUMBERED TWO:**

The differential system of this model is now (Module numbered two)

\[ \frac{dG_{16}}{dt} = (a_{16})^{(2)} G_{17} - \left[ (a'_{16})^{(2)} + (a''_{16})^{(2)} (T_{17}, t) \right] G_{16} \]

\[ \frac{dG_{17}}{dt} = (a_{17})^{(2)} G_{16} - \left[ (a'_{17})^{(2)} + (a''_{17})^{(2)} (T_{17}, t) \right] G_{17} \]

\[ \frac{dG_{18}}{dt} = (a_{18})^{(2)} G_{17} - \left[ (a'_{18})^{(2)} + (a''_{18})^{(2)} (T_{17}, t) \right] G_{18} \]

\[ \frac{dT_{16}}{dt} = (b_{16})^{(2)} T_{17} - \left[ (b'_{16})^{(2)} - (b''_{16})^{(2)} ((G_{19}), t) \right] T_{16} \]

\[ \frac{dT_{17}}{dt} = (b_{17})^{(2)} T_{16} - \left[ (b'_{17})^{(2)} - (b''_{17})^{(2)} ((G_{19}), t) \right] T_{17} \]

\[ \frac{dT_{18}}{dt} = (b_{18})^{(2)} T_{17} - \left[ (b'_{18})^{(2)} - (b''_{18})^{(2)} ((G_{19}), t) \right] T_{18} \]

\[ + (a''_{17})^{(2)} (T_{17}, t) = \text{First augmentation factor} \]

\[ - (b''_{17})^{(2)} ((G_{19}), t) = \text{First detritions factor} \]
SPACE TIME:

MODULE NUMBERED THREE

The differential system of this model is now (Module numbered three)

\[
\frac{dG_{20}}{dt} = (a_{20}')^{(3)} G_{21} - \left[ (a_{21}')^{(3)} + (a_{20}')^{(3)} (T_{21}, t) \right] G_{20}
\]

\[
\frac{dG_{21}}{dt} = (a_{21}')^{(3)} G_{20} - \left[ (a_{21}')^{(3)} + (a_{21}')^{(3)} (T_{21}, t) \right] G_{21}
\]

\[
\frac{dG_{22}}{dt} = (a_{22}')^{(3)} G_{21} - \left[ (a_{22}')^{(3)} + (a_{22}')^{(3)} (T_{21}, t) \right] G_{22}
\]

\[
\frac{dT_{20}}{dt} = (b_{20}')^{(3)} T_{21} - \left[ (b_{20}')^{(3)} - (b_{20}')^{(3)} (G_{23}, t) \right] T_{20}
\]

\[
\frac{dT_{21}}{dt} = (b_{21}')^{(3)} T_{20} - \left[ (b_{21}')^{(3)} - (b_{21}')^{(3)} (G_{23}, t) \right] T_{21}
\]

\[
\frac{dT_{22}}{dt} = (b_{22}')^{(3)} T_{21} - \left[ (b_{22}')^{(3)} - (b_{22}')^{(3)} (G_{23}, t) \right] T_{22}
\]

\[+(a_{20}')^{(3)} (T_{21}, t) = \text{First augmentation factor}
\]

\[-(b_{20}')^{(3)} (G_{23}, t) = \text{First detritions factor}
\]

MASS AND ENERY

: MODULE NUMBERED FOUR

The differential system of this model is now (Module numbered Four)

\[
\frac{dG_{24}}{dt} = (a_{24}')^{(4)} G_{25} - \left[ (a_{24}')^{(4)} + (a_{24}')^{(4)} (T_{25}, t) \right] G_{24}
\]

\[
\frac{dG_{25}}{dt} = (a_{25}')^{(4)} G_{24} - \left[ (a_{25}')^{(4)} + (a_{25}')^{(4)} (T_{25}, t) \right] G_{25}
\]

\[
\frac{dG_{26}}{dt} = (a_{26}')^{(4)} G_{25} - \left[ (a_{26}')^{(4)} + (a_{26}')^{(4)} (T_{25}, t) \right] G_{26}
\]

\[
\frac{dT_{24}}{dt} = (b_{24}')^{(4)} T_{25} - \left[ (b_{24}')^{(4)} - (b_{24}')^{(4)} ((G_{27}), t) \right] T_{24}
\]

\[
\frac{dT_{25}}{dt} = (b_{25}')^{(4)} T_{24} - \left[ (b_{25}')^{(4)} - (b_{25}')^{(4)} ((G_{27}), t) \right] T_{25}
\]

\[
\frac{dT_{26}}{dt} = (b_{26}')^{(4)} T_{25} - \left[ (b_{26}')^{(4)} - (b_{26}')^{(4)} ((G_{27}), t) \right] T_{26}
\]

\[+(a_{24}')^{(4)} (T_{25}, t) = \text{First augmentation factor}
\]

\[-(b_{24}')^{(4)} ((G_{27}), t) = \text{First detritions factor}
\]
MODULE NUMBERED FIVE

The differential system of this model is now (Module number five)

\[
\frac{d\hat{G}_{28}}{dt} = (a_{28})^{(5)} \hat{G}_{28} - \left[ (a'_{28})^{(5)} + (a''_{28})^{(5)} (T_{29}, t) \right] G_{28} \tag{36}
\]

\[
\frac{d\hat{G}_{29}}{dt} = (a_{29})^{(5)} G_{28} - \left[ (a'_{29})^{(5)} + (a''_{29})^{(5)} (T_{29}, t) \right] G_{29} \tag{37}
\]

\[
\frac{d\hat{G}_{30}}{dt} = (a_{30})^{(5)} G_{29} - \left[ (a'_{30})^{(5)} + (a''_{30})^{(5)} (T_{29}, t) \right] G_{30} \tag{38}
\]

\[
\frac{d\hat{T}_{28}}{dt} = (b_{28})^{(5)} \hat{T}_{29} - \left[ (b'_{28})^{(5)} - (b''_{28})^{(5)} (G_{31}, t) \right] T_{28} \tag{39}
\]

\[
\frac{d\hat{T}_{29}}{dt} = (b_{29})^{(5)} \hat{T}_{28} - \left[ (b'_{29})^{(5)} - (b''_{29})^{(5)} (G_{31}, t) \right] T_{29} \tag{40}
\]

\[
\frac{d\hat{T}_{30}}{dt} = (b_{30})^{(5)} \hat{T}_{29} - \left[ (b'_{30})^{(5)} - (b''_{30})^{(5)} (G_{31}, t) \right] T_{30} \tag{41}
\]

\[
+ (a''_{29})^{(5)} (T_{29}, t) = \text{First augmentation factor} \tag{42}
\]

\[- (b''_{28})^{(5)} (G_{31}, t) = \text{First detritation factor} \tag{43}\]

CATEGORY ONE OF GRATIFICATION PRODUCING ACTIONS AND CATEGORY TWO OF DEPRIVATION PRODUCING ACTIONS:

MODULE NUMBERED SIX:

The differential system of this model is now (Module numbered Six)

\[
\frac{d\hat{G}_{32}}{dt} = (a_{32})^{(6)} \hat{G}_{33} - \left[ (a'_{32})^{(6)} + (a''_{32})^{(6)} (T_{33}, t) \right] G_{32} \tag{46}
\]

\[
\frac{d\hat{G}_{33}}{dt} = (a_{33})^{(6)} G_{32} - \left[ (a'_{33})^{(6)} + (a''_{33})^{(6)} (T_{33}, t) \right] G_{33} \tag{47}
\]

\[
\frac{d\hat{G}_{34}}{dt} = (a_{34})^{(6)} \hat{G}_{33} - \left[ (a'_{34})^{(6)} + (a''_{34})^{(6)} (T_{33}, t) \right] G_{34} \tag{48}
\]

\[
\frac{d\hat{T}_{32}}{dt} = (b_{32})^{(6)} \hat{T}_{33} - \left[ (b'_{32})^{(6)} - (b''_{32})^{(6)} (G_{35}, t) \right] T_{32} \tag{49}
\]

\[
\frac{d\hat{T}_{33}}{dt} = (b_{33})^{(6)} T_{32} - \left[ (b'_{33})^{(6)} - (b''_{33})^{(6)} (G_{35}, t) \right] T_{33} \tag{50}
\]

\[
\frac{d\hat{T}_{34}}{dt} = (b_{34})^{(6)} T_{33} - \left[ (b'_{34})^{(6)} - (b''_{34})^{(6)} (G_{35}, t) \right] T_{34} \tag{51}
\]
The differential system of this model is now (SEVENTH MODULE)

\[
\frac{dG_{36}}{dt} = \begin{pmatrix} (a_{36}^{(1)})^{(1)(T_{14}, t)} + (a_{36}^{(2)})^{(2)(T_{14}, t)} + (a_{36}^{(3)})^{(3)(T_{21}, t)} \\ + (a_{24}^{(1)(4)(4)(4)(T_{25}, t)} + (a_{28}^{(5)(5)(5)(5)(T_{29}, t)} + (a_{23}^{(3)(5)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} G_{14}
\]

\[
\frac{dG_{37}}{dt} = \begin{pmatrix} (a_{37}^{(1)})^{(1)(T_{14}, t)} + (a_{37}^{(2)})^{(2)(T_{14}, t)} + (a_{37}^{(3)})^{(3)(T_{21}, t)} \\ + (a_{24}^{(1)(4)(4)(4)(T_{25}, t)} + (a_{28}^{(5)(5)(5)(5)(T_{29}, t)} + (a_{23}^{(3)(5)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} G_{13}
\]

\[
\frac{dG_{38}}{dt} = \begin{pmatrix} (a_{38}^{(1)})^{(1)(T_{14}, t)} + (a_{38}^{(2)})^{(2)(T_{14}, t)} + (a_{38}^{(3)})^{(3)(T_{21}, t)} \\ + (a_{24}^{(1)(4)(4)(4)(T_{25}, t)} + (a_{28}^{(5)(5)(5)(5)(T_{29}, t)} + (a_{23}^{(3)(5)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} G_{13}
\]

\[
\frac{dT_{36}}{dt} = \begin{pmatrix} (b_{36}^{(1)})^{(1)(T_{14}, t)} + (b_{36}^{(2)})^{(2)(T_{14}, t)} + (b_{36}^{(3)})^{(3)(T_{21}, t)} \\ + (b_{36}^{(4)(4)(4)(4)(T_{25}, t)} + (b_{36}^{(5)(5)(5)(5)(T_{29}, t)} + (b_{36}^{(6)(6)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} T_{36}
\]

\[
\frac{dT_{37}}{dt} = \begin{pmatrix} (b_{37}^{(1)})^{(1)(T_{14}, t)} + (b_{37}^{(2)})^{(2)(T_{14}, t)} + (b_{37}^{(3)})^{(3)(T_{21}, t)} \\ + (b_{37}^{(4)(4)(4)(4)(T_{25}, t)} + (b_{37}^{(5)(5)(5)(5)(T_{29}, t)} + (b_{37}^{(6)(6)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} T_{37}
\]

\[
\frac{dT_{38}}{dt} = \begin{pmatrix} (b_{38}^{(1)})^{(1)(T_{14}, t)} + (b_{38}^{(2)})^{(2)(T_{14}, t)} + (b_{38}^{(3)})^{(3)(T_{21}, t)} \\ + (b_{38}^{(4)(4)(4)(4)(T_{25}, t)} + (b_{38}^{(5)(5)(5)(5)(T_{29}, t)} + (b_{38}^{(6)(6)(6)(6)(6)(T_{33}, t)}) \end{pmatrix} T_{38}
\]
\[
\frac{dG_{14}}{dt} = (a_{13})^{(1)}G_{14} - \left[ (a_{13})^{(1)}(T_{14}, t) + (a_{14})^{(2,2)}(T_{16}, t) + (a_{15})^{(3,3)}(T_{17}, t) \right] G_{15}
\]

Where \((a_{13})^{(1)}(T_{14}, t)\), \((a_{14})^{(2,2)}(T_{16}, t)\), and \((a_{15})^{(3,3)}(T_{17}, t)\) are first augmentation coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(1)}T_{14} - \left[ (b_{13})^{(1)}(T_{14}, t) - (b_{16})^{(1)}(G_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(1)}T_{13} - \left[ (b_{14})^{(1)}(T_{14}, t) - (b_{16})^{(2,2)}(G_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(1)}T_{14} - \left[ (b_{15})^{(1)}(T_{14}, t) - (b_{18})^{(2,2)}(G_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(1)}(G_{14}, t)\), \(-(b_{15})^{(1)}(G_{14}, t)\), and \(-(b_{16})^{(1)}(G_{14}, t)\) are first detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(2,2)}(G_{14}, t) - \left[ (b_{13})^{(2,2)}(T_{14}, t) - (b_{16})^{(2,2)}(G_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(2,2)}(G_{14}, t) - \left[ (b_{14})^{(2,2)}(T_{14}, t) - (b_{16})^{(3,3)}(G_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(3,3)}(G_{14}, t) - \left[ (b_{15})^{(3,3)}(T_{14}, t) - (b_{16})^{(3,3)}(G_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(2,2)}(G_{14}, t)\), \(-(b_{15})^{(2,2)}(G_{14}, t)\), and \(-(b_{16})^{(2,2)}(G_{14}, t)\) are second detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(3,3)}(G_{14}, t) - \left[ (b_{13})^{(3,3)}(T_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(3,3)}(G_{14}, t) - \left[ (b_{14})^{(3,3)}(T_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(3,3)}(G_{14}, t) - \left[ (b_{15})^{(3,3)}(T_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(3,3)}(G_{14}, t)\), \(-(b_{15})^{(3,3)}(G_{14}, t)\), and \(-(b_{16})^{(3,3)}(G_{14}, t)\) are third detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(4,4,4)}(G_{14}, t) - \left[ (b_{13})^{(4,4,4)}(T_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(4,4,4)}(G_{14}, t) - \left[ (b_{14})^{(4,4,4)}(T_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(4,4,4)}(G_{14}, t) - \left[ (b_{15})^{(4,4,4)}(T_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(4,4,4)}(G_{14}, t)\), \(-(b_{14})^{(4,4,4)}(G_{14}, t)\), and \(-(b_{15})^{(4,4,4)}(G_{14}, t)\) are fourth detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(5,5,5)}(G_{14}, t) - \left[ (b_{13})^{(5,5,5)}(T_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(5,5,5)}(G_{14}, t) - \left[ (b_{14})^{(5,5,5)}(T_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(5,5,5)}(G_{14}, t) - \left[ (b_{15})^{(5,5,5)}(T_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(5,5,5)}(G_{14}, t)\), \(-(b_{14})^{(5,5,5)}(G_{14}, t)\), and \(-(b_{15})^{(5,5,5)}(G_{14}, t)\) are fifth detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(6,6,6)}(G_{14}, t) - \left[ (b_{13})^{(6,6,6)}(T_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(6,6,6)}(G_{14}, t) - \left[ (b_{14})^{(6,6,6)}(T_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(6,6,6)}(G_{14}, t) - \left[ (b_{15})^{(6,6,6)}(T_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(6,6,6)}(G_{14}, t)\), \(-(b_{14})^{(6,6,6)}(G_{14}, t)\), and \(-(b_{15})^{(6,6,6)}(G_{14}, t)\) are sixth detritions coefficients for category 1, 2, and 3.

\[
\frac{dT_{13}}{dt} = (b_{13})^{(7)}(G_{14}, t) - \left[ (b_{13})^{(7)}(T_{14}, t) \right] T_{13}
\]

\[
\frac{dT_{14}}{dt} = (b_{14})^{(7)}(G_{14}, t) - \left[ (b_{14})^{(7)}(T_{14}, t) \right] T_{14}
\]

\[
\frac{dT_{15}}{dt} = (b_{15})^{(7)}(G_{14}, t) - \left[ (b_{15})^{(7)}(T_{14}, t) \right] T_{15}
\]

Where \(-(b_{13})^{(7)}(G_{14}, t)\), \(-(b_{14})^{(7)}(G_{14}, t)\), and \(-(b_{15})^{(7)}(G_{14}, t)\) are seventh detritions coefficients.
COEFFICIENTS

\[
\frac{dR_{15}}{dt} = (b_{15})^{(1)}T_{14} - \begin{bmatrix}
(b_{15}^{(1)})^{(1)}(G, t) & -(b_{15}^{(1)})^{(2,2)}(G_{19}, t) & -(b_{15}^{(1)})^{(3,3)}(G_{23}, t) \\
-(b_{15}^{(1)})^{(4,4,4,4)}(G_{25}, t) & -(b_{15}^{(1)})^{(5,5,5,5)}(G_{31}, t) & -(b_{15}^{(1)})^{(6,6,6,6)}(G_{35}, t)
\end{bmatrix} \cdot T_{15}
\]

Where \(-(b_{15}^{(1)})^{(1)}(G, t)\), \( -(b_{15}^{(1)})^{(2,2)}(G_{19}, t)\), \( -(b_{15}^{(1)})^{(3,3)}(G_{23}, t)\) are first detrition coefficients for category 1, 2 and 3.

\( -(b_{15}^{(1)})^{(2,2)}(G_{19}, t)\), \( -(b_{15}^{(1)})^{(3,3)}(G_{23}, t)\) are second detritus coefficients for category 1, 2 and 3.

\( -(b_{15}^{(1)})^{(3,3)}(G_{23}, t)\), \( -(b_{15}^{(1)})^{(4,4,4,4)}(G_{25}, t)\) are third detritus coefficients for category 1, 2 and 3.

\( -(b_{15}^{(1)})^{(4,4,4,4)}(G_{25}, t)\), \( -(b_{15}^{(1)})^{(5,5,5,5)}(G_{31}, t)\), \( -(b_{15}^{(1)})^{(6,6,6,6)}(G_{35}, t)\) are fourth detritus coefficients for category 1, 2 and 3.

\( -(b_{15}^{(1)})^{(5,5,5,5)}(G_{31}, t)\), \( -(b_{15}^{(1)})^{(6,6,6,6)}(G_{35}, t)\) are fifth detritus coefficients for category 1, 2 and 3.

\( -(b_{15}^{(1)})^{(6,6,6,6)}(G_{35}, t)\), \( -(b_{15}^{(1)})^{(7,7,7)}(T_{37}, t)\) are sixth detritus coefficients for category 1, 2 and 3.

SECOND MODULE CONCATENATION

\[
\frac{dG_{16}}{dt} = (a_{16})^{(2)}G_{17} - \begin{bmatrix}
(a_{16}^{(2)})^{(2)}(T_{17}, t) & +(a_{16}^{(2)})^{(2)}(T_{14}, t) & +(a_{16}^{(2)})^{(3,3)}(T_{21}, t) \\
+(a_{26}^{(4,4,4,4)}(T_{25}, t) & +(a_{26}^{(5,5,5,5)}(T_{29}, t) & +(a_{26}^{(6,6,6,6)}(T_{33}, t)
\end{bmatrix} \cdot G_{16}
\]

Where \(+(a_{16}^{(2)})^{(2)}(T_{17}, t)\), \( +(a_{16}^{(2)})^{(2)}(T_{14}, t)\), \( +(a_{16}^{(2)})^{(3,3)}(T_{21}, t)\) are first augmentation coefficients for category 1, 2 and 3.

\( +(a_{26}^{(4,4,4,4)}(T_{25}, t)\), \( +(a_{26}^{(5,5,5,5)}(T_{29}, t)\), \( +(a_{26}^{(6,6,6,6)}(T_{33}, t)\) are second augmentation coefficients for category 1, 2 and 3.

\( +(a_{36}^{(5,5,5,5)}(T_{25}, t)\), \( +(a_{36}^{(5,5,5,5)}(T_{29}, t)\), \( +(a_{36}^{(6,6,6,6)}(T_{33}, t)\) are third augmentation coefficients for category 1, 2 and 3.

\( +(a_{46}^{(4,4,4,4)}(T_{25}, t)\), \( +(a_{46}^{(5,5,5,5)}(T_{29}, t)\), \( +(a_{46}^{(6,6,6,6)}(T_{33}, t)\) are fourth augmentation coefficients for category 1, 2 and 3.

\( +(a_{56}^{(5,5,5,5)}(T_{25}, t)\), \( +(a_{56}^{(5,5,5,5)}(T_{29}, t)\), \( +(a_{56}^{(6,6,6,6)}(T_{33}, t)\) are fifth augmentation coefficients for category 1, 2 and 3.

\( +(a_{66}^{(4,4,4,4)}(T_{25}, t)\), \( +(a_{66}^{(5,5,5,5)}(T_{29}, t)\), \( +(a_{66}^{(6,6,6,6)}(T_{33}, t)\) are sixth augmentation coefficients for category 1, 2 and 3.

\( +(a_{76}^{(7,7,7)}(T_{37}, t)\), \( +(a_{76}^{(7,7,7)}(T_{37}, t)\), \( +(a_{76}^{(7,7,7)}(T_{37}, t)\) are seventh augmentation coefficients for category 1, 2 and 3.
The variables $dT_{16}/dt$, $dT_{17}/dt$, and $dT_{18}/dt$ are defined as follows:

$$\frac{dT_{16}}{dt} = (b_{16})^{(2)}T_{16} - \left[ \begin{array}{c} (b_{16}^{t})^{(2)} + (b_{16}^{t})^{(2)}G_{19}, t \\ -(b_{16}^{t})^{(1,1)}(G_{10}, t) \\ -(b_{16}^{t})^{(3,3,3)}(G_{23}, t) \\ -(b_{16}^{t})^{(4,4,4,4)}(G_{25}, t) \\ -(b_{16}^{t})^{(5,5,5,5,5)}(G_{31}, t) \\ -(b_{16}^{t})^{(6,6,6,6,6)}(G_{35}, t) \\ -(b_{16}^{t})^{(7,7,7)}(G_{39}, t) \end{array} \right]$$

$$\frac{dT_{17}}{dt} = (b_{17})^{(2)}T_{17} - \left[ \begin{array}{c} (b_{17}^{t})^{(2)} + (b_{17}^{t})^{(2)}G_{19}, t \\ -(b_{17}^{t})^{(1,1)}(G_{10}, t) \\ -(b_{17}^{t})^{(3,3,3)}(G_{23}, t) \\ -(b_{17}^{t})^{(4,4,4,4)}(G_{25}, t) \\ -(b_{17}^{t})^{(5,5,5,5,5)}(G_{31}, t) \\ -(b_{17}^{t})^{(6,6,6,6,6)}(G_{35}, t) \\ -(b_{17}^{t})^{(7,7,7)}(G_{39}, t) \end{array} \right]$$

$$\frac{dT_{18}}{dt} = (b_{18})^{(2)}T_{18} - \left[ \begin{array}{c} (b_{18}^{t})^{(2)} + (b_{18}^{t})^{(2)}G_{19}, t \\ -(b_{18}^{t})^{(1,1)}(G_{10}, t) \\ -(b_{18}^{t})^{(3,3,3)}(G_{23}, t) \\ -(b_{18}^{t})^{(4,4,4,4)}(G_{25}, t) \\ -(b_{18}^{t})^{(5,5,5,5,5)}(G_{31}, t) \\ -(b_{18}^{t})^{(6,6,6,6,6)}(G_{35}, t) \\ -(b_{18}^{t})^{(7,7,7)}(G_{39}, t) \end{array} \right]$$

where $-(b_{16}^{t})^{(2)}(G_{19}, t)$, $-(b_{16}^{t})^{(3,3,3)}(G_{23}, t)$, $-(b_{16}^{t})^{(4,4,4,4)}(G_{25}, t)$, and $-(b_{16}^{t})^{(7,7,7)}(G_{39}, t)$ are first, second, third, and fourth deterioration coefficients for category 1, 2, and 3, respectively.

$-(b_{17}^{t})^{(2)}(G_{19}, t)$, $-(b_{17}^{t})^{(3,3,3)}(G_{23}, t)$, $-(b_{17}^{t})^{(4,4,4,4)}(G_{25}, t)$, and $-(b_{17}^{t})^{(7,7,7)}(G_{39}, t)$ are also first, second, third, and fourth deterioration coefficients for category 1, 2, and 3, respectively.

$-(b_{18}^{t})^{(2)}(G_{19}, t)$, $-(b_{18}^{t})^{(3,3,3)}(G_{23}, t)$, $-(b_{18}^{t})^{(4,4,4,4)}(G_{25}, t)$, and $-(b_{18}^{t})^{(7,7,7)}(G_{39}, t)$ are first, second, third, and fourth deterioration coefficients for category 1, 2, and 3, respectively.

Finally, $-(b_{36}^{t})^{(7,7)}(G_{39}, t)$, $-(b_{36}^{t})^{(7,7)}(G_{39}, t)$, and $-(b_{36}^{t})^{(7,7)}(G_{39}, t)$ are fifth, sixth, and seventh deterioration coefficients for category 1, 2, and 3, respectively.

**THIRD MODULE CONCATENATION**

$$\frac{dG_{20}}{dt} = \left[ \begin{array}{c} (a_{20}^{t})^{(3)}G_{20} - \left[ \begin{array}{c} (a_{20}^{t})^{(3)} + (a_{20}^{t})^{(3)}T_{21}, t \\ +(a_{20}^{t})^{(4,4,4,4)}(T_{25}, t) \\ +(a_{20}^{t})^{(5,5,5,5,5)}(T_{29}, t) \\ +(a_{20}^{t})^{(6,6,6,6,6)}(T_{33}, t) \\ +(a_{20}^{t})^{(7,7,7)}(T_{37}, t) \end{array} \right] \\ \end{array} \right]$$

$$\frac{dG_{21}}{dt} = \left[ \begin{array}{c} (a_{21}^{t})^{(3)}G_{21} - \left[ \begin{array}{c} (a_{21}^{t})^{(3)} + (a_{21}^{t})^{(3)}(T_{23}, t) + (a_{21}^{t})^{(2,2,2)}(T_{17}, t) + (a_{21}^{t})^{(1,1,1)}(T_{14}, t) \\ +(a_{21}^{t})^{(4,4,4,4)}(T_{25}, t) + (a_{21}^{t})^{(5,5,5,5,5)}(T_{29}, t) + (a_{21}^{t})^{(6,6,6,6,6)}(T_{33}, t) \\ +(a_{21}^{t})^{(7,7,7)}(T_{37}, t) \end{array} \right] \\ \end{array} \right]$$

$$\frac{dG_{22}}{dt} = \left[ \begin{array}{c} (a_{22}^{t})^{(3)}G_{22} - \left[ \begin{array}{c} (a_{22}^{t})^{(3)} + (a_{22}^{t})^{(3)}(T_{23}, t) + (a_{22}^{t})^{(2,2,2)}(T_{17}, t) + (a_{22}^{t})^{(1,1,1)}(T_{14}, t) \\ +(a_{22}^{t})^{(4,4,4,4)}(T_{25}, t) + (a_{22}^{t})^{(5,5,5,5,5)}(T_{29}, t) + (a_{22}^{t})^{(6,6,6,6,6)}(T_{33}, t) \\ +(a_{22}^{t})^{(7,7,7)}(T_{37}, t) \end{array} \right] \\ \end{array} \right]$$
The document contains a complex mathematical derivation involving coefficients for different categories. The text is typified with equations that require careful reading and understanding, particularly for someone unfamiliar with the context or the field of study.
FOURTH MODULE CONCATENATION:

\[
\frac{dG_{24}}{dt} = (a_{24})^{(4)} G_{25} - \left[ (a_{24})^{(4)} (T_{25}, t) + (a_{28})^{(5,5)} (T_{29}, t) + (a_{32})^{(6,6)} (T_{33}, t) \right]
\]

\[
\frac{dG_{25}}{dt} = (a_{25})^{(4)} G_{24} - \left[ (a_{25})^{(4)} (T_{25}, t) + (a_{29})^{(5,5)} (T_{29}, t) + (a_{33})^{(6,6)} (T_{33}, t) \right]
\]

\[
\frac{dG_{26}}{dt} = (a_{26})^{(4)} G_{25} - \left[ (a_{26})^{(4)} (T_{25}, t) + (a_{30})^{(5,5)} (T_{29}, t) + (a_{34})^{(6,6)} (T_{33}, t) \right]
\]

Where \((a_{24})^{(4)} (T_{25}, t)\), \((a_{28})^{(5,5)} (T_{29}, t)\), \((a_{32})^{(6,6)} (T_{33}, t)\) are first augmentation coefficients for category 1, 2 and 3

\((a_{25})^{(4)} (T_{25}, t)\), \((a_{29})^{(5,5)} (T_{29}, t)\), \((a_{33})^{(6,6)} (T_{33}, t)\) are second augmentation coefficient for category 1, 2 and 3

\((a_{26})^{(4)} (T_{25}, t)\), \((a_{30})^{(5,5)} (T_{29}, t)\), \((a_{34})^{(6,6)} (T_{33}, t)\) are third augmentation coefficient for category 1, 2 and 3

\((a_{24})^{(1,1,1,1)} (T_{14}, t)\), \((a_{25})^{(1,1,1,1)} (T_{14}, t)\), \((a_{26})^{(1,1,1,1)} (T_{14}, t)\) are fourth augmentation coefficients for category 1, 2, and 3

\((a_{28})^{(2,2,2,2)} (T_{17}, t)\), \((a_{29})^{(2,2,2,2)} (T_{17}, t)\), \((a_{32})^{(2,2,2,2)} (T_{17}, t)\) are fifth augmentation coefficients for category 1, 2, and 3

\((a_{27})^{(3,3,3,3)} (T_{21}, t)\), \((a_{28})^{(3,3,3,3)} (T_{21}, t)\), \((a_{31})^{(3,3,3,3)} (T_{21}, t)\) are sixth augmentation coefficients for category 1, 2, and 3

\((a_{30})^{(7,7,7,7)} (T_{37}, t)\), \((a_{31})^{(7,7,7,7)} (T_{37}, t)\), \((a_{32})^{(7,7,7,7)} (T_{37}, t)\) are seventh augmentation coefficients

\[
\frac{dT_{24}}{dt} = (b_{24})^{(4)} T_{25} - \left[ (b_{24})^{(4)} (G_{27}, t) + (b_{28})^{(5,5)} (G_{31}, t) + (b_{32})^{(6,6)} (G_{35}, t) \right]
\]

\[
\frac{dT_{25}}{dt} = (b_{25})^{(4)} T_{24} - \left[ (b_{25})^{(4)} (G_{27}, t) + (b_{29})^{(5,5)} (G_{31}, t) + (b_{33})^{(6,6)} (G_{35}, t) \right]
\]
\[
\frac{dT_{26}}{dt} = (b_{26})^{(4)} T_{25} - \begin{pmatrix}
(b_{26})^{(4)} - (b_{26})^{(4)}(G_{27}, t) & - (b_{26})^{(5,5)}(G_{27}, t) & - (b_{26})^{(6,6)}(G_{27}, t) \\
(b_{26})^{(1,1,1,1)}(G, t) & - (b_{26})^{(2,2,2,2)}(G_{19}, t) & - (b_{26})^{(3,3,3,3)}(G_{29}, t) \\
(b_{26})^{(7,7,7,7)}(G_{39}, t) & & 
\end{pmatrix} T_{26}
\]

Where \(- (b_{26})^{(4)}(G_{27}, t)\), \(- (b_{26})^{(4)}(G_{27}, t)\), and \(- (b_{26})^{(4)}(G_{27}, t)\) are first detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(5,5)}(G_{31}, t)\), \(- (b_{26})^{(5,5)}(G_{31}, t)\), and \(- (b_{26})^{(5,5)}(G_{31}, t)\) are second detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(6,6)}(G_{35}, t)\), \(- (b_{26})^{(6,6)}(G_{35}, t)\), and \(- (b_{26})^{(6,6)}(G_{35}, t)\) are third detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(1,1,1,1)}(G, t)\), \(- (b_{26})^{(1,1,1,1)}(G, t)\), and \(- (b_{26})^{(1,1,1,1)}(G, t)\) are fourth detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(2,2,2,2)}(G_{19}, t)\), \(- (b_{26})^{(2,2,2,2)}(G_{19}, t)\), and \(- (b_{26})^{(2,2,2,2)}(G_{19}, t)\) are fifth detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(3,3,3,3)}(G_{23}, t)\), \(- (b_{26})^{(3,3,3,3)}(G_{23}, t)\), and \(- (b_{26})^{(3,3,3,3)}(G_{23}, t)\) are sixth detription coefficients for category 1, 2, and 3
\(- (b_{26})^{(7,7,7,7)}(G_{39}, t)\) and \(- (b_{26})^{(7,7,7,7)}(G_{39}, t)\) are seventh detription coefficients

**FIFTH MODULE CONCATENATION:**

\[
\frac{dG_{28}}{dt} = (a_{28})^{(5)} G_{29} - \begin{pmatrix}
(a_{28})^{(5)} + (a_{28})^{(5)}(T_{29}, t) & + (a_{28})^{(4,4)}(T_{25}, t) & + (a_{28})^{(6,6)}(T_{33}, t) \\
+ (a_{28})^{(1,1,1,1)}(T_{14}, t) & + (a_{28})^{(2,2,2,2)}(T_{17}, t) & + (a_{28})^{(3,3,3,3)}(T_{21}, t) \\
+ (a_{28})^{(7,7,7,7)}(T_{37}, t) & & 
\end{pmatrix} G_{29}
\]

\[
\frac{dG_{29}}{dt} = (a_{29})^{(5)} G_{29} - \begin{pmatrix}
(a_{29})^{(5)} + (a_{29})^{(5)}(T_{29}, t) & + (a_{29})^{(4,4)}(T_{25}, t) & + (a_{29})^{(6,6)}(T_{33}, t) \\
+ (a_{29})^{(1,1,1,1)}(T_{14}, t) & + (a_{29})^{(2,2,2,2)}(T_{17}, t) & + (a_{29})^{(3,3,3,3)}(T_{21}, t) \\
+ (a_{29})^{(7,7,7,7)}(T_{37}, t) & & 
\end{pmatrix} G_{29}
\]

\[
\frac{dG_{30}}{dt} = (a_{30})^{(5)} G_{29} - \begin{pmatrix}
(a_{30})^{(5)} + (a_{30})^{(5)}(T_{29}, t) & + (a_{30})^{(4,4)}(T_{25}, t) & + (a_{30})^{(6,6)}(T_{33}, t) \\
+ (a_{30})^{(1,1,1,1)}(T_{14}, t) & + (a_{30})^{(2,2,2,2)}(T_{17}, t) & + (a_{30})^{(3,3,3,3)}(T_{21}, t) \\
+ (a_{30})^{(7,7,7,7)}(T_{37}, t) & & 
\end{pmatrix} G_{30}
\]

Where \(+ (a_{28})^{(5)}(T_{29}, t)\), \(+ (a_{28})^{(5)}(T_{29}, t)\), and \(+ (a_{28})^{(5)}(T_{29}, t)\) are first augmentation coefficients for category 1, 2, and 3
\(+ (a_{29})^{(4,4)}(T_{25}, t)\), \(+ (a_{29})^{(4,4)}(T_{25}, t)\), and \(+ (a_{29})^{(4,4)}(T_{25}, t)\) are second augmentation coefficients for category 1, 2, and 3
\(+ (a_{28})^{(6,6)}(T_{33}, t)\), \(+ (a_{28})^{(6,6)}(T_{33}, t)\), and \(+ (a_{28})^{(6,6)}(T_{33}, t)\) are third augmentation coefficients for category 1, 2, and 3
\(+ (a_{29})^{(1,1,1,1)}(T_{14}, t)\), \(+ (a_{29})^{(1,1,1,1)}(T_{14}, t)\), and \(+ (a_{29})^{(1,1,1,1)}(T_{14}, t)\) are fourth augmentation coefficients for category 1, 2, and 3
\(+ (a_{30})^{(2,2,2,2)}(T_{17}, t)\), \(+ (a_{30})^{(2,2,2,2)}(T_{17}, t)\), and \(+ (a_{30})^{(2,2,2,2)}(T_{17}, t)\) are fifth augmentation coefficients for category 1, 2, and 3...
\[ \begin{align*}
\frac{dT_{28}}{dt} &= (b_{28})^{(5)}T_{29} - \left[ (b_{29})^{(5)}(G_{31}, t) - (b_{24})^{(4,4)}(G_{23}, t) - (b_{22})^{(6,6,6)}(G_{35}, t) \right] T_{28} \\
\frac{dT_{29}}{dt} &= (b_{29})^{(5)}T_{29} - \left[ (b_{29})^{(5)}(G_{31}, t) - (b_{25})^{(4,4)}(G_{27}, t) - (b_{23})^{(6,6,6)}(G_{35}, t) \right] T_{29} \\
\frac{dT_{30}}{dt} &= (b_{30})^{(5)}T_{29} - \left[ (b_{30})^{(5)}(G_{31}, t) - (b_{26})^{(4,4)}(G_{27}, t) - (b_{24})^{(6,6,6)}(G_{35}, t) \right] T_{30}
\end{align*} \]

where \[ -(b_{29})^{(5)}(G_{31}, t), -(b_{29})^{(5)}(G_{31}, t), -(b_{30})^{(5)}(G_{32}, t) \] are first integration coefficients for category 1, 2, and 3.

\[ -(b_{29})^{(4,4)}(G_{23}, t), -(b_{29})^{(4,4)}(G_{23}, t), -(b_{29})^{(4,4)}(G_{23}, t) \] are second integration coefficients for category 1, 2, and 3.

\[ -(b_{22})^{(6,6,6)}(G_{35}, t), -(b_{22})^{(6,6,6)}(G_{35}, t), -(b_{22})^{(6,6,6)}(G_{35}, t) \] are third integration coefficients for category 1, 2, and 3.

\[ -(b_{14})^{(1,1,1,1)}(G_{2}, t), -(b_{14})^{(1,1,1,1)}(G_{2}, t), -(b_{14})^{(1,1,1,1)}(G_{2}, t) \] are fourth integration coefficients for category 1, 2, and 3.

\[ -(b_{22})^{(2,2,2,2,2)}(G_{19}, t), -(b_{22})^{(2,2,2,2,2)}(G_{19}, t), -(b_{22})^{(2,2,2,2,2)}(G_{19}, t) \] are fifth integration coefficients for category 1, 2, and 3.

\[ -(b_{22})^{(3,3,3,3)}(G_{23}, t), -(b_{22})^{(3,3,3,3)}(G_{23}, t), -(b_{22})^{(3,3,3,3)}(G_{23}, t) \] are sixth integration coefficients for category 1, 2, and 3.

**SIXTH MODULE CONCATENATION**

\[ \frac{dG_{32}}{dt} = (a_{32})^{(6)}G_{33} - \left[ (a_{32})^{(6)}(T_{32}, t) + (a_{32})^{(6)}(T_{33}, t) + (a_{32})^{(6)}(T_{34}, t) + (a_{32})^{(6)}(T_{35}, t) + (a_{32})^{(6)}(T_{36}, t) \right] G_{32} \]

\[ \frac{dG_{33}}{dt} = (a_{33})^{(6)}G_{32} - \left[ (a_{33})^{(6)}(T_{33}, t) + (a_{33})^{(6)}(T_{33}, t) + (a_{33})^{(6)}(T_{34}, t) + (a_{33})^{(6)}(T_{35}, t) + (a_{33})^{(6)}(T_{36}, t) \right] G_{33} \]
\[
\frac{dG_{34}}{dt} = (a_{34})^6 G_{33} - \left[\begin{array}{c}
(a_{31})^6 (T_{33}, t) + (a_{31})^6 (T_{33}, t) + (a_{30})^{(5,5,5)} (T_{29}, t) + (a_{30})^{(4,4,4)} (T_{29}, t) \\
+ (a_{21})^{(1,1,1,1,1)} (T_{14}, t) + (a_{21})^{(2,2,2,2,2)} (T_{17}, t) + (a_{22})^{(3,3,3,3,3)} (T_{21}, t) \\
+ (a_{30})^{(7,7,7,7,7,7)} (T_{37}, t)
\end{array}\right] G_{34}
\]

are first augmentation coefficients for category 1, 2 and 3

\[
+ (a_{31})^{(5,5,5)} (T_{29}, t) + (a_{31})^{(5,5,5)} (T_{29}, t) + (a_{30})^{(5,5,5)} (T_{29}, t)
\]

are second augmentation coefficients for category 1, 2 and 3

\[
+ (a_{32})^{(4,4,4)} (T_{25}, t) + (a_{32})^{(4,4,4)} (T_{25}, t) + (a_{30})^{(4,4,4)} (T_{25}, t)
\]

are third augmentation coefficients for category 1, 2 and 3

\[
+ (a_{31})^{(1,1,1,1,1)} (T_{14}, t) + (a_{21})^{(1,1,1,1,1)} (T_{14}, t) + (a_{30})^{(1,1,1,1,1)} (T_{14}, t)
\]

- are fourth augmentation coefficients

\[
+ (a_{32})^{(2,2,2,2,2)} (T_{17}, t) + (a_{32})^{(2,2,2,2,2)} (T_{17}, t) + (a_{30})^{(2,2,2,2,2)} (T_{17}, t)
\]

- fifth augmentation coefficients

\[
+ (a_{31})^{(3,3,3,3,3)} (T_{21}, t) + (a_{21})^{(3,3,3,3,3)} (T_{21}, t) + (a_{22})^{(3,3,3,3,3)} (T_{21}, t)
\]

sixth augmentation coefficients

\[
+ (a_{30})^{(7,7,7,7,7,7)} (T_{37}, t) + (a_{30})^{(7,7,7,7,7,7)} (T_{37}, t) + (a_{30})^{(7,7,7,7,7,7)} (T_{37}, t)
\]

ARE SEVENTH AUGMENTATION COEFFICIENTS

\[
\frac{dT_{32}}{dt} = (b_{32})^6 T_{33} - \left[\begin{array}{c}
(b_{32})^6 (G_{33}, t) - (b_{29})^{(5,5,5)} (G_{31}, t) - (b_{30})^{(4,4,4)} (G_{32}, t) \\
- (b_{30})^{(1,1,1,1,1)} (G_{33}, t) - (b_{29})^{(2,2,2,2,2)} (G_{31}, t) - (b_{29})^{(3,3,3,3,3)} (G_{32}, t)
\end{array}\right] T_{32}
\]

\[
\frac{dT_{33}}{dt} = (b_{33})^6 T_{32} - \left[\begin{array}{c}
(b_{33})^6 (G_{33}, t) - (b_{29})^{(5,5,5)} (G_{31}, t) - (b_{30})^{(4,4,4)} (G_{32}, t) \\
- (b_{30})^{(1,1,1,1,1)} (G_{33}, t) - (b_{29})^{(2,2,2,2,2)} (G_{31}, t) - (b_{29})^{(3,3,3,3,3)} (G_{32}, t)
\end{array}\right] T_{33}
\]

\[
\frac{dT_{34}}{dt} = (b_{34})^6 T_{33} - \left[\begin{array}{c}
(b_{34})^6 (G_{33}, t) - (b_{30})^{(5,5,5)} (G_{31}, t) - (b_{30})^{(4,4,4)} (G_{32}, t) \\
- (b_{30})^{(1,1,1,1,1)} (G_{33}, t) - (b_{30})^{(2,2,2,2,2)} (G_{31}, t) - (b_{30})^{(3,3,3,3,3)} (G_{32}, t)
\end{array}\right] T_{34}
\]

are first detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(5,5,5)} (G_{32}, t) - (b_{30})^{(5,5,5)} (G_{32}, t) - (b_{30})^{(5,5,5)} (G_{32}, t)
\]

are second detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(4,4,4)} (G_{32}, t) - (b_{30})^{(4,4,4)} (G_{32}, t) - (b_{30})^{(4,4,4)} (G_{32}, t)
\]

are third detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(1,1,1,1,1)} (G_{32}, t) - (b_{30})^{(1,1,1,1,1)} (G_{32}, t) - (b_{30})^{(1,1,1,1,1)} (G_{32}, t)
\]

are fourth detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(2,2,2,2,2)} (G_{32}, t) - (b_{30})^{(2,2,2,2,2)} (G_{32}, t) - (b_{30})^{(2,2,2,2,2)} (G_{32}, t)
\]

are fifth detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(3,3,3,3,3)} (G_{32}, t) - (b_{21})^{(3,3,3,3,3)} (G_{32}, t) - (b_{30})^{(3,3,3,3,3)} (G_{32}, t)
\]

are sixth detrition coefficients for category 1, 2 and 3

\[
- (b_{30})^{(7,7,7,7,7,7)} (G_{39}, t) - (b_{30})^{(7,7,7,7,7,7)} (G_{39}, t) - (b_{30})^{(7,7,7,7,7,7)} (G_{39}, t)
\]

ARE SEVENTH DETRITION
COEFFICIENTS

SEVENTH MODULE CONCATENATION:

\[ \frac{dG_{36}}{dt} = (a_{36}^{(7)})G_{37} - \left[ (a_{36}^{(7)}(T_{37}, t)) + (a_{36}^{(7)}(T_{17}, t)) + (a_{20}^{(7)}(T_{21}, t)) + (a_{20}^{(7)}(T_{23}, t)G_{36}) + (a_{20}^{(7)}(T_{29}, t)) + (a_{32}^{(7)}(T_{33}, t)) + (a_{13}^{(7)}(T_{14}, t)) \right] G_{36} \]

\[ \frac{dG_{37}}{dt} = (a_{37}^{(7)})G_{36} - \left[ (a_{37}^{(7)}(T_{17}, t)) + (a_{25}^{(7)}(T_{25}, t)) + (a_{33}^{(7)}(T_{33}, t)) + (a_{20}^{(7)}(T_{29}, t)) \right] G_{37} \]

\[ \frac{dG_{38}}{dt} = (a_{38}^{(7)})G_{37} - \left[ (a_{38}^{(7)}(T_{37}, t)) + (a_{15}^{(7)}(T_{14}, t)) + (a_{22}^{(7)}(T_{21}, t)) + (a_{18}^{(7)}(T_{17}, t)) + (a_{26}^{(7)}(T_{25}, t)) + (a_{34}^{(7)}(T_{33}, t)) + (a_{30}^{(7)}(T_{29}, t)) \right] G_{38} \]

\[ \frac{dT_{36}}{dt} = (b_{36}^{(7)}(T_{37}) - \left[ (b_{36}^{(7)}(G_{36}, t)) - (b_{16}^{(7)}(G_{16}, t)) - (b_{13}^{(7)}(G_{14}, t)) - (b_{20}^{(7)}(G_{23}, t)) - (b_{28}^{(7)}(G_{31}, t)) \right] T_{36} \]

\[ \frac{dT_{37}}{dt} = (b_{37}^{(7)}T_{36} - \left[ (b_{37}^{(7)}(G_{36}, t)) - (b_{17}^{(7)}(G_{16}, t)) - (b_{19}^{(7)}(G_{14}, t)) - (b_{21}^{(7)}(G_{23}, t)) - (b_{29}^{(7)}(G_{31}, t)) \right] T_{37} \]
Where we suppose

(A)  
\[
(a_i^{(1)}(t), a_i^{(1)}(t), a_i^{(1)}(t), b_j^{(1)}(t), b_j^{(1)}(t), b_i^{(1)}(t)) > 0,
\]
\[i, j = 13, 14, 15\]

(B)  
The functions \((a_i^{(1)}(t), b_i^{(1)}(t))\) are positive continuous increasing and bounded.  
\[
\text{Definition of } (p_i^{(1)}(t), r_i^{(1)}(t)):\n\]
\[
(a_i^{(1)}(t)(T_{14}, t) \leq (p_i^{(1)}(t) \leq (\hat{A}_{13})^{(1)}
\]
\[
(b_i^{(1)}(t)(G, t) \leq (r_i^{(1)}(t) \leq (\hat{B}_{13})^{(1)}
\]

(C)  
\[
\lim_{T_{14} \to 0} (a_i^{(1)}(t)(T_{14}, t) = (p_i^{(1)}
\]
\[
\lim_{G \to 0} (b_i^{(1)}(t)(G, t) = (r_i^{(1)}
\]

\[
\text{Definition of } (\hat{A}_{13})^{(1)}, (\hat{B}_{13})^{(1)}:\n\]
\[
\text{Where } (\hat{A}_{13})^{(1)}, (\hat{B}_{13})^{(1)}, (p_i^{(1)}), (r_i^{(1)})\text{ are positive constants}
\]
\[i = 13, 14, 15\]

They satisfy Lipschitz condition:  
\[
\left|(a_i^{(1)}(T_{14}^t) - (a_i^{(1)}(T_{14}^t)) \leq (\hat{K}_{13})^{(1)} |T_{14} - T_{14}^t| e^{-(\hat{M}_{13})^{(1)} t}
\right|
\[
\left|(b_i^{(1)}(G, t) - (b_i^{(1)}(G, t)) \leq (\hat{K}_{13})^{(1)} ||G - G'|| e^{-(\hat{M}_{13})^{(1)} t}
\right|
\]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i^{(1)}(T_{14}^t), b_i^{(1)}(G, T))\).  
\((T_{14}^t)\) and \((T_{14}, t)\) are points belonging to the interval \([\hat{K}_{13}, \hat{M}_{13}]\).  
It is to be noted that \((a_i^{(1)}(T_{14}^t), b_i^{(1)}(G, T))\) is uniformly continuous.  
In the eventuality of the fact, that if \((\hat{M}_{13})^{(1)} = 1\) then the function \((a_i^{(1)}(T_{14}^t))\), the  
first augmentation coefficient attributable to terrestrial organisms, would be absolutely continuous.

\[
\text{Definition of } (\hat{M}_{13})^{(1)}, (\hat{K}_{13})^{(1)}:\n\]

(D)  
\[
(\hat{M}_{13})^{(1)}, (\hat{K}_{13})^{(1)}, \text{ are positive constants}
\]
\[
\frac{(a_i^{(1)}(t))}{(M_{13})^{(1)}} \cdot \frac{(b_i^{(1)}(t))}{(M_{13})^{(1)}} < 1
\]

\[
\text{Definition of } (\hat{P}_{13})^{(1)}, (\hat{Q}_{13})^{(1)}:\n\]

(E)  
There exists two constants \((\hat{P}_{13})^{(1)}\) and \((\hat{Q}_{13})^{(1)}\) which together with  
\((\hat{M}_{13})^{(1)}, (\hat{K}_{13})^{(1)}, (\hat{A}_{13})^{(1)}\) and \((\hat{B}_{13})^{(1)}\) and the constants  
\((a_i^{(1)}), (a_j^{(1)}), (b_i^{(1)}), (b_j^{(1)}), (p_i^{(1)}), (r_i^{(1)}), i = 13, 14, 15\),  
satisfy the inequalities  
\[
\frac{1}{(\hat{M}_{13})^{(1)}} \left[ (a_i^{(1)}) + (a_j^{(1)}) + (\hat{A}_{13})^{(1)} + (\hat{P}_{13})^{(1)} (\hat{K}_{13})^{(1)} < 1
\]
\[
\frac{1}{(\hat{M}_{13})^{(1)}} \left[ (b_i^{(1)}) + (b_j^{(1)}) + (\hat{B}_{13})^{(1)} + (\hat{Q}_{13})^{(1)} (\hat{K}_{13})^{(1)} < 1
\]
\[
\frac{dT_{38}}{dt} = \left( b_{38}^{(7)}(G_{38}, t) - b_{26}^{(7)}(G_{26}, t) - b_{28}^{(7)}(G_{28}, t) - b_{20}^{(7)}(G_{20}, t) - (b_{26}^{(7)}(G_{26}, t) - b_{28}^{(7)}(G_{28}, t) - b_{30}^{(7)}(G_{30}, t) - b_{32}^{(7)}(G_{32}, t)) T_{38} \right)
\]

\[\] + \left( a_{36}^{(7)}(G_{36}, t) \right)  

**First augmentation factor**

(1) (a_1^{(2)}, a_2^{(2)}, a_3^{(2)}, b_1^{(2)}, b_2^{(2)}, b_3^{(2)}, b_4^{(2)}, b_5^{(2)}, b_6^{(2)}, b_7^{(2)}, b_8^{(2)}, b_9^{(2)}, b_{10}^{(2)}, b_{11}^{(2)}, b_{12}^{(2)}, b_{13}^{(2)}, b_{14}^{(2)}, b_{15}^{(2)}, b_{16}^{(2)}, b_{17}^{(2)}, b_{18}^{(2)}, b_{19}^{(2)}, b_{20}^{(2)}) > 0, \quad i, j = 16, 17, 18

(F) (2) The functions (a_i^{(2)}, b_j^{(2)}) are positive continuous increasing and bounded.

**Definition of** \( p_i^{(2)}, \quad (r_j^{(2)}) : \)

\[
(a_i^{(2)}(T_{i7}, t) \leq p_i^{(2)} \leq (A_{16})^{(2)}
\]

\[
(b_j^{(2)}(G_{19}, t) \leq (r_j^{(2)} \leq (B_{16})^{(2)}
\]

**Definition of** \( \hat{a}_i^{(2)}, \hat{b}_j^{(2)} : \)

\[
\lim_{T_{i7} \to 0}(a_i^{(2)}(T_{i7}, t) = (p_i^{(2)}
\]

\[
\lim_{G_{19} \to 0}(b_j^{(2)}(G_{19}, t) = (r_j^{(2)}
\]

**Definition of** \( (\hat{A}_{16})^{(2)}, (\hat{B}_{16})^{(2)} : \)

Where \((\hat{A}_{16})^{(2)}, (\hat{B}_{16})^{(2)}, (p_i^{(2)}, (r_j^{(2)}) \) are positive constants and \( i = 16, 17, 18 \)

They satisfy Lipschitz condition:

\[
|(a_i^{(2)}(T_{i7}, t) - (a_i^{(2)}(T_{i7}, t)| \leq (\hat{A}_{16})^{(2)}|T_{i7} - T_{i7}||e^{-((\hat{A}_{16})^{(2)}t}
\]

\[
|(b_j^{(2)}(G_{19}, t) - (b_j^{(2)}(G_{19}, t)| < (\hat{B}_{16})^{(2)}||G_{19} - (G_{19})'||e^{-((\hat{A}_{16})^{(2)}t}
\]

With the Lipschitz condition, we place a restriction on the behavior of functions \( (a_i^{(2)}(T_{i7}, t) \) and \( (b_j^{(2)}(T_{i7}, t) \). (T_{i7}, t) \quad A_{16}^{(2)}(T_{i7}, t) \quad T_{i7}, t) \quad A_{16}^{(2)}(T_{i7}, t) \quad T_{i7}, t) \quad A_{16}^{(2)}(T_{i7}, t) \quad T_{i7}, t) \quad A_{16}^{(2)}(T_{i7}, t) \quad T_{i7}, t)

It is to be noted that \( (a_i^{(2)}(T_{i7}, t) \) is uniformly continuous. In the eventuality of the fact, that if \( (\hat{M}_{16})^{(2)} = 1 \) then the function \( (a_i^{(2)}(T_{i7}, t) \) , the SECOND augmentation coefficient would be absolutely continuous.

**Definition of** \( (\hat{M}_{16})^{(2)}, (\hat{k}_{16})^{(2)} : \)

\[
(a_1^{(2)}, (\hat{k}_{16})^{(2)}, (\hat{k}_{16})^{(2)}), \quad (\hat{k}_{16})^{(2)}, \quad (\hat{k}_{16})^{(2)}, \quad (\hat{k}_{16})^{(2)}< 1
\]

**Definition of** \( (\hat{P}_{13})^{(2)}, (\hat{Q}_{13})^{(2)} : \)

There exists two constants \( (\hat{P}_{13})^{(2)} \) and \( (\hat{Q}_{13})^{(2)} \) which together with \( (\hat{M}_{16})^{(2)}, (\hat{M}_{16})^{(2)}, (\hat{A}_{16})^{(2)} \) and \( (\hat{B}_{16})^{(2)} \) and the constants \( (a_i^{(2)}, (a_i^{(2)}, (b_j^{(2)}, (b_j^{(2)}, (b_i^{(2)}, (b_i^{(2)}, (p_i^{(2)}, (r_j^{(2)})), i = 16, 17, 18, \)
satisfy the inequalities
\[
\frac{1}{(A_{16})^{(2)}} [(a_i)^{(2)} + (a'_i)^{(2)} + (\bar{A}_{16})^{(2)} + (\bar{B}_{16})^{(2)} (\bar{K}_{16})^{(2)}] < 1
\]
\[
\frac{1}{(A_{16})^{(2)}} [(b_i)^{(2)} + (b'_i)^{(2)} + (\bar{B}_{16})^{(2)} + (\bar{Q}_{16})^{(2)} (\bar{K}_{16})^{(2)}] < 1
\]
Where we suppose
\[(I)\quad (a_i)^{(3)}, (a'_i)^{(3)}, (a''_i)^{(3)}, (b_i)^{(3)}, (b'_i)^{(3)}, (b''_i)^{(3)} > 0, \quad i, j = 20, 21, 22\]
The functions \((a''_i)^{(3)}, (b''_i)^{(3)}\) are positive continuous increasing and bounded.

**Definition of \((p_i)^{(3)}, \quad (r_i)^{(3)}:\)**
\[
(a''_i)^{(3)}(T_{21}, t) \leq (p_i)^{(3)} \leq (\bar{A}_{20})^{(3)}
\]
\[
(b''_i)^{(3)}(G_{23}, t) \leq (r_i)^{(3)} \leq (\bar{B}_{20})^{(3)}
\]
\[
\lim_{T_{21} \to \infty}(a''_i)^{(3)}(T_{21}, t) = (p_i)^{(3)}
\]
\[
\lim_{G_{23} \to \infty}(b''_i)^{(3)}(G_{23}, t) = (r_i)^{(3)}
\]

**Definition of \((\bar{A}_{20})^{(3)}, \quad (\bar{B}_{20})^{(3)}:\)**
Where \((\bar{A}_{20})^{(3)}, (\bar{B}_{20})^{(3)}, (p_i)^{(3)}, (r_i)^{(3)}\) are positive constants and \(i = 20, 21, 22\)

They satisfy Lipschitz condition:
\[
|(a''_i)^{(3)}(T'_{21}, t) - (a''_i)^{(3)}(T_{21}, t)| \leq (\bar{K}_{20})^{(3)}|T_{21} - T'_{21}|e^{-(\bar{\sigma}_{20})^{(3)}t}
\]
\[
|(b''_i)^{(3)}(G_{23}, t) - (b''_i)^{(3)}(G_{23}, t)| < (\bar{K}_{20})^{(3)}|G_{23} - G'_{23}'|e^{-(\bar{\sigma}_{20})^{(3)}t}
\]
With the Lipschitz condition, we place a restriction on the behavior of functions \((a''_i)^{(3)}(T'_{21}, t)\)
and\((a''_i)^{(3)}(T_{21}, t)\). And \((T_{21}, t)\) are points belonging to the interval \([\bar{K}_{20})^{(3)}, (\bar{M}_{20})^{(3)}]\). It is to be noted that \((a''_i)^{(3)}(T_{21}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\bar{M}_{20})^{(3)} = 1\) then the function \((a''_i)^{(3)}(T_{21}, t)\), the THIRD augmentation coefficient, would be absolutely continuous.

**Definition of \((\bar{M}_{20})^{(3)}, \quad (\bar{K}_{20})^{(3)}:\)**
\[(J)\quad (\bar{M}_{20})^{(3)}, (\bar{K}_{20})^{(3)}, \text{ are positive constants}\]
\[
\frac{(a_i)^{(3)}}{(\bar{M}_{20})^{(3)}}, \frac{(b_i)^{(3)}}{(\bar{M}_{20})^{(3)}} < 1
\]
There exists two constants \((\bar{P}_{20})^{(3)}\) and \((\bar{Q}_{20})^{(3)}\) which together with \((\bar{M}_{20})^{(3)}, (\bar{K}_{20})^{(3)}, (\bar{A}_{20})^{(3)}\) and \((\bar{B}_{20})^{(3)}\) and the constants \((a_i)^{(3)}, (a'_i)^{(3)}, (b_i)^{(3)}, (b'_i)^{(3)}, (p_i)^{(3)}, (r_i)^{(3)}, i = 20, 21, 22\), satisfy the inequalities
\[
\frac{1}{(\bar{M}_{20})^{(3)}} [(a_i)^{(3)} + (a'_i)^{(3)} + (\bar{A}_{20})^{(3)} + (\bar{B}_{20})^{(3)} (\bar{K}_{20})^{(3)}] < 1
\]
\[
\frac{1}{(\bar{M}_{20})^{(3)}} [(b_i)^{(3)} + (b'_i)^{(3)} + (\bar{B}_{20})^{(3)} + (\bar{Q}_{20})^{(3)} (\bar{K}_{20})^{(3)}] < 1
\]
(L) The functions \((a_i')^{(4)}, (b_i')^{(4)}\) are positive continuous increasing and bounded.

**Definition of** \((p_i)^{(4)}, (r_i)^{(4)}\):

\[ (a_i')^{(4)}(T_{25}, t) \leq (p_i)^{(4)} \leq (A_24)^{(4)} \]
\[ (b_i')^{(4)}((G_{27}, t) \leq (r_i)^{(4)} \leq (B_24)^{(4)} \]

\[ \lim_{T_{25} \to \infty} (a_i'')^{(4)}(T_{25}, t) = (p_i)^{(4)} \]
\[ \lim_{G_{27} \to \infty} (b_i'')^{(4)}((G_{27}, t) = (r_i)^{(4)} \]

(M) The functions \((M_4)^{(4)}, (\bar{M}_4)^{(4)}\):

Where \((\hat{A}_24)^{(4)}, (\hat{B}_24)^{(4)}, (\hat{P}_24)^{(4)}, (\hat{Q}_24)^{(4)}\) are positive constants and \(l = 24, 25, 26\)

They satisfy Lipschitz condition:

\[ |(a_i'')^{(4)}(T_{25}, t) - (a_i'')^{(4)}(T_{25}, t)| \leq (\hat{k}_{24})^{(4)}|T_{25} - T_{25}'|e^{-(\hat{M}_24)^{(4)}t} \]
\[ |(b_i'')^{(4)}((G_{27}, t) - (b_i'')^{(4)}((G_{27}, t)| < (\hat{k}_{24})^{(4)}|((G_{27}) - (G_{27})'|e^{-(\hat{M}_24)^{(4)}t} \]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i'')^{(4)}(T_{25}, t)\) and \((b_i'')^{(4)}((G_{27}, t)\). And \((T_{25}, t)\) and \((G_{27}, t)\) are points belonging to the interval \([\hat{k}_{24})^{(4)}, (\hat{M}_24^{(4)}\).

It is to be noted that \((a_i'')^{(4)}(T_{25}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\hat{M}_24)^{(4)} = 4\) then the function \((a_i'')^{(4)}(T_{25}, t)\), the FOURTH augmentation coefficient WOULD be absolutely continuous.

| **Definition of** \((M_4)^{(4)}, (\bar{M}_4)^{(4)}\):

\[ (M_4^{(4)}, \bar{M}_4^{(4)})\]

\[ \frac{(a_i)^{(4)}}{(M_4)^{(4)}}, (b_i)^{(4)}{(\bar{M}_4)^{(4)}} < 1 \]

| **Definition of** \((\hat{P}_24)^{(4)}, (\hat{Q}_24)^{(4)}\):

\[ \frac{1}{(M_4)^{(4)}}[(a_i)^{(4)} + (a_i)^{(4)} + (\hat{A}_24)^{(4)} + (\hat{P}_24)^{(4)}(\hat{K}_24)^{(4)}] < 1 \]
\[ \frac{1}{(\bar{M}_4)^{(4)}}[(b_i)^{(4)} + (b_i)^{(4)} + (\hat{B}_24)^{(4)} + (\hat{Q}_24)^{(4)}(\hat{K}_24)^{(4)}] < 1 \]
Where we suppose

\[(a_i^{(5)}, b_i^{(5)}, a_i^{(6)}, b_i^{(6)}, b_i^{(6)}) > 0, \quad i, j = 28, 29, 30\]  

(10) The functions \((a_i^{(5)}), (b_i^{(5)})\) are positive continuous increasing and bounded.

**Definition of** \((p_i^{(5)}), (r_i^{(5)})\):

\[a_i^{(5)}(T_{29}, t) \leq (p_i^{(5)}) \leq (A_{28})^{(5)}\]

\[b_i^{(5)}((G_{31}), t) \leq (r_i^{(5)}) \leq (B_{28})^{(5)}\]

\[(S)\]

\[\lim_{T_{29} \to \infty}(a_i^{(5)})(T_{29}, t) = (p_i^{(5)})\]

\[\lim_{G_{31} \to 0}(b_i^{(5)})(G_{31}, t) = (r_i^{(5)})\]

**Definition of** \((A_{28})^{(5)}, (B_{28})^{(5)}\):

Where \([A_{28}]^{(5)}, [B_{28}]^{(5)}, (p_i^{(5)}), (r_i^{(5)})\) are positive constants and \([i = 28, 29, 30]\)

They satisfy Lipschitz condition:

\[|a_i^{(5)}(T_{29}, t) - (a_i^{(5)}(T_{29}, t)| \leq (\hat{k}_{28})^{(5)}|T_{29} - T'_{29}|(\hat{M}_{28})^{(5)}t\]

\[|b_i^{(5)}((G_{31}), t) - (b_i^{(5)}((G_{31}), t)| < (\hat{g}_{28})^{(5)}|((G_{31}) - (G_{31}))|e^{-\hat{M}_{28}}^{(5)}t\]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i^{(5)}(T_{29}, t)\) and \((a_i^{(5)}(T_{29}, t))\) - \((T_{29}, t)\) and \((T_{29}, t)\) are points belonging to the interval \([\hat{k}_{28})^{(5)}, (\hat{M}_{28})^{(5)}\]. It is to be noted that \((a_i^{(5)}(T_{29}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\hat{M}_{28})^{(5)} = S\) then the function \((a_i^{(5)}(T_{29}, t)\), the FIFTH augmentation coefficient attributable would be absolutely continuous.

**Definition of** \((\hat{M}_{28})^{(5)}, (\hat{k}_{28})^{(5)}\):

\[\hat{a}_i^{(5)}(\hat{k}_{28})^{(5)}, (\hat{b}_i^{(5)})(\hat{M}_{28})^{(5)}, (\hat{M}_{28})^{(5)} < 1\]

**Definition of** \((\hat{p}_{28})^{(5)}, (\hat{q}_{28})^{(5)}\):

There exists two constants \((\hat{p}_{28})^{(5)}\) and \((\hat{q}_{28})^{(5)}\) which together with \((\hat{M}_{28})^{(5)}, (\hat{k}_{28})^{(5)}, (\hat{A}_{28})^{(5)}(\hat{B}_{28})^{(5)}\) and the constants \((a_i^{(5)}), (a_i^{(6)}), (b_i^{(5)}), (b_i^{(6)}), (p_i^{(5)}), (r_i^{(5)})\), \([i = 28, 29, 30]\), satisfy the inequalities

\[\frac{1}{(M_{28})^{(5)}}[a_i^{(5)} + (a_i^{(5)})(A_{28})^{(5)} + (\hat{p}_{28})^{(5)}(\hat{k}_{28})^{(5)}] < 1\]

\[\frac{1}{(M_{28})^{(5)}}[b_i^{(5)} + (b_i^{(5)}) + (\hat{B}_{28})^{(5)} + (\hat{q}_{28})^{(5)}(\hat{k}_{28})^{(5)}] < 1\]

Where we suppose

\[(a_i^{(6)}, (a_i^{(6)}), (a_i^{(6)}), (b_i^{(6)}), (b_i^{(6)}), (b_i^{(6)}), (b_i^{(6)}) > 0, \quad i, j = 32, 33, 34\]

(12) The functions \((a_i^{(6)}), (b_i^{(6)})\) are positive continuous increasing and bounded.
Definition of \((p_1)^{(6)}, (r_1)^{(6)}\):

\[
(a_i^{(6)}(T_{33}, t) \leq (p_1)^{(6)} \leq (\hat{A}_{32})^{(6)}
\]

\[
(b_i^{(6)}((G_{35}), t) \leq (r_1)^{(6)} \leq (b_i^{(6)}(\hat{B}_{32})^{(6)}
\]

\[\text{(13)}\]

\[
\lim_{T_{33} \to t}(a_i^{(6)}(T_{33}, t) = (p_1)^{(6)}
\]

\[
\lim_{G_{35} \to t}(b_i^{(6)}((G_{35}), t) = (r_1)^{(6)}
\]

Definition of \((\hat{A}_{32})^{(6)}, (\hat{B}_{32})^{(6)}\):

Where \((\hat{A}_{32})^{(6)}, (\hat{B}_{32})^{(6)}, (p_1)^{(6)}, (r_1)^{(6)}\) are positive constants and \(i = 32, 33, 34\)

They satisfy the Lipschitz condition:

\[
|\frac{\partial(\hat{A}_{32})^{(6)}(T_{33}, t)}{\partial T_{33}}| \leq \frac{\partial(\hat{B}_{32})^{(6)}(T_{33}, t)}{\partial T_{33}} = \frac{\partial(\hat{B}_{32})^{(6)}(T_{33}, t)}{\partial T_{33}}
\]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i^{(6)}(T_{33}, t)\) and \((b_i^{(6)}((G_{35}), t)\) and \((T_{33}, t)\) and \((T_{33}, t)\) are points belonging to the interval \([\hat{k}_{32}^{(6)}, \hat{M}_{32}^{(6)}]\). It is to be noted that \((a_i^{(6)}(T_{33}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\hat{M}_{32})^{(6)} = 6\) then the function \((a_i^{(6)}(T_{33}, t)\), the SIXTH augmentation coefficient would be absolutely continuous.

Definition of \((\hat{M}_{32})^{(6)}, (\hat{k}_{32})^{(6)}\):

\[
(\hat{M}_{32})^{(6)}, (\hat{k}_{32})^{(6)}\), are positive constants
\]

\[
\frac{(a_i^{(6)})}{(\hat{M}_{32})^{(6)}} < 1, \frac{(b_i^{(6)})}{(\hat{M}_{32})^{(6)}} < 1
\]

Definition of \((\hat{P}_{32})^{(6)}, (\hat{Q}_{32})^{(6)}\):

There exists two constants \((\hat{P}_{32})^{(6)}\) and \((\hat{Q}_{32})^{(6)}\) which together with \((\hat{M}_{32})^{(6)}, (\hat{k}_{32})^{(6)}, (\hat{A}_{32})^{(6)}\) and \((\hat{B}_{32})^{(6)}\) and the constants \((a_i^{(6)}, (a_i^{(6)}), (b_i^{(6)}, (b_i^{(6)}), (p_1)^{(6)}, (r_1)^{(6)})), i = 32, 33, 34\), satisfy the inequalities

\[
\frac{1}{(\hat{M}_{32})^{(6)}}[(a_i^{(6)} + (a_i^{(6)}) + (\hat{A}_{32})^{(6)} + (\hat{P}_{32})^{(6)}(\hat{k}_{32})^{(6)}] < 1
\]

\[
\frac{1}{(\hat{M}_{32})^{(6)}}[(b_i^{(6)} + (b_i^{(6)}) + (\hat{B}_{32})^{(6)} + (\hat{Q}_{32})^{(6)}(\hat{k}_{32})^{(6)}] < 1
\]

Where we suppose
The functions \((a_i)^{(7)}, (b_i)^{(7)}\) are positive continuous increasing and bounded.

Definition of \((p_i)^{(7)}, (r_i)^{(7)}\):

\[
(a_i)^{(7)}(T_{37}, t) \leq (p_i)^{(7)} \leq (\bar{A}_{36})^{(7)}
\]

\[
(b_i)^{(7)}(G, t) \leq (r_i)^{(7)} \leq (b_i)^{(7)} \leq (\bar{B}_{36})^{(7)}
\]

Definition of \((\bar{A}_{36})^{(7)}, (\bar{B}_{36})^{(7)}\):

Where \([ar{A}_{36}]^{(7)}, [\bar{B}_{36}]^{(7)}, (p_i)^{(7)}, (r_i)^{(7)}\] are positive constants and \(i = 36, 37, 38\)

They satisfy Lipschitz condition:

\[
|(a_i)^{(7)}(T_{37}, t) - (a_i)^{(7)}(T_{37}, t)| \leq (\bar{k}_{36})^{(7)}|T_{37} - T_{37}|e^{-\left(\bar{\theta}_{36}\right)^{(7)}t}
\]

\[
|(b_i)^{(7)}((G_{39}), t) - (b_i)^{(7)}((G_{39}), (T_{39}))| \leq (\bar{k}_{36})^{(7)}|(G_{39}) - (G_{39})|e^{-\left(\bar{\theta}_{36}\right)^{(7)}t}
\]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i)^{(7)}(T_{37}, t)\)
and \((a_i)^{(7)}(T_{37}, t) : (T_{37}, t)\) and \((T_{37}, t)\) are points belonging to the interval \([\bar{k}_{36}]^{(7)}, [\bar{M}_{36}]^{(7)}\). It is to be noted that \((a_i)^{(7)}(T_{37}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\bar{\theta}_{36})^{(7)} = 7\) then the function \((a_i)^{(7)}(T_{37}, t)\), the first augmentation coefficient attributable to terrestrial organisms, would be absolutely continuous.

Definition of \((\bar{\theta}_{36})^{(7)}, (\bar{M}_{36})^{(7)}\):

\[\textbf{66}\]
(Y) \((\widehat{M}_{36})^{(7)}, (\widehat{k}_{36})^{(7)}\) are positive constants

\[
\frac{(a_i)^{(7)}}{(\widehat{M}_{36})^{(7)}} \cdot \frac{(b_i)^{(7)}}{(\widehat{M}_{36})^{(7)}} < 1
\]

Definition of \((\widehat{P}_{36})^{(7)}, (\widehat{Q}_{36})^{(7)}\):

(Z) There exists two constants \((\widehat{P}_{36})^{(7)}\) and \((\widehat{Q}_{36})^{(7)}\) which together with \((\widehat{M}_{36})^{(7)}, (\widehat{k}_{36})^{(7)}, (\widehat{A}_{36})^{(7)}, (\widehat{B}_{36})^{(7)}\) and the constants \((a_i)^{(7)}, (a_j)^{(7)}, (b_i)^{(7)}, (b_j)^{(7)}, (p_i)^{(7)}, (r_j)^{(7)}, i = 36, 37, 38,\)
satisfy the inequalities

\[
\frac{1}{(\widehat{M}_{36})^{(7)}} \left[ (a_i)^{(7)} + (a_j)^{(7)} + (\widehat{A}_{36})^{(7)} + (\widehat{P}_{36})^{(7)} (\widehat{k}_{36})^{(7)} \right] < 1
\]

\[
\frac{1}{(\widehat{M}_{36})^{(7)}} \left[ (b_i)^{(7)} + (b_j)^{(7)} + (\widehat{B}_{36})^{(7)} + (\widehat{Q}_{36})^{(7)} (\widehat{k}_{36})^{(7)} \right] < 1
\]

Definition of \(G_i(0), T_i(0)\):

\[
G_i(t) \leq (\widehat{P}_{28})^{(5)} e^{(\widehat{M}_{28})^{(5)} t}, \quad G_i(0) = G_i^0 > 0\]

\[
T_i(t) \leq (\widehat{Q}_{28})^{(5)} e^{(\widehat{M}_{28})^{(5)} t}, \quad T_i(0) = T_i^0 > 0\]

Definition of \(G_i(0), T_i(0)\):

\[
G_i(t) \leq (\widehat{P}_{32})^{(6)} e^{(\widehat{M}_{32})^{(6)} t}, \quad G_i(0) = G_i^0 > 0\]

\[
T_i(t) \leq (\widehat{Q}_{32})^{(6)} e^{(\widehat{M}_{32})^{(6)} t}, \quad T_i(0) = T_i^0 > 0\]

Definition of \(G_i(0), T_i(0)\):
Proof: Consider operator \( \mathcal{A}^{(1)} \) defined on the space of sextuples of continuous functions \( G_i, T_i: \mathbb{R}_+ \to \mathbb{R}_+ \) which satisfy

\[
G_i(t) = G_i^0, \quad T_i(t) = T_i^0, \quad G_i^0 \leq (\bar{\mathcal{P}}_{36})^{(1)}e^{(\bar{\mathcal{Q}}_{36})^{(1)}t}, \quad T_i^0 = T_i^0 > 0
\]

By

\[
\tilde{G}_{13}(t) = G_{13}^0 + \int_0^t \left( (a_{13})^{(1)}G_{14}(s_{13}) - \left( (a_{13}')^{(1)} + a_{13}''^{(1)} \right)(T_{14}(s_{13}), s_{13}) \right) G_{13}(s_{13}) ds_{13}
\]

\[
\tilde{G}_{14}(t) = G_{14}^0 + \int_0^t \left( (a_{14})^{(1)}G_{13}(s_{13}) - \left( (a_{14}')^{(1)} + a_{14}''^{(1)} \right)(T_{14}(s_{13}), s_{13}) \right) G_{14}(s_{13}) ds_{13}
\]

\[
\tilde{G}_{15}(t) = G_{15}^0 + \int_0^t \left( (a_{15})^{(1)}G_{14}(s_{13}) - \left( (a_{15}')^{(1)} + a_{15}''^{(1)} \right)(T_{14}(s_{13}), s_{13}) \right) G_{15}(s_{13}) ds_{13}
\]

\[
\tilde{T}_{13}(t) = T_{13}^0 + \int_0^t \left( (b_{13})^{(1)}T_{14}(s_{13}) - \left( (b_{13}')^{(1)} - (b_{13}''^{(1)}) \right)(G(s_{13}), s_{13}) \right) T_{13}(s_{13}) ds_{13}
\]

\[
\tilde{T}_{14}(t) = T_{14}^0 + \int_0^t \left( (b_{14})^{(1)}T_{13}(s_{13}) - \left( (b_{14}')^{(1)} - (b_{14}''^{(1)}) \right)(G(s_{13}), s_{13}) \right) T_{14}(s_{13}) ds_{13}
\]

\[
\tilde{T}_{15}(t) = T_{15}^0 + \int_0^t \left( (b_{15})^{(1)}T_{14}(s_{13}) - \left( (b_{15}')^{(1)} - (b_{15}''^{(1)}) \right)(G(s_{13}), s_{13}) \right) T_{15}(s_{13}) ds_{13}
\]

Where \( s_{13} \) is the integrand that is integrated over an interval \((0, t)\)

if the conditions IN THE FOREGOING above are fulfilled, there exists a solution satisfying the conditions

Definition of \( G_i(0), T_i(0) \):

\[
G_i(0) = G_i^0, \quad T_i(0) = T_i^0, \quad G_i^0 \leq (\bar{\mathcal{P}}_{36})^{(1)}e^{(\bar{\mathcal{Q}}_{36})^{(1)}t}, \quad T_i^0 = T_i^0 > 0
\]

Consider operator \( \mathcal{A}^{(7)} \) defined on the space of sextuples of continuous functions \( G_i, T_i: \mathbb{R}_+ \to \mathbb{R}_+ \) which satisfy

\[
G_i(t) = G_i^0, \quad T_i(t) = T_i^0, \quad G_i^0 \leq (\bar{\mathcal{P}}_{36})^{(7)}, \quad T_i^0 \leq (\bar{\mathcal{Q}}_{36})^{(7)},
\]

\[
0 \leq G_i(t) - G_i^0 \leq (\bar{\mathcal{P}}_{36})^{(7)}e^{(\bar{\mathcal{Q}}_{36})^{(7)}t}
\]
\[ 0 \leq T_i(t) - T_i^0 \leq \left( \hat{G}_{36} \right)^{(7)} e^\left( \hat{R}_{36} \right)^{(7)} t \]

By

\[
\hat{G}_{36}(t) = G_{36}^0 + \int_0^t \left[ (a_{36})^{(7)} G_{37}(s_{(36)}) - \left( (a_{36}')^{(7)} + (a_{36}''^{(7)} (T_{37}(s_{(36)}), s_{(36)}) G_{36}(s_{(36)}) \right) ds_{(36)}
\]

\[
\hat{G}_{37}(t) = G_{37}^0 + \int_0^t \left[ (a_{37})^{(7)} G_{36}(s_{(36)}) - \left( (a_{37}')^{(7)} + (a_{37}''^{(7)} (T_{37}(s_{(36)}), s_{(36)}) G_{37}(s_{(36)}) \right) ds_{(36)}
\]

\[
\hat{G}_{38}(t) = G_{38}^0 + \int_0^t \left[ (a_{38})^{(7)} G_{37}(s_{(36)}) - \left( (a_{38}')^{(7)} + (a_{38}''^{(7)} (T_{38}(s_{(36)}), s_{(36)}) G_{38}(s_{(36)}) \right) ds_{(36)}
\]

\[
\hat{T}_{36}(t) = T_{36}^0 + \int_0^t \left[ (b_{36})^{(7)} T_{37}(s_{(36)}) - \left( (b_{36}')^{(7)} - (b_{36}''^{(7)} (G(s_{(36)}), s_{(36)}) \right) T_{36}(s_{(36)}) \right] ds_{(36)}
\]

\[
\hat{T}_{37}(t) = T_{37}^0 + \int_0^t \left[ (b_{37})^{(7)} T_{36}(s_{(36)}) - \left( (b_{37}')^{(7)} - (b_{37}''^{(7)} (G(s_{(36)}), s_{(36)}) \right) T_{37}(s_{(36)}) \right] ds_{(36)}
\]

\[
\hat{T}_{38}(t) = T_{38}^0 + \int_0^t \left[ (b_{38})^{(7)} T_{37}(s_{(36)}) - \left( (b_{38}')^{(7)} - (b_{38}''^{(7)} (G(s_{(36)}), s_{(36)}) \right) T_{38}(s_{(36)}) \right] ds_{(36)}
\]

Where \( s_{(36)} \) is the integrand that is integrated over an interval \((0, t)\)
Consider operator $\mathcal{A}^{(2)}$ defined on the space of sextuples of continuous functions $G_i$, $T_i$: $\mathbb{R}_+ \rightarrow \mathbb{R}_+$ which satisfy

$G_i(0) = G_i^0$, $T_i(0) = T_i^0$, $G_i^0 \leq (\tilde{P}_{16})^{(2)}$, $T_i^0 \leq (\tilde{Q}_{16})^{(2)}$, $0 \leq G_i(t) - G_i^0 \leq (\tilde{P}_{16})^{(2)} e^{(\theta_{16})^{(2)} t}$

$0 \leq T_i(t) - T_i^0 \leq (\tilde{Q}_{16})^{(2)} e^{(\theta_{16})^{(2)} t}$

By

$\tilde{G}_{16}(t) = G_{16}^0 + \int_0^t \left( (a_{16})^{(2)} G_{17}(s_{16}) - \left( (a'_{16})^{(2)} + a''_{16} \right)^{(2)} T_{17}(s_{16}), s_{16}) \right) G_{16}(s_{16}) ds_{16}$

$\tilde{G}_{17}(t) = G_{17}^0 + \int_0^t \left( (a_{17})^{(2)} G_{16}(s_{16}) - \left( (a'_{17})^{(2)} + (a'_{17})^{(2)} \right) T_{16}(s_{16}), s_{16}) \right) G_{17}(s_{16}) ds_{16}$

$\tilde{G}_{18}(t) = G_{18}^0 + \int_0^t \left( (a_{18})^{(2)} G_{17}(s_{16}) - \left( (a'_{18})^{(2)} + (a'_{18})^{(2)} \right) T_{17}(s_{16}), s_{16}) \right) G_{18}(s_{16}) ds_{16}$

$\tilde{T}_{16}(t) = T_{16}^0 + \int_0^t \left( (b_{16})^{(2)} T_{17}(s_{16}) - \left( (b'_{16})^{(2)} - (b''_{16})^{(2)} \right) G(s_{16}), s_{16}) \right) T_{16}(s_{16}) ds_{16}$

$\tilde{T}_{17}(t) = T_{17}^0 + \int_0^t \left( (b_{17})^{(2)} T_{16}(s_{16}) - \left( (b'_{17})^{(2)} - (b''_{17})^{(2)} \right) G(s_{16}), s_{16}) \right) T_{17}(s_{16}) ds_{16}$

$\tilde{T}_{18}(t) = T_{18}^0 + \int_0^t \left( (b_{18})^{(2)} T_{17}(s_{16}) - \left( (b'_{18})^{(2)} - (b''_{18})^{(2)} \right) G(s_{16}), s_{16}) \right) T_{18}(s_{16}) ds_{16}$

Where $s_{16}$ is the integrand that is integrated over an interval $(0,t)$

Consider operator $\mathcal{A}^{(3)}$ defined on the space of sextuples of continuous functions $G_i$, $T_i$: $\mathbb{R}_+ \rightarrow \mathbb{R}_+$ which satisfy

$G_i(0) = G_i^0$, $T_i(0) = T_i^0$, $G_i^0 \leq (\tilde{P}_{20})^{(3)}$, $T_i^0 \leq (\tilde{Q}_{20})^{(3)}$, $0 \leq G_i(t) - G_i^0 \leq (\tilde{P}_{20})^{(3)} e^{(\theta_{20})^{(3)} t}$

$0 \leq T_i(t) - T_i^0 \leq (\tilde{Q}_{20})^{(3)} e^{(\theta_{20})^{(3)} t}$

By

$\tilde{G}_{20}(t) = G_{20}^0 + \int_0^t \left( (a_{20})^{(3)} G_{21}(s_{20}) - \left( (a'_{20})^{(3)} + a''_{20} \right)^{(3)} T_{21}(s_{20}), s_{20}) \right) G_{20}(s_{20}) ds_{20}$

$\tilde{G}_{21}(t) = G_{21}^0 + \int_0^t \left( (a_{21})^{(3)} G_{20}(s_{20}) - \left( (a'_{21})^{(3)} + a''_{21} \right)^{(3)} T_{20}(s_{20}), s_{20}) \right) G_{21}(s_{20}) ds_{20}$

$\tilde{G}_{22}(t) = G_{22}^0 + \int_0^t \left( (a_{22})^{(3)} G_{21}(s_{20}) - \left( (a'_{22})^{(3)} + a''_{22} \right)^{(3)} T_{21}(s_{20}), s_{20}) \right) G_{22}(s_{20}) ds_{20}$

$\tilde{T}_{20}(t) = T_{20}^0 + \int_0^t \left( (b_{20})^{(3)} T_{21}(s_{20}) - \left( (b'_{20})^{(3)} - (b''_{20})^{(3)} \right) G(s_{20}), s_{20}) \right) T_{20}(s_{20}) ds_{20}$

$\tilde{T}_{21}(t) = T_{21}^0 + \int_0^t \left( (b_{21})^{(3)} T_{20}(s_{20}) - \left( (b'_{21})^{(3)} - (b''_{21})^{(3)} \right) G(s_{20}), s_{20}) \right) T_{21}(s_{20}) ds_{20}$

$\tilde{T}_{22}(t) = T_{22}^0 + \int_0^t \left( (b_{22})^{(3)} T_{21}(s_{20}) - \left( (b'_{22})^{(3)} - (b''_{22})^{(3)} \right) G(s_{20}), s_{20}) \right) T_{22}(s_{20}) ds_{20}
\[ T_{24}(t) = T_{21}^0 + \int_0^t \left[ \left( b_{21}(s) \right) T_{26}(s) - \left( b_{21}''(s) \right) T_{22}(s) \right] ds \]

\[ T_{25}(t) = T_{22}^0 + \int_0^t \left[ \left( b_{22}(s) \right) T_{27}(s) - \left( b_{22}''(s) \right) T_{23}(s) \right] ds \]

Where \( s(20) \) is the integrand that is integrated over an interval \((0, t)\).

Consider operator \( \mathcal{A}^{(4)} \) defined on the space of sextuples of continuous functions \( G_i, T_i: \mathbb{R}_+ \rightarrow \mathbb{R}_+ \) which satisfy

\[ G_i(0) = G_i^0, \quad T_i(0) = T_i^0, \quad G_i(t) \leq (P_{24})^{(4)}, \quad T_i(t) \leq (Q_{24})^{(4)}, \quad 0 \leq G_i(t) - G_i^0 \leq (P_{24})^{(4)} e^{(P_{24})^{(4)} t} \]

\[ 0 \leq T_i(t) - T_i^0 \leq (Q_{24})^{(4)} e^{(Q_{24})^{(4)} t} \]

By

\[ G_{24}(t) = G_{24}^0 + \int_0^t \left[ \left( a_{24}^{(4)} G_{25}(s) \right) - \left( a_{24}''^{(4)} G_{25}(s) \right) \right] ds \]

\[ G_{25}(t) = G_{25}^0 + \int_0^t \left[ \left( a_{25}^{(4)} G_{25}(s) \right) - \left( a_{25}''^{(4)} G_{25}(s) \right) \right] ds \]

\[ G_{26}(t) = G_{26}^0 + \int_0^t \left[ \left( a_{26}^{(4)} G_{25}(s) \right) - \left( a_{26}''^{(4)} G_{25}(s) \right) \right] ds \]

\[ T_{24}(t) = T_{24}^0 + \int_0^t \left[ \left( b_{24}^{(4)} T_{25}(s) \right) - \left( b_{24}''^{(4)} T_{25}(s) \right) \right] ds \]

\[ T_{25}(t) = T_{25}^0 + \int_0^t \left[ \left( b_{25}^{(4)} T_{25}(s) \right) - \left( b_{25}''^{(4)} T_{25}(s) \right) \right] ds \]

\[ T_{26}(t) = T_{26}^0 + \int_0^t \left[ \left( b_{26}^{(4)} T_{25}(s) \right) - \left( b_{26}''^{(4)} T_{25}(s) \right) \right] ds \]

Where \( s(24) \) is the integrand that is integrated over an interval \((0, t)\).

Consider operator \( \mathcal{A}^{(5)} \) defined on the space of sextuples of continuous functions \( G_i, T_i: \mathbb{R}_+ \rightarrow \mathbb{R}_+ \) which satisfy

\[ G_i(0) = G_i^0, \quad T_i(0) = T_i^0, \quad G_i(t) \leq (P_{28})^{(5)}, \quad T_i(t) \leq (Q_{28})^{(5)}, \quad 0 \leq G_i(t) - G_i^0 \leq (P_{28})^{(5)} e^{(P_{28})^{(5)} t} \]

\[ 0 \leq T_i(t) - T_i^0 \leq (Q_{28})^{(5)} e^{(Q_{28})^{(5)} t} \]

By

\[ G_{28}(t) = G_{28}^0 + \int_0^t \left[ \left( a_{28}^{(5)} G_{29}(s) \right) - \left( a_{28}''^{(5)} G_{29}(s) \right) \right] ds \]

\[ G_{29}(t) = G_{29}^0 + \int_0^t \left[ \left( a_{29}^{(5)} G_{29}(s) \right) - \left( a_{29}''^{(5)} G_{29}(s) \right) \right] ds \]

\[ G_{30}(t) = G_{30}^0 + \int_0^t \left[ \left( a_{30}^{(5)} G_{29}(s) \right) - \left( a_{30}''^{(5)} G_{29}(s) \right) \right] ds \]
\[ \bar{T}_{29}(t) = T_{29}^0 + \int_0^t \left[ (b_{28})^{(5)} T_{29}(s_{28}) - \left( (b'_{28})^{(5)} - (b''_{28})^{(5)} (G(s_{28}), s_{28}) \right) T_{29}(s_{28}) \right] ds_{28} \]

\[ \bar{T}_{29}(t) = T_{29}^0 + \int_0^t \left[ (b_{29})^{(5)} T_{29}(s_{28}) - \left( (b'_{29})^{(5)} - (b''_{29})^{(5)} (G(s_{28}), s_{28}) \right) T_{29}(s_{28}) \right] ds_{28} \]

\[ \bar{T}_{30}(t) = T_{30}^0 + \int_0^t \left[ (b_{30})^{(5)} T_{29}(s_{28}) - \left( (b'_{30})^{(5)} - (b''_{30})^{(5)} (G(s_{28}), s_{28}) \right) T_{30}(s_{28}) \right] ds_{28} \]

Where \( s_{28} \) is the integrand that is integrated over an interval \((0, t)\)

Consider operator \( \mathcal{A}^{(6)} \) defined on the space of sextuples of continuous functions \( G_i, T_i : \mathbb{R}_+ \to \mathbb{R}_+ \) which satisfy

\[ G_i(0) = G_i^0, \quad T_i(0) = T_i^0, \quad G_i(0) \leq (\bar{P}_{32})^{(6)}, T_i(0) \leq (\bar{Q}_{32})^{(6)}, \]

\[ 0 \leq G_i(t) - G_i^0 \leq (\bar{P}_{32})^{(6)} e^{(\mathcal{A}_{32})^{(6)} t} \]

\[ 0 \leq T_i(t) - T_i^0 \leq (\bar{Q}_{32})^{(6)} e^{(\mathcal{A}_{32})^{(6)} t} \]

By

\[ \bar{G}_{32}(t) = G_{32}^0 + \int_0^t \left[ (a_{32})^{(6)} G_{32}(s_{32}) - \left( (a'_{32})^{(6)} + a''_{32})^{(6)} (T_{32}(s_{32}), s_{32}) \right) G_{32}(s_{32}) \right] ds_{32} \]

\[ \bar{G}_{33}(t) = G_{33}^0 + \int_0^t \left[ (a_{33})^{(6)} G_{32}(s_{32}) - \left( (a'_{33})^{(6)} + (a''_{33})^{(6)} (T_{33}(s_{32}), s_{32}) \right) G_{33}(s_{32}) \right] ds_{32} \]

\[ \bar{G}_{34}(t) = G_{34}^0 + \int_0^t \left[ (a_{34})^{(6)} G_{33}(s_{32}) - \left( (a'_{34})^{(6)} + (a''_{34})^{(6)} (T_{34}(s_{32}), s_{32}) \right) G_{34}(s_{32}) \right] ds_{32} \]

\[ \bar{T}_{32}(t) = T_{32}^0 + \int_0^t \left[ (b_{32})^{(6)} T_{32}(s_{32}) - \left( (b'_{32})^{(6)} - (b''_{32})^{(6)} (G(s_{32}), s_{32}) \right) T_{32}(s_{32}) \right] ds_{32} \]

\[ \bar{T}_{33}(t) = T_{33}^0 + \int_0^t \left[ (b_{33})^{(6)} T_{32}(s_{32}) - \left( (b'_{33})^{(6)} - (b''_{33})^{(6)} (G(s_{32}), s_{32}) \right) T_{33}(s_{32}) \right] ds_{32} \]

\[ \bar{T}_{34}(t) = T_{34}^0 + \int_0^t \left[ (b_{34})^{(6)} T_{33}(s_{32}) - \left( (b'_{34})^{(6)} - (b''_{34})^{(6)} (G(s_{32}), s_{32}) \right) T_{34}(s_{32}) \right] ds_{32} \]

Where \( s_{32} \) is the integrand that is integrated over an interval \((0, t)\)

If the conditions IN THE FOREGOING are fulfilled, there exists a solution satisfying the conditions

**Definition of** \( G_i(0), T_i(0) : \)

\[ G_i(t) \leq (\bar{P}_{36})^{(7)} e^{(\mathcal{A}_{36})^{(7)} t} \]

\[ T_i(t) \leq (\bar{Q}_{36})^{(7)} e^{(\mathcal{A}_{36})^{(7)} t} \]

**Proof:**

Consider operator \( \mathcal{A}^{(7)} \) defined on the space of sextuples of continuous functions \( G_i, T_i : \mathbb{R}_+ \to \mathbb{R}_+ \)
which satisfy

\[ G_i(0) = G^0_i, \quad T_i(0) = T^0_i, \quad G^0_i \leq (\mathcal{P}_{36})^{(7)}, \quad T^0_i \leq (\mathcal{Q}_{36})^{(7)} \]

\[ 0 \leq G_i(t) - G^0_i \leq (\mathcal{P}_{36})^{(7)} e^{(\mathcal{M}_{36})^{(7)} t} \]

\[ 0 \leq T_i(t) - T^0_i \leq (\mathcal{Q}_{36})^{(7)} e^{(\mathcal{M}_{36})^{(7)} t} \]

By

\[ \mathcal{G}_{36}(t) = G^0_{36} + \int_0^t \left[ (a_{36})^{(7)} G_{37}(s_{36}) - \left( (a^*_3)^{(7)} + a^{**}_{36} \right) (T_{37}(s_{36}), s_{36}) \right] d s_{36} \]

\[ \mathcal{G}_{37}(t) = G^0_{37} + \int_0^t \left[ (a_{37})^{(7)} G_{38}(s_{36}) - \left( (a^*_3)^{(7)} + a^{**}_{37} \right) (T_{38}(s_{36}), s_{36}) \right] d s_{36} \]

\[ \mathcal{G}_{38}(t) = G^0_{38} + \int_0^t \left[ (a_{38})^{(7)} G_{37}(s_{36}) - \left( (a^*_3)^{(7)} + a^{**}_{38} \right) (T_{37}(s_{36}), s_{36}) \right] d s_{36} \]

\[ \mathcal{T}_{36}(t) = T^0_{36} + \int_0^t \left[ (b_{36})^{(7)} T_{37}(s_{36}) - \left( (b^*_3)^{(7)} - (b^{**}_{36})^{(7)} G(s_{36}), s_{36} \right) \right] d s_{36} \]

\[ \mathcal{T}_{37}(t) = T^0_{37} + \int_0^t \left[ (b_{37})^{(7)} T_{38}(s_{36}) - \left( (b^*_3)^{(7)} - (b^{**}_{37})^{(7)} G(s_{36}), s_{36} \right) \right] d s_{36} \]

\[ \mathcal{T}_{38}(t) = T^0_{38} + \int_0^t \left[ (b_{38})^{(7)} T_{37}(s_{36}) - \left( (b^*_3)^{(7)} - (b^{**}_{38})^{(7)} G(s_{36}), s_{36} \right) \right] d s_{36} \]
Where $S_{(36)}$ is the integrand that is integrated over an interval $(0, t)$

Analogous inequalities hold also for $G_{21}, G_{22}, T_{20}, T_{21}, T_{22}$

(a) The operator $\mathcal{A}^{(4)}$ maps the space of functions satisfying GLOBAL EQUATIONS into itself. Indeed it is obvious that

$$G_{24}(t) \leq G_{24}^0 + \int_0^t \left[ (a_{24})^{(4)} \left( \hat{A}_{24}^0 + (\hat{P}_{24})^{(4)} e^{(\hat{A}_{24})^{(4)} S_{(24)}} \right) \right] dS_{(24)} =$$

$$\left( 1 + (a_{24})^{(4)} t \right) G_{25}^0 + \frac{(a_{24})^{(4)} (\hat{P}_{24})^{(4)}}{(\hat{A}_{24})^{(4)}} e^{(\hat{A}_{24})^{(4)} t} - 1$$

From which it follows that

$$\left( G_{24}(t) - G_{24}^0 \right) e^{-(\hat{A}_{24})^{(4)} t} \leq \frac{(a_{24})^{(4)}}{(\hat{A}_{24})^{(4)}} \left( \left( \hat{P}_{24} \right)^{(4)} + G_{25}^0 \right) e^{\frac{(-\hat{P}_{24})^{(4)} c^2_{24}}{2c^2_{24}}} + (\hat{P}_{24})^{(4)}$$

($G_{24}^0$) is as defined in the statement of theorem 1

(b) The operator $\mathcal{A}^{(5)}$ maps the space of functions satisfying GLOBAL EQUATIONS into itself. Indeed it is obvious that

$$G_{28}(t) \leq G_{28}^0 + \int_0^t \left[ (a_{28})^{(5)} \left( \hat{A}_{28}^0 + (\hat{P}_{28})^{(5)} e^{(\hat{A}_{28})^{(5)} S_{(28)}} \right) \right] dS_{(28)} =$$

$$\left( 1 + (a_{28})^{(5)} t \right) G_{29}^0 + \frac{(a_{28})^{(5)} (\hat{P}_{28})^{(5)}}{(\hat{A}_{28})^{(5)}} e^{(\hat{A}_{28})^{(5)} t} - 1$$

From which it follows that

$$\left( G_{28}(t) - G_{28}^0 \right) e^{-(\hat{A}_{28})^{(5)} t} \leq \frac{(a_{28})^{(5)}}{(\hat{A}_{28})^{(5)}} \left( \left( \hat{P}_{28} \right)^{(5)} + G_{29}^0 \right) e^{\frac{(-\hat{P}_{28})^{(5)} c^2_{28}}{2c^2_{28}}} + (\hat{P}_{28})^{(5)}$$

($G_{28}^0$) is as defined in the statement of theorem 1

(c) The operator $\mathcal{A}^{(6)}$ maps the space of functions satisfying GLOBAL EQUATIONS into itself. Indeed it is obvious that

$$G_{32}(t) \leq G_{32}^0 + \int_0^t \left[ (a_{32})^{(6)} \left( \hat{A}_{32}^0 + (\hat{P}_{32})^{(6)} e^{(\hat{A}_{32})^{(6)} S_{(32)}} \right) \right] dS_{(32)} =$$

$$\left( 1 + (a_{32})^{(6)} t \right) G_{33}^0 + \frac{(a_{32})^{(6)} (\hat{P}_{32})^{(6)}}{(\hat{A}_{32})^{(6)}} e^{(\hat{A}_{32})^{(6)} t} - 1$$

From which it follows that

$$\left( G_{32}(t) - G_{32}^0 \right) e^{-(\hat{A}_{32})^{(6)} t} \leq \frac{(a_{32})^{(6)}}{(\hat{A}_{32})^{(6)}} \left( \left( \hat{P}_{32} \right)^{(6)} + G_{33}^0 \right) e^{\frac{(-\hat{P}_{32})^{(6)} c^2_{32}}{2c^2_{32}}} + (\hat{P}_{32})^{(6)}$$

($G_{32}^0$) is as defined in the statement of theorem 1
Analogous inequalities hold also for $G_{25}, G_{26}, T_{24}, T_{25}, T_{26}$

(d) The operator $\mathcal{A}^{(7)}$ maps the space of functions satisfying 37,35,36 into itself. Indeed it is obvious that

\[ G_{36}(t) \leq G_{36}^0 + \int_0^t \left[ (a_{36})^{(7)} \left( G_{37}^0 + (\dot{P}_{36})^{(7)} e^{(\dot{R}_{36})^{(7)} t} \right) \right] \, ds_{36} = \]

\[ (1 + (a_{36})^{(7)} t) G_{37}^0 + \frac{(a_{36})^{(7)} (\dot{P}_{36})^{(7)}}{(\dot{R}_{36})^{(7)}} \left( e^{(\dot{R}_{36})^{(7)} t} - 1 \right) \]

From which it follows that

\[ (G_{36}(t) - G_{36}^0) e^{-(\dot{R}_{36})^{(7)} t} \leq \frac{(a_{36})^{(7)}}{(\dot{R}_{36})^{(7)}} \left[ \left( \dot{P}_{36} \right)^{(7)} + G_{37}^0 e^{-\frac{(\dot{P}_{36})^{(7)} + G_{37}^0}{(\dot{R}_{36})^{(7)}}} + (\dot{P}_{36})^{(7)} \right) \]

$(G_i^0)$ is as defined in the statement of theorem 7

It is now sufficient to take $\frac{(a_j)^{1(1)}}{(\dot{R}_{13})^{1(1)}}$, $\frac{(b_j)^{1(1)}}{(\bar{R}_{13})^{1(1)}} < 1$ and to choose $(\bar{P}_{13})^{(1)}$ and $(\bar{Q}_{13})^{(1)}$ large to have

\[ \left( \frac{(a_j)^{1(1)}}{(\bar{R}_{13})^{1(1)}} \right) \left( \bar{P}_{13} \right)^{(1)} + \left( \frac{(b_j)^{1(1)}}{(\bar{R}_{13})^{1(1)}} \right) \left( \bar{Q}_{13} \right)^{(1)} \leq \left( \bar{P}_{13} \right)^{(1)} \]

\[ \left( \frac{(a_j)^{1(1)}}{(\bar{R}_{13})^{1(1)}} \right) \left( \bar{Q}_{13} \right)^{(1)} + \left( \frac{(b_j)^{1(1)}}{(\bar{R}_{13})^{1(1)}} \right) \left( (\bar{Q}_{13})^{(1)} + (\bar{T}_{j}^0) e^{-\left( \frac{(\bar{Q}_{13})^{(1)} + (\bar{T}_{j}^0)}{\bar{T}_{j}^0} \right)} \right) \leq \left( \bar{Q}_{13} \right)^{(1)} \]

In order that the operator $\mathcal{A}^{(1)}$ transforms the space of sextuples of functions $G_i, T_i$ satisfying GLOBAL EQUATIONS into itself

The operator $\mathcal{A}^{(1)}$ is a contraction with respect to the metric

\[ d \left( (G^{(1)}, T^{(1)}), (G^{(2)}, T^{(2)}) \right) = \sup \max \left| G_i^{(1)}(t) - G_i^{(2)}(t) \right| e^{-\left( \frac{(\bar{R}_{13})^{(1)} + (\bar{T}_{j}^0)}{(\bar{T}_{j}^0)} \right)} \max \left| T_i^{(1)}(t) - T_i^{(2)}(t) \right| e^{-\left( \frac{(\bar{R}_{13})^{(1)}}{(\bar{T}_{j}^0)} \right)} \]

Indeed if we denote

**Definition of $\tilde{G}, \tilde{T}$:**

\[ (\tilde{G}, \tilde{T}) = \mathcal{A}^{(1)}(G, T) \]

It results
\[ |\tilde{G}_i^{(1)} - \tilde{G}_i^{(2)}| \leq \int_0^t (a_{13}^{(1)}) G_{14}^{(1)} - G_{14}^{(2)} e^{-\tilde{R}_{13}(1)\tilde{x}(13)} e^{(\tilde{R}_{13})(1)\tilde{x}(13)} dS(13) + \]

\[ \int_0^t (a_{13}^{(1)}) G_{13}^{(1)} - G_{13}^{(2)} e^{-\tilde{R}_{13}(1)\tilde{x}(13)} e^{(\tilde{R}_{13})(1)\tilde{x}(13)} + \]

\[ (a_{13}^{(1)}(T_{14}^{(1)}, s(13))) G_{13}^{(1)} - G_{13}^{(2)} e^{(\tilde{R}_{13})(1)\tilde{x}(13)} e^{(\tilde{R}_{13})(1)\tilde{x}(13)} + \]

\[ G_{13}^{(2)} (a_{13}^{(1)}(T_{14}^{(2)}, s(13))) - (a_{13}^{(1)}(T_{14}^{(2)}, s(13))) e^{(\tilde{R}_{13})(1)\tilde{x}(13)} e^{(\tilde{R}_{13})(1)\tilde{x}(13)} dS(13) \]

Where \( S(13) \) represents integrant that is integrated over the interval \([0, t]\)

From the hypotheses it follows

\[ \int_0^t (a_{13}^{(1)}) G_{14}^{(1)} - G_{14}^{(2)} e^{-\tilde{R}_{13}(1)\tilde{x}(13)} \leq \frac{1}{\tilde{R}_{13}(1)} \left( (a_{13}^{(1)}) + (a_{13}^{(2)}) + (\tilde{A}_{13}) + (\tilde{P}_{13})(\tilde{k}_{13}) \right) d \left( (G^{(1)}, T^{(1)}); (G^{(2)}, T^{(2)}) \right) \]

And analogous inequalities for \( G_i \) and \( T_i \). Taking into account the hypothesis the result follows

**Remark 1:** The fact that we supposed \((a_{13}^{(1)})\) and \((b_{13}^{(1)})\) depending also on \( t \) can be considered as not conformal with the reality, however we have put this hypothesis in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by \((\tilde{P}_{13})(\tilde{k}_{13}) e^{(\tilde{R}_{13})(1)\tilde{x}(13)}\) and \((\tilde{Q}_{13})(\tilde{k}_{13}) e^{(\tilde{R}_{13})(1)\tilde{x}(13)}\) respectively of \( \mathbb{R}^+ \).

If instead of proving the existence of the solution on \( \mathbb{R}^+ \), we have to prove it only on a compact then it suffices to consider that \((a_{13}^{(1)}) \) and \((b_{13}^{(1)})\), \( i = 13, 14, 15 \) depend only on \( T_{14} \) and respectively on \( G(\text{and not on } t) \) and hypothesis can be replaced by a usual Lipschitz condition.

**Remark 2:** There does not exist any \( t \) where \( G_i (t) = 0 \) and \( T_i (t) = 0 \)

From 19 to 24 it results

\[ G_i (t) \geq G_i^0 e^{-\tilde{R}_{13}(1)\tilde{x}(13)} dS(13) \geq 0 \]

\[ T_i (t) \geq T_i^0 e^{-b_{13}(1)\tilde{x}(13)} > 0 \quad \text{for } t > 0 \]

**Definition of** \((\tilde{M}_{13})^{(1)})_i\) and \((\tilde{M}_{13})^{(1)})_3\)

**Remark 3:** if \( G_{13} \) is bounded, the same property have also \( G_{14} \) and \( G_{15} \). Indeed if

\[ G_{13} < (\tilde{M}_{13})^{(1)} \quad \text{it follows } \frac{dG_{14}}{dt} \leq (G^{(1)})_1 - (a_{14}^{(1)}) G_{14} \]

and by integrating

\[ G_{14} \leq G_{14}^0 + 2(a_{14}^{(1)})(\tilde{M}_{13})^{(1)}_1 / (\tilde{a}_{14}^{(1)}) \]

In the same way, one can obtain

\[ G_{15} \leq G_{15}^0 + 2(\tilde{a}_{15}^{(1)})(\tilde{M}_{13})^{(1)}_2 / (\tilde{a}_{15}^{(1)}) \]

If \( G_{14} \) or \( G_{15} \) is bounded, the same property follows for \( G_{13}, G_{15} \) and \( G_{13}, G_{14} \) respectively.

**Remark 4:** If \( G_{13} \) is bounded, from below, the same property holds for \( G_{14} \) and \( G_{15} \). The proof is analogous with the preceding one. An analogous property is true if \( G_{14} \) is bounded from below.

**Remark 5:** If \( T_{13} \) is bounded from below and \( \lim_{t \to + \infty} (b_{14}^{(1)})(G(t), t) \) = \( (b_{14}^{(1)}) \) then \( T_{14} \to + \infty \).

**Definition of** \((m)^{(1)}\) and \( \varepsilon_1 \)
Indeed let \( t_1 \) be so that for \( t > t_1 \)
\[(b_{14})^{(1)} - (b_{14})^{(1)}(G(t), t) < \varepsilon_1, T_{13}(t) > (m)^{(1)} \]

Then \( \frac{dT_{14}}{dt} \geq (a_{14})^{(1)}(m)^{(1)} - \varepsilon_1 T_{14} \) which leads to

\[ T_{14} \geq \left( \frac{(a_{14})^{(1)}(m)^{(1)}}{\varepsilon_1} \right) \left(1 - e^{-\varepsilon_1 t} + T_{14}^0 e^{-\varepsilon_1 t} \right) \]

If we take \( t \) such that \( e^{-\varepsilon_1 t} = \frac{1}{2} \) it results

\[ T_{14} \geq \left( \frac{(a_{14})^{(1)}(m)^{(1)}}{2} \right), \quad t = \log \frac{2}{\varepsilon_1} \]

By taking now \( \varepsilon_1 \) sufficiently small one sees that \( T_{14} \) is unbounded. The same property holds for \( T_{15} \) if \( \lim_{t \to \infty} (b_{15})^{(1)}(G(t), t) = (b_{15})^{(1)} \)

We now state a more precise theorem about the behaviors at infinity of the solutions

It is now sufficient to take \( \frac{(a_{14})^{(2)}}{(M_{14})^{(2)}} \), \( \frac{(b_{14})^{(2)}}{(M_{16})^{(2)}} < 1 \) and to choose

\[(\tilde{P}_{16})^{(2)} \text{ and } (\tilde{Q}_{16})^{(2)} \]

large to have

\[ \left( \frac{(a_{14})^{(2)}}{(M_{14})^{(2)}} \right) \left( \tilde{P}_{16} \right)^{(2)} + \left( \tilde{Q}_{16} \right)^{(2)} = \leq \left( \tilde{P}_{16} \right)^{(2)} \]

\[ \left( \frac{(b_{14})^{(2)}}{(M_{16})^{(2)}} \right) \left( (\tilde{Q}_{16})^{(2)} + T_{14}^0 e^{-\frac{(\tilde{Q}_{16})^{(2)} + T_{14}^0}{T_1^0}} \right) \leq (\tilde{Q}_{16})^{(2)} \]

In order that the operator \( \mathcal{A}^{(2)} \) transforms the space of sextuples of functions \( G_i, T_i \) satisfying

The operator \( \mathcal{A}^{(2)} \) is a contraction with respect to the metric

\[ d \left( \left( (G_{19})^{(1)}, (T_{19})^{(1)} \right), \left( (G_{19})^{(2)}, (T_{19})^{(2)} \right) \right) = \]

\[ \sup_{i \in \mathbb{R}^+} \max \left| G_{i}^{(1)}(t) - G_{i}^{(2)}(t) e^{-\left( M_{16} \right)^{(2)} t}, \max_{i \in \mathbb{R}^+} \left| T_{i}^{(1)}(t) - T_{i}^{(2)}(t) e^{-\left( M_{16} \right)^{(2)} t} \right| \right| \]

Indeed if we denote

**Definition of** \( \tilde{G}_{19} \overline{T}_{19} : (\tilde{G}_{19}, \overline{T}_{19}) = \mathcal{A}^{(2)}(G_{19}, T_{19}) \)

It results

\[ |\tilde{G}_{19}^{(1)} - \tilde{G}_{19}^{(2)}| \leq \int_0^t (a_{16})^{(2)}(G_{17}^{(1)} - G_{17}^{(2)}) e^{-\left( M_{16} \right)^{(2)} x_{16}} e^{(N_{16})^{(2)} x_{16}} ds_{16} + \]

\[ \int_0^t (a_{16})^{(2)}(G_{16}^{(1)} - G_{16}^{(2)}) e^{-\left( M_{16} \right)^{(2)} x_{16}} e^{(N_{16})^{(2)} x_{16}} + \]

\[ (a_{16})^{(2)}(T_{17}^{(1)}, s_{16})(G_{16}^{(1)} - G_{16}^{(2)}) e^{-\left( M_{16} \right)^{(2)} x_{16}} e^{(N_{16})^{(2)} x_{16}} + \]

\[ (a_{16})^{(2)}(T_{17}^{(1)}, s_{16})(G_{16}^{(1)} - G_{16}^{(2)}) e^{-\left( M_{16} \right)^{(2)} x_{16}} e^{(N_{16})^{(2)} x_{16}} ds_{16} \]

Where \( s_{16} \) represents integrand that is integrated over the interval \([0, t]\)
From the hypotheses it follows

\[
\begin{align*}
\frac{1}{\hat{M}_{16}^{(2)}} \left( a_{16}^{(2)} + a_{16}^{(2)} + (\hat{A}_{16})^{(2)} + (\hat{P}_{16}^{(2)})(\hat{K}_{16}^{(2)})^{d} \left( ((G_{19})^{(1)} + (T_{19})^{(1)} ; (G_{19})^{(2)} + (T_{19})^{(2)} \right) \right)
\end{align*}
\]

And analogous inequalities for \( G_i \) and \( T_i \). Taking into account the hypothesis the result follows

**Remark 1:** The fact that we supposed \((a_1')^{(2)}\) and \((b_1')^{(2)}\) depending also on \( t \) can be considered as not conformal with the reality, however we have put this hypothesis in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by \((\hat{P}_{16}^{(2)})^{(2)} \hat{c}^{(16)}^{(2)} e^{(16)}^{(2)} \) and \((\hat{T}_{16}^{(2)})^{(2)} \hat{c}^{(16)}^{(2)} e^{(16)}^{(2)} \) respectively of \( \mathbb{R}_+ \).

If instead of proving the existence of the solution on \( \mathbb{R}_+ \), we have to prove it only on a compact then it suffices to consider that \((a_1')^{(2)}\) and \((b_1')^{(2)}\), \( i = 16,17,18 \) depend only on \( T_{17} \) and respectively on \((G_{19})(and not on t\) and hypothesis can replaced by a usual Lipschitz condition.

**Remark 2:** There does not exist any \( t \) where \( G_i(t) = 0 \) and \( T_i(t) = 0 \)

From 19 to 24 it results

\[
\begin{align*}
\frac{G_i(t)}{G_i(t)} \geq e^{\int_{0}^{t}((a_1')^{(2)} - (a_1')^{(2)}((T_{17}^{(16)})^{(16)}))dt} \geq 0
\end{align*}
\]

\[
\begin{align*}
T_i(t) \geq 0 \quad \text{for } t > 0
\end{align*}
\]

**Definition of \((\hat{M}_{16}^{(2)})_{,1}^{(2)}, (\hat{M}_{16}^{(2)})_{,2}^{(2)}\) and \((\hat{M}_{16}^{(2)})_{,3}^{(2)}\):**

**Remark 3:** if \( G_{16} \) is bounded, the same property have also \( G_{17} \) and \( G_{18} \). indeed if

\[
\begin{align*}
G_{16} \leq (\hat{M}_{16}^{(2)}) \frac{dG_{12}}{dt} \leq ((\hat{M}_{16}^{(2)})) - (a_1')^{(2)} G_{17} \text{ and by integrating}
\end{align*}
\]

\[
\begin{align*}
G_{17} \leq ((\hat{M}_{16}^{(2)}))_1 = G_{17}^{(2)} + 2(a_1')^{(2)}((\hat{M}_{16}^{(2)}))_1 / (a_1')^{(2)}
\end{align*}
\]

\[
\begin{align*}
G_{18} \leq ((\hat{M}_{16}^{(2)}))_2 = G_{18}^{(2)} + 2(a_1')^{(2)}((\hat{M}_{16}^{(2)}))_2 / (a_1')^{(2)}
\end{align*}
\]

If \( G_{17} \) or \( G_{18} \) is bounded, the same property follows for \( G_{16}, G_{18} \) and \( G_{16}, G_{17} \) respectively.

**Remark 4:** If \( G_{16} \) is bounded, from below, the same property holds for \( G_{17} \) and \( G_{18} \). The proof is analogous with the preceding one. An analogous property is true if \( G_{17} \) is bounded from below.

**Remark 5:** If \( T_{16} \) is bounded from below and \( \lim_{t \to \infty} ((b_1')^{(2)}((G_{19})(t), t)) = (b_1')^{(2)} \) then \( T_{17} \to \infty \).

**Definition of \((m)^{(2)}\) and \( \epsilon_2 \):**

Indeed let \( t_2 \) be so that for \( t > t_2 \)

\[
\begin{align*}
(b_{17})^{(2)} - (b_1')^{(2)}((G_{19})(t), t) < \epsilon_2, T_{16}(t) > (m)^{(2)}
\end{align*}
\]

Then \( \frac{dT_{17}}{dt} \geq (a_1')^{(2)}(m)^{(2)} - \epsilon_2 T_{17} \) which leads to

\[
\begin{align*}
T_{17} \geq \frac{(a_1')^{(2)}(m)^{(2)}}{\epsilon_2} (1 - e^{-\epsilon_2 t}) + T_{17}^{0} e^{-\epsilon_2 t} \text{ If we take } t \text{ such that } e^{-\epsilon_2 t} = \frac{1}{2} \text{ it results}
\end{align*}
\]
By taking now $s$ sufficiently small one sees that $T_1$ is unbounded. The same property holds for $T_8$ if

$$\lim_{t \to \infty} (b_{18}(t), G_{19}(t), t) = (b_{18}(0), G_{19}(0), 0)$$

We now state a more precise theorem about the behaviors at infinity of the solutions.

It is now sufficient to take $\left( \frac{a_{i}(3)}{(M_{20})^3}, \frac{b_{i}(3)}{(M_{20})^3} \right) < 1$ and to choose

$$(\bar{P}_{20})^{(3)} \text{ and } (\bar{Q}_{20})^{(3)} \text{ large to have}$$

$$\left( \frac{a_{i}(3)}{(M_{20})^3} \left[ (\bar{P}_{20})^{(3)} + (\bar{Q}_{20})^{(3)} + G_{j}^{-}\bar{T}_{j} \right] e^{-\frac{(\bar{P}_{20})^{(3)}+\bar{T}}{\bar{T}}} \right) \leq (\bar{P}_{20})^{(3)}$$

$$\left( \frac{b_{i}(3)}{(M_{20})^3} \left[ (\bar{Q}_{20})^{(3)} + \bar{T}_{j}^{2} \right] e^{-\frac{(\bar{Q}_{20})^{(3)}+\bar{T}}{\bar{T}}} \right) \leq (\bar{Q}_{20})^{(3)}$$

In order that the operator $\mathcal{A}(3)$ transforms the space of sextuples of functions $G_i, T_i$ into itself.

The operator $\mathcal{A}(3)$ is a contraction with respect to the metric

$$d \left( ((G_{23})^{(1)}, (T_{23})^{(1)}), ((G_{23})^{(2)}, (T_{23})^{(2)}) \right) =$$

$$\sup_{t \in \mathbb{R}^+} \max_{i \in \mathbb{R}^+} |G_i^{(1)}(t) - G_i^{(2)}(t)| e^{-(\bar{M}_{20})^{(3)}x_{20}} \max_{i \in \mathbb{R}^+} |T_i^{(1)}(t) - T_i^{(2)}(t)| e^{-(\bar{M}_{20})^{(3)}x_{20}}$$

Indeed if we denote

**Definition of $\tilde{G}_{23}, \tilde{T}_{23}: (\tilde{G}_{23}, \tilde{T}_{23}) = \mathcal{A}(3)((G_{23}), (T_{23}))$**

It results

$$|\tilde{G}_{20}^{(3)} - \tilde{G}_{i}^{(2)}| \leq \int_{0}^{t} \left( |a_{20}^{(3)}| G_{21}^{(1)} - G_{21}^{(2)} | \bar{T}_{20}^{(3)} + \bar{T}_{20}^{(2)} \right) e^{-(\bar{M}_{20})^{(3)}x_{20}} e^{(\bar{M}_{20})^{(3)}x_{20}} ds_{20} +$$

$$\int_{0}^{t} \left( |a_{20}^{(3)}| G_{20}^{(1)} - G_{20}^{(2)} | \bar{T}_{21}^{(3)} + \bar{T}_{21}^{(2)} \right) e^{-(\bar{M}_{20})^{(3)}x_{20}} e^{(\bar{M}_{20})^{(3)}x_{20}} ds_{20} +$$

$$G_{20}^{(2)} \left( |a_{20}^{(3)}| (\bar{T}_{21}^{(3)} + s_{20}) - (a_{20}^{(3)}(\bar{T}_{21}^{(2)} + s_{20}) \right) e^{-(\bar{M}_{20})^{(3)}x_{20}} e^{(\bar{M}_{20})^{(3)}x_{20}} ds_{20}$$

Where $s_{20}$ represents integrand that is integrated over the interval $[0, t]$.

From the hypotheses it follows

$$\left| G^{(1)} - G^{(2)} e^{-(\bar{M}_{20})^{(3)}x_{20}} \right|$$

$$= \frac{1}{(\bar{M}_{20})^{3}} \left( |a_{20}^{(3)}| + |a_{20}^{(3)}| + (\bar{T}_{20}^{(3)}) + (\bar{T}_{20}^{(3)}) \right) d \left( ((G_{23})^{(1)}, (T_{23})^{(1)}), ((G_{23})^{(2)}, (T_{23})^{(2)}) \right)$$

And analogous inequalities for $G_i$ and $T_i$ Taking into account the hypothesis the result follows

**Remark 1:** The fact that we supposed $(a_{20}^{(3)})$ and $(b_{20}^{(3)})$ depending also on $t$ can be considered as...
not conformal with the reality, however we have put this hypothesis, in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by 
\( (P_{20})^{(3)} e^{(M_{20})^{(3)} t} \) and \( (Q_{20})^{(3)} e^{(M_{20})^{(3)} t} \) respectively of \( \mathbb{R}_+ \).

If instead of proving the existence of the solution on \( \mathbb{R}_+ \), we have to prove it only on a compact then it suffices to consider that \((a_i^{''}(3)) (b_i^{''}(3)), i = 20, 21, 22 \) depend only on \( T_{21} \) and respectively on \( (G_{23}) (\text{not on } t) \) and hypothesis can replaced by a usual Lipschitz condition.

**Remark 2:** There does not exist any \( t \) where \( G_i(t) = 0 \) and \( T_i(t) = 0 \)

From 19 to 24 it results

\[
G_i(t) \geq G_i^0 e^{-\int_0^t (a_i^{''}(3)(T_{21}(s(20)), x(20))) ds(20)} \geq 0
\]

\[
T_i(t) \geq T_i^0 e^{-\int_0^t (b_i^{''}(3)) ds(20)} > 0 \quad \text{for } t > 0
\]

**Definition of** \((M_{20})^{(3)} \), \((M_{20})^{(3)} \), and \((M_{20})^{(3)} \):

**Remark 3:** If \( G_{20} \) is bounded, the same property have also \( G_{21} \) and \( G_{22} \). Indeed if

\[
G_{20} < (M_{20})^{(3)} \text{ it follows } \frac{dG_{21}}{dt} \leq (M_{20})^{(3)} - (a_{21})^{(3)} G_{21} \text{ and by integrating}
\]

\[
G_{21} \leq (M_{20})^{(3)} e^{(a_{21})^{(3)} t} / (a_{21})^{(3)}
\]

In the same way, one can obtain

\[
G_{22} \leq (M_{20})^{(3)} e^{(a_{22})^{(3)} t} / (a_{22})^{(3)}
\]

If \( G_{21} \) or \( G_{22} \) is bounded, the same property follows for \( G_{20} \), \( G_{22} \) and \( G_{20} \), \( G_{21} \) respectively.

**Remark 4:** If \( G_{20} \) is bounded, from below, the same property holds for \( G_{21} \) and \( G_{22} \). The proof is analogous with the preceding one. An analogous property is true if \( G_{21} \) is bounded from below.

**Remark 5:** If \( T_{20} \) is bounded from below and \( \lim_{t \to \infty} ((b_i^{''}(3))(G_{23})(t), t) = (b_i^{''}(3)) \) then

\[
T_{21} \to \infty.
\]

**Definition of** \((m)^{(3)} \) and \( \varepsilon_3 \):

Indeed let \( t_3 \) be so that for \( t > t_3 \)

\[
(b_{21})^{(3)} - (b_i^{''}(3))(G_{23})(t), t) < \varepsilon_3, T_{20}(t) > (m)^{(3)}
\]

Then \( \frac{dT_{21}}{dt} \geq (a_{21})^{(3)}(m)^{(3)} - \varepsilon_3 T_{21} \) which leads to

\[
T_{21} \geq \frac{(a_{21})^{(3)}(m)^{(3)}}{\varepsilon_3} (1 - e^{-\varepsilon_3 t}) + T_{21}^0 e^{-\varepsilon_3 t} \quad \text{If we take } t \text{ such that } e^{-\varepsilon_3 t} = \frac{1}{2} \text{ it results}
\]

\[
T_{21} \geq \frac{(a_{21})^{(3)}(m)^{(3)}}{2} \quad \text{By taking now } \varepsilon_3 \text{ sufficiently small one sees that } T_{21} \text{ is unbounded. The same property holds for } T_{22} \text{ if } \lim_{t \to \infty} ((b_i^{''}(3))(G_{23})(t), t) = (b_i^{''}(3))
\]

We now state a more precise theorem about the behaviors at infinity of the solutions

It is now sufficient to take \( \frac{(a_i)^{(4)}}{(M_{24})^{(4)}} \), \( \frac{(b_i)^{(4)}}{(M_{24})^{(4)}} < 1 \) and to choose
In order that the operator $A^{(4)}$ transforms the space of sextuples of functions $G_i, T_i$ satisfying \( \text{IN} \) to itself.

The operator $A^{(4)}$ is a contraction with respect to the metric

\[
d \left( ((G_{27})^{(1)}, (T_{27})^{(1)}), ((G_{27})^{(2)}, (T_{27})^{(2)}) \right) = 
\sup_{t} \left( \max_{t \in \mathbb{R}^+} |G_i^{(1)}(t) - G_i^{(2)}(t)| e^{-((\theta_{24})^{(4)})t}, \max_{t \in \mathbb{R}^+} |T_i^{(1)}(t) - T_i^{(2)}(t)| e^{-((\theta_{24})^{(4)})t} \right)
\]

Indeed if we denote

**Definition of** $(\overline{G_{27}}), (\overline{T_{27}})$ : $( (\overline{G_{27}}), (\overline{T_{27}})) = A^{(4)}((G_{27}), (T_{27}))$

It results

\[
\left| G_{24}^{(2)} - G_{24}^{(1)} \right| \leq \int_{0}^{t} \left( a_{24}^{(4)} \right) G_{24}^{(1)} - G_{24}^{(2)} | e^{-((\theta_{24})^{(4)}) s_{24}} e^{((\theta_{24})^{(4)}) s_{24}} dS_{24} + \right.
\]

\[
\left. \int_{0}^{t} \left( a_{24}'^{(4)} \right) G_{24}^{(1)} - G_{24}^{(2)} | e^{-((\theta_{24})^{(4)}) s_{24}} e^{((\theta_{24})^{(4)}) s_{24}} + \right.
\]

\[
( a_{24}''^{(4)} ) (T_{25}^{(1)}, s_{24}) | G_{24}^{(1)} - G_{24}^{(2)} | e^{-((\theta_{24})^{(4)}) s_{24}} e^{((\theta_{24})^{(4)}) s_{24}} + \right.
\]

\[
G_{24}^{(2)} | ( a_{24}''^{(4)} ) (T_{25}^{(1)}, s_{24}) - ( a_{24}''^{(4)} ) (T_{25}^{(2)}, s_{24}) | e^{-((\theta_{24})^{(4)}) s_{24}} e^{((\theta_{24})^{(4)}) s_{24}} dS_{24}
\]

Where $s_{24}$ represents integrand that is integrated over the interval $[0, t]$

From the hypotheses it follows

\[
| (G_{27})^{(1)} - (G_{27})^{(2)} | e^{-((\theta_{24})^{(4)}) t} \leq \frac{1}{(\theta_{24})^{(4)}} (a_{24}^{(4)} + (a_{24}')^{(4)} + (a_{24}'')^{(4)} + (P_{24})^{(4)} (T_{24})^{(4)} + (Q_{24})^{(4)} (T_{24})^{(4)} d \left( ((G_{27})^{(1)}, (T_{27})^{(1)}), (G_{27})^{(2)}, (T_{27})^{(2)}) \right)
\]

And analogous inequalities for $G_i$ and $T_i$. Taking into account the hypothesis the result follows

**Remark 1**: The fact that we supposed $(a_{24}'')^{(4)}$ and $(b_{24}'')^{(4)}$ depending also on $t$ can be considered as not conformal with the reality, however we have put this hypothesis in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by $(P_{24})^{(4)} e^{((\theta_{24})^{(4)}) t}$ and $(Q_{24})^{(4)} e^{((\theta_{24})^{(4)}) t}$ respectively of $\mathbb{R}^+$. 

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If instead of proving the existence of the solution on \( \mathbb{R}_+ \), we have to prove it only on a compact then it suffices to consider that \((a''_i(t), b''_i(t)) = (a''_i(t'), b''_i(t'))\) for \( i = 24, 25, 26 \) depend only on \( T_{25} \) and respectively on \( (G_{27}) \) and not on \( t \) and hypothesis can replaced by a usual Lipschitz condition.

**Remark 2:** There does not exist any \( t \) where \( G_i(t) = 0 \) and \( T_i(t) = 0 \). From GLOBAL EQUATIONS it results

\[
G_i(t) \geq G_i^0 e^{\left( -\int_{0}^{t} \left( (a''_i(t') - (a''_i(t'))(T_{25}(t'))(\sigma_{25}(t'))\right) dt'_1 \right)} \geq 0
\]

\[
T_i(t) \geq T_i^0 e^{(-b''_i(t'))} > 0 \quad \text{for } t > 0
\]

**Definition of** \((\overline{M}_{24})^{(4)}_1, (\overline{M}_{24})^{(4)}_2 \) and \((\overline{M}_{24})^{(4)}_3)\):

**Remark 3:** if \( G_{24} \) is bounded, the same property have also \( G_{25} \) and \( G_{26} \), indeed if

\[
G_{24} < (\overline{M}_{24})^{(4)} \text{ it follows } \frac{dG_{24}}{dt} \leq (\overline{M}_{24})^{(4)} - (a_{25})^{(4)}G_{25} \text{ and by integrating}
\]

\[
G_{25} \leq (\overline{M}_{24})^{(4)}_2 = G_{25}^0 + 2(a_{25})^{(4)}(\overline{M}_{24})^{(4)}_1/(a_{25})^{(4)}
\]

In the same way, one can obtain

\[
G_{26} \leq (\overline{M}_{24})^{(4)}_3 = G_{26}^0 + 2(a_{26})^{(4)}(\overline{M}_{24})^{(4)}_1/(a_{26})^{(4)}
\]

If \( G_{25} \) or \( G_{26} \) is bounded, the same property follows for \( G_{24} \), \( G_{26} \) and \( G_{24}, G_{25} \) respectively.

**Remark 4:** If \( G_{24} \) is bounded, from below, the same property holds for \( G_{25} \) and \( G_{26} \), The proof is analogous with the preceding one. An analogous property is true if \( G_{25} \) is bounded from below.

**Remark 5:** If \( T_{24} \) is bounded from below and \( \lim_{x \to \infty} ((b''_i(t), (G_{27})(t), t)) = (b''_i(t), (G_{27})(t), t)) \) then \( T_{25} \to \infty \).

**Definition of** \((m)^{(4)} \) and \( \varepsilon_4 \):

Indeed let \( t_4 \) be so that for \( t > t_4 \)

\[
(b_{25})^{(4)} - (b''_{25})^{(4)}((G_{27})(t), t) < \varepsilon_4, T_{24}(t) > (m)^{(4)}
\]

Then \( \frac{dT_{25}}{dt} \geq (a_{25})^{(4)}(m)^{(4)} - \varepsilon_4 T_{25} \) which leads to

\[
T_{25} \geq \left( \frac{(a_{25})^{(4)}(m)^{(4)}}{\varepsilon_4} \right) (1 - e^{-\varepsilon_4 t}) + T_{25}^0 e^{-\varepsilon_4 t} \text{ If we take } t \text{ such that } e^{-\varepsilon_4 t} = \frac{1}{2} \text{ it results}
\]

\[
T_{25} \geq \left( \frac{(a_{25})^{(4)}(m)^{(4)}}{2} \right), \quad t = \log \frac{2}{\varepsilon_4} \text{ By taking now } \varepsilon_4 \text{ sufficiently small one sees that } T_{25} \text{ is unbounded. The same property holds for } T_{26} \text{ if } \lim_{x \to \infty} ((b''_i(t), (G_{27})(t), t)) = (b''_i(t), (G_{27})(t), t))
\]

We now state a more precise theorem about the behaviors at infinity of the solutions ANALOGOUS inequalities hold also for \( G_{29}, G_{30}, T_{28}, T_{29}, T_{30} \).
It is now sufficient to take \( \frac{(a_i)^{(5)}}{(M_{28})^{(5)}} \), \( \frac{(b_j)^{(5)}}{(M_{28})^{(5)}} \) < 1 and to choose

\( \left( \hat{P}_{28} \right)^{(5)} \) and \( \left( \hat{Q}_{28} \right)^{(5)} \) large to have

\[
\left( \frac{(a_i)^{(5)}}{(M_{28})^{(5)}} \right) \left( \hat{P}_{28} \right)^{(5)} + \left( \hat{G}_j \right)^{(5)} e^{-\left( \frac{(\hat{P}_{28})^{(5)} + \hat{G}_j^{(5)}}{\sigma_j} \right)} \leq \left( \hat{P}_{28} \right)^{(5)}
\]

\[
\left( \frac{(b_j)^{(5)}}{(M_{28})^{(5)}} \right) \left( \left( \hat{Q}_{28} \right)^{(5)} + \left( T_j \right)^{(5)} e^{-\left( \frac{(\hat{Q}_{28})^{(5)} + T_j^{(5)}}{\tau_j} \right)} \right) \leq \left( \hat{Q}_{28} \right)^{(5)}
\]

In order that the operator \( \mathcal{A}^{(5)} \) transforms the space of sextuples of functions \( G_i, T_i \) into itself

The operator \( \mathcal{A}^{(5)} \) is a contraction with respect to the metric

\[
d \left( \left( G_{31}^{(1)}, T_{31}^{(1)} \right), \left( G_{31}^{(2)}, T_{31}^{(2)} \right) \right) = \sup \{ \max_{t \in \mathbb{R}^+} \left| G_i^{(1)}(t) - G_i^{(2)}(t) \right| e^{-\left( N_{28}^{(5)}t \right)} \}
\]

Indeed if we denote

**Definition of** \( \left( \overline{G_{31}}, \overline{T_{31}} \right) : \left( \left( \overline{G_{31}}, \overline{T_{31}} \right) \right) = \mathcal{A}^{(5)} \left( \left( G_{31}, T_{31} \right) \right) \)

It results

\[
\left| \overline{G_{28}}^{(1)} - \overline{G_i}^{(2)} \right| \leq \int_0^t \left( a_{28}^{(5)} \right) \left| \overline{G_2}^{(1)} - \overline{G_2}^{(2)} \right| e^{-\left( N_{28}^{(5)}x_{28} \right)} e^{\left( N_{28}^{(5)}x_{28} \right)} ds_{28} + \]

\[
\int_0^t \left( a_{28}^{(5)} \right) \left| \overline{G_2}^{(1)} - \overline{G_2}^{(2)} \right| e^{-\left( N_{28}^{(5)}x_{28} \right)} e^{\left( N_{28}^{(5)}x_{28} \right)} ds_{28} +
\]

\[
\left( a_{28}^{(5)} \right) \left( T_2^{(1)}, s_{28} \right) \left| \overline{G_2}^{(1)} - \overline{G_2}^{(2)} \right| e^{-\left( N_{28}^{(5)}x_{28} \right)} e^{\left( N_{28}^{(5)}x_{28} \right)} ds_{28} + \]

Where \( s_{28} \) represents integrand that is integrated over the interval \([0, t]\)

From the hypotheses it follows

\[
\left| \left( G_{31}^{(1)} - G_{31}^{(2)} \right) \right| e^{-\left( N_{28}^{(5)}t \right)} \leq \frac{1}{\left( M_{28}^{(5)} \right)} \left( a_{28}^{(5)} + a_{28}^{(5)} + \overline{T_{28}}^{(5)} \right)
\]

And analogous inequalities for \( G_i \) and \( T_i \). Taking into account the hypothesis \( (35, 35, 36) \) the result follows
Remark 1: The fact that we supposed \((a''_{28})^{(5)}(t)\) and \((b''_{28})^{(5)}(t)\) depending also on \(t\) can be considered as not conformal with the reality, however we have put this hypothesis in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by \((\tilde{P}_{28})^{(5)}(\tilde{M}_{28})^{(5)}\) and \((\tilde{Q}_{28})^{(5)}(\tilde{M}_{28})^{(5)}\) respectively of \(\mathbb{R}_+\).

If instead of proving the existence of the solution on \(\mathbb{R}_+\), we have to prove it only on a compact then it suffices to consider that \((a''_{28})^{(5)}(t)\) and \((b''_{28})^{(5)}(t)\), \(t = 28, 29, 30\) depend only on \(T_{29}\) and respectively on \((G_{31})\) (and not on \(t\)) and hypothesis can replaced by a usual Lipschitz condition.

Remark 2: There does not exist any \(t\) where \(G_{1}(t) = 0\) and \(T_{1}(t) = 0\)

From GLOBAL EQUATIONS it results:

\[
G_{1}(t) \geq G_{1}^{0} e^{-\int_{t}^{t_{0}} ((a'_{1}^{(5)})^{(5)} - (a'_{28})^{(5)}(T_{28}(x(28)), x(28))) ds(t_{28})} \geq 0
\]

\[
T_{1}(t) \geq T_{1}^{0} e^{-(b'_{1})^{(5)}} > 0 \quad \text{for } t > 0
\]

Definition of \((\tilde{M}_{28})^{(5)}_{1}\), \((\tilde{M}_{28})^{(5)}_{2}\) and \((\tilde{M}_{28})^{(5)}_{3}\):

Remark 3: if \(G_{28}\) is bounded, the same property have also \(G_{29}\) and \(G_{30}\). Indeed if \(G_{29} < (\tilde{M}_{28})^{(5)}\) it follows

\[
\frac{dG_{29}}{dt} \leq ((\tilde{M}_{28})^{(5)})_{1} - (a'_{28})^{(5)}G_{29} \quad \text{and by integrating}
\]

\[
G_{29} \leq ((\tilde{M}_{28})^{(5)})_{2} = G_{29}^{0} + 2(a_{29}^{(5)})((\tilde{M}_{28})^{(5)})_{1}/(a'_{28})^{(5)}
\]

In the same way, one can obtain

\[
G_{30} \leq ((\tilde{M}_{28})^{(5)})_{3} = G_{30}^{0} + 2(a_{30}^{(5)})((\tilde{M}_{28})^{(5)})_{2}/(a'_{30})^{(5)}
\]

If \(G_{29}\) or \(G_{30}\) is bounded, the same property follows for \(G_{28}\), \(G_{30}\) and \(G_{28}\), \(G_{29}\) respectively.

Remark 4: If \(G_{28}\) is bounded, from below, the same property holds for \(G_{29}\) and \(G_{30}\). The proof is analogous with the preceding one. An analogous property is true if \(G_{29}\) is bounded from below.

Remark 5: If \(T_{29}\) is bounded from below and \(\lim_{t \to \infty} ((b''_{29})^{(5)}((G_{31})(t), t)) = (b''_{29})^{(5)}\) then \(T_{29} \to \infty\).

Definition of \((m)^{(5)}\) and \(\xi_{5}\):

Indeed let \(t_{5}\) be so that for \(t > t_{5}\)

\[
(b_{29})^{(5)} - (b''_{29})^{(5)}((G_{31})(t), t) < \xi_{5}, T_{28}(t) > (m)^{(5)}
\]

Then

\[
\frac{dT_{29}}{dt} \geq (a_{29})^{(5)}(m)^{(5)} - \xi_{5} T_{29} \quad \text{which leads to}
\]

\[
T_{29} \geq \left(\frac{(a_{29})^{(5)}(m)^{(5)}}{\xi_{5}}\right)(1 - e^{-\xi_{5}T}) + T_{29}^{0}e^{-\xi_{5}T} \quad \text{If we take } T \text{ such that } e^{-\xi_{5}T} = \frac{1}{2} \text{ it results}
\]

\[
T_{29} \geq \left(\frac{(a_{29})^{(5)}(m)^{(5)}}{2\xi_{5}}\right), \quad T = \log \frac{2}{\xi_{5}} \quad \text{By taking now } \xi_{5} \text{ sufficiently small one sees that } T_{29} \text{ is}
\]
unbounded. The same property holds for $T_{30}$ if $\lim_{t \to \infty} (b_{32})^{(5)} ((G_{31})(t), t) = (b_{30})^{(5)}$

We now state a more precise theorem about the behaviors at infinity of the solutions

Analogous inequalities hold also for $G_{33}, G_{34}, T_{32}, T_{33}, T_{34}$

It is now sufficient to take $(a_{i1})^{(6)} (M_{i2})^{(6)} (b_{j2})^{(6)} (M_{i2})^{(6)} < 1$ and to choose

$(\mathcal{P}_{32})^{(6)}$ and $(\mathcal{Q}_{32})^{(6)}$ large to have

$$ \left[ (a_{i1})^{(6)} (M_{i2})^{(6)} \left( \mathcal{P}_{32} \right)^{(6)} + \left( \mathcal{Q}_{32} \right)^{(6)} e^{-\left( \mathcal{P}_{32} \right)^{(6)} + \mathcal{Q}_{32}} \right] \leq \left( \mathcal{P}_{32} \right)^{(6)} $$

$$ \left[ (a_{i1})^{(6)} (M_{i2})^{(6)} \left( \mathcal{Q}_{32} \right)^{(6)} + \mathcal{Q}_{32} e^{-\left( \mathcal{Q}_{32} \right)^{(6)} + \mathcal{T}_{32}} \right] \leq \left( \mathcal{Q}_{32} \right)^{(6)} $$

In order that the operator $\mathcal{A}^{(6)}$ transforms the space of sextuples of functions $G_i, T_i$ into itself

The operator $\mathcal{A}^{(6)}$ is a contraction with respect to the metric

$\sup_{t \in [0, t]} \left| G_i^{(1)}(t) - G_i^{(2)}(t) \right| e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}}$.

Indeed if we denote

**Definition of $(G_{35}, T_{35})$:** $(G_{35}, T_{35}) = \mathcal{A}^{(6)}((G_{35}), (T_{35}))$

It results

$$ \left| G_{32}^{(1)} - G_{32}^{(2)} \right| \leq \int_0^t (a_{32})^{(6)} (G_{31}^{(1)} - G_{31}^{(2)}) e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}} dS_{32} + $$

$$ \int_0^t (a_{32})^{(6)} (G_{31}^{(1)} - G_{31}^{(2)}) e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}} dS_{32} + $$

$$ (a_{32})^{(6)} (T_{32}^{(1)} + S_{32}) (G_{31}^{(1)} - G_{31}^{(2)}) e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}} + $$

$$ (a_{32})^{(6)} (T_{32}^{(1)} + S_{32}) (G_{31}^{(1)} - G_{31}^{(2)}) e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}} + $$

$$ (a_{32})^{(6)} (T_{32}^{(1)} + S_{32}) (G_{31}^{(1)} - G_{31}^{(2)}) e^{-\left( \mathcal{M}_{32} \right)^{(6)} + \mathcal{Q}_{32}} dS_{32} $$

Where $S_{32}$ represents integrand that is integrated over the interval $[0, t]$

From the hypotheses, it follows

1. $(a) (a) (a)^{(1)}, (b) (b)^{(1)}, (b)^{(1)}, (b)^{(1)} > 0$,
2. $i, j = 13, 14, 15$

(2) The functions $(a) (a) (a)^{(1)}, (b) (b)^{(1)}$ are positive continuous increasing and bounded.
Definition of \((p_i)^{(1)}\), \((r_i)^{(1)}\):

\[
(a_i^{(1)}(T_{14}, t) \leq (p_i)^{(1)} \leq (A_{13})^{(1)}
\]

\[
(b_i^{(1)}(t) \leq (r_i)^{(1)} \leq (B_{13})^{(1)}
\]

\[
\lim_{T_{20} \to (a_i^{(1)}(T_{14}, t) = (p_i)^{(1)}
\]

\[
\lim_{t \to (b_i^{(1)}(t) = (r_i)^{(1)}
\]

Definition of \((\hat{A}_{13})^{(1)}, (\hat{B}_{13})^{(1)}\):

Where \((\hat{A}_{13})^{(i)}, (\hat{B}_{13})^{(i)}, (p_i)^{(1)}, (r_i)^{(1)}\) are positive constants and \(i = 13,14,15\)

They satisfy Lipschitz condition:

\[
|a_i^{(1)}(T_{14}, t) - (a_i^{(1)}(T_{14}, t)| \leq (\hat{A}_{13})^{(1)}|T_{14} - T_{14}^t|e^{-\hat{A}_{13}^{(1)}t}
\]

\[
|b_i^{(1)}(G, t) - (b_i^{(1)}(G, T)| \leq (\hat{B}_{13})^{(1)}|G - G^t|e^{-\hat{B}_{13}^{(1)}t}
\]

With the Lipschitz condition, we place a restriction on the behavior of functions \((a_i^{(1)}(T_{14}, t), (a_i^{(1)}(T_{14}, t)\)

\((T_{14}, t)\) and \((T_{14}, t)\) are points belonging to the interval \([\hat{A}_{13}^{(1)}, \hat{B}_{13}^{(1)}]\). It is to be noted that \((a_i^{(1)}(T_{14}, t)\) is uniformly continuous. In the eventuality of the fact, that if \((\hat{B}_{13}^{(1)} = 1\) then the function \((a_i^{(1)}(T_{14}, t),\) the first augmentation coefficient attributable to terrestrial organisms, would be absolutely continuous.

Definition of \((\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}\):

\[
(AA) \quad (\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}, are positive constants
\]

\[
(a_i^{(1)}(M_{13})^{(1)} < 1
\]

Definition of \((\hat{P}_{13})^{(1)}, (\hat{Q}_{13})^{(1)}\):

\[
(BB) \quad There exists two constants \((\hat{P}_{13})^{(1)}, (\hat{Q}_{13})^{(1)}\) which together with \((\hat{M}_{13})^{(1)}, (\hat{k}_{13})^{(1)}, (\hat{A}_{13})^{(1)}\) and \((\hat{B}_{13})^{(1)}\) and the constants \((a_i^{(1)}, (a_i^{(1)}(b_i^{(1)}), (b_i^{(1)}), (p_i)^{(1)}, (r_i)^{(1)}), i = 13,14,15,\) satisfy the inequalities

\[
\frac{1}{(\hat{M}_{13})^{(1)}[a_i^{(1)} + (a_i^{(1)} + (\hat{A}_{13})^{(1)} + (\hat{P}_{13})^{(1)}(\hat{k}_{13})^{(1)}] < 1
\]

\[
\frac{1}{(\hat{M}_{13})^{(1)}[b_i^{(1)} + (b_i^{(1)} + (\hat{B}_{13})^{(1)} + (\hat{Q}_{13})^{(1)}(\hat{k}_{13})^{(1)}] < 1
\]

Analogous inequalities hold also for \(G_{37}, G_{38}, T_{36}, T_{37}, T_{38}\)

It is now sufficient to take \(\frac{a_i^{(1)}}{(M_{36})^{(1)}}, \frac{b_i^{(1)}}{(M_{36})^{(1)} < 7\) and to choose
\[ (\tilde{P}_{36})^{(7)} \text{ and } (\tilde{Q}_{36})^{(7)} \text{ large to have} \]

\[
\frac{(a_j)^{(7)}}{M_{36}} %
\left[ \frac{P_{36}}{(7)} + \left( \frac{\tilde{P}_{36}}{(7)} + G_j^0 \right) e^{-\frac{(\tilde{P}_{36})^{(7)} + G_j^0}{G_j^0}} \right] \leq (\tilde{P}_{36})^{(7)}
\]

\[
\frac{(b_j)^{(7)}}{M_{36}} %
\left[ (\tilde{Q}_{36})^{(7)} + T_j^0 e^{-\frac{(\tilde{Q}_{36})^{(7)} + T_j^0}{T_j^0}} + (\tilde{Q}_{36})^{(7)} \right] \leq (\tilde{Q}_{36})^{(7)}
\]

In order that the operator \( \mathcal{A}^{(7)} \) transforms the space of sextuples of functions \( G_i, T_i \) satisfying 37,35,36 into itself.

The operator \( \mathcal{A}^{(7)} \) is a contraction with respect to the metric

\[
d \left( (G_{39})^{(1)}, (T_{39})^{(1)} \right), \left( (G_{39})^{(2)}, (T_{39})^{(2)} \right) = \\
\sup_{t \in \mathbb{R}^+} \max \left| G_i^{(1)}(t) - G_i^{(2)}(t) \right| e^{-\left( G_{36}^{(7)} \right) t} ; \max_{t \in \mathbb{R}^+} \left| T_i^{(1)}(t) - T_i^{(2)}(t) \right| e^{-\left( G_{36}^{(7)} \right) t}
\]

Indeed if we denote

**Definition of** \((G_{39}), (T_{39})\) :

\[ (G_{39}, T_{39}) = \mathcal{A}^{(7)}((G_{39}), (T_{39})) \]

It results

\[
\left| G_{36}^{(1)} - \tilde{G}_i^{(2)} \right| \leq \int_0^t \left( a_{36}^{(7)} \right) \left| G_{37}^{(1)} - G_{37}^{(2)} \right| e^{-\left( G_{36}^{(7)} \right) x(36)} e^{\left( G_{36}^{(7)} \right) S(36)} dS(36) + \\
\int_0^t \left( a_{36}^{(7)} \right) \left| G_{36}^{(1), S(36)} - G_{36}^{(2), S(36)} \right| e^{-\left( G_{36}^{(7)} \right) x(36)} e^{\left( G_{36}^{(7)} \right) S(36)} + \\
\left( a_{36}^{(7)} \right) \left( T_{37}^{(1)}, S(36) \right) \left| G_{36}^{(1)} - G_{36}^{(2)} \right| e^{-\left( G_{36}^{(7)} \right) x(36)} e^{\left( G_{36}^{(7)} \right) S(36)} + \\
G_{36}^{(2)} \left( a_{36}^{(7)} \right) \left( T_{37}^{(1)}, S(36) \right) - \left( a_{36}^{(7)} \right) \left( T_{37}^{(2)}, S(36) \right) \left| e^{-\left( G_{36}^{(7)} \right) x(36)} e^{\left( G_{36}^{(7)} \right) S(36)} \right) dS(36)
\]
Where $s_{(36)}$ represents integrand that is integrated over the interval $[0, t]$

From the hypotheses it follows

\[
\left| (G_{39})^{(1)} - (G_{39})^{(2)} \right| e^{-\beta_{36} t} \leq \frac{1}{(\beta_{36})^{(2)}} \left( (a_{36})^{(3)} + (a_{36})^{(7)} + (A_{36})^{(2)} + (P_{36})^{(7)} \right) (k_{36})^{(7)} d \left( (G_{39})^{(1)}, (T_{39})^{(1)}; (G_{39})^{(2)}, (T_{39})^{(2)} \right)
\]

And analogous inequalities for $G_i$ and $T_i$. Taking into account the hypothesis (37,35,36) the result follows

**Remark 1:** The fact that we supposed $(a_{36})^{(7)}$ and $(b_{36})^{(7)}$ depending also on $t$ can be considered as not conformal with the reality, however we have put this hypothesis in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by $(P_{36})^{(7)} e^{(\beta_{36}) t}$ and $(Q_{36})^{(7)} e^{(\beta_{36}) t}$ respectively of $\mathbb{R}_+$. If instead of proving the existence of the solution on $\mathbb{R}_+$, we have to prove it only on a compact then it suffices to consider that $(a^{(7)}_i)$ and $(b^{(7)}_i)$, $i = 36, 37, 38$ depend only on $T_{37}$ and respectively on $(G_{39})$ **and not on $t$** and hypothesis can replaced by a usual Lipschitz condition.

**Remark 2:** There does not exist any $t$ where $G_i (t) = 0$ and $T_i (t) = 0$

From 79 to 36 it results

\[
G_i (t) \geq G_i^0 e^{-\int_0^t [ (a_i^{(7)} - a_i^{(7)} (T_{37}(x_{(36)}), x_{(36)}) ) ] dx_{(36)}} \geq 0
\]
\[ T_i(t) \geq T_i^a e^{-\left(b_i^a(t)\right)} > 0 \quad \text{for } t > 0 \]

**Definition of** \( \left( \overline{M}_{36}(\tau) \right)_1, \left( \overline{M}_{36}(\tau) \right)_2 \) and \( \left( \overline{M}_{36}(\tau) \right)_3 : \)

**Remark 3:** if \( G_{36} \) is bounded, the same property have also \( G_{37} \) and \( G_{38} \). indeed if

\[ G_{36} < \left( \overline{M}_{36}(\tau) \right)_1 \] it follows \( \frac{dG_{37}}{dt} \leq \left( \left( \overline{M}_{36}(\tau) \right)_1 - (a_{37})^{(7)} \right) G_{37} \) and by integrating

\[ G_{37} \leq \left( \left( \overline{M}_{36}(\tau) \right)_2 = G_{37}^0 + 2(a_{37})^{(7)} \left( \left( \overline{M}_{36}(\tau) \right)_1 / (a_{37})^{(7)} \right) \]

In the same way, one can obtain

\[ G_{38} \leq \left( \left( \overline{M}_{36}(\tau) \right)_3 = G_{38}^0 + 2(a_{38})^{(7)} \left( \left( \overline{M}_{36}(\tau) \right)_2 / (a_{38})^{(7)} \right) \]

If \( G_{37} \) or \( G_{38} \) is bounded, the same property follows for \( G_{36} \), \( G_{38} \) and \( G_{36}, G_{37} \) respectively.

**Remark 7:** If \( G_{36} \) is bounded, from below, the same property holds for \( G_{37} \) and \( G_{38} \). The proof is analogous with the preceding one. An analogous property is true if \( G_{37} \) is bounded from below.

**Remark 5:** If \( T_{36} \) is bounded from below and \( \lim_{\tau \to \infty} \left( b_i^\tau \right) \left( \left( G_{39}(t), t \right) \right) = \left( b_{37}^\tau \right) \) then \( T_{37} \to \infty. \)

**Definition of** \( (m)^{(7)} \) and \( \varepsilon_7 : \)

Indeed let \( t_7 \) be so that for \( t > t_7 \)

\[ (b_{37})^{(7)} - (b_i^\tau)^{(7)} \left( \left( G_{39}(t), t \right) \right) < \varepsilon_7, T_{36} (t) > (m)^{(7)} \]
Then \( \frac{dT_{37}}{dt} \geq (a_{37})^{(7)}(m)^{(7)} - \varepsilon_{\tau} T_{37} \) which leads to

\[
T_{37} \geq \left( \frac{(a_{37})^{(7)}(m)^{(7)}}{\varepsilon_{\tau}} \right) (1 - e^{-\varepsilon_{\tau} t}) + T_{37}^{0} e^{-\varepsilon_{\tau} t}
\]

If we take \( t \) such that \( e^{-\varepsilon_{\tau} t} = \frac{1}{2} \) it results

\[
T_{37} \geq \left( \frac{(a_{37})^{(7)}(m)^{(7)}}{2} \right), \quad t = \log \frac{2}{\varepsilon_{\tau}}
\]

By taking now \( \varepsilon_{\tau} \) sufficiently small one sees that \( T_{37} \) is unbounded. The same property holds for \( T_{38} \) if \( \lim_{t \to \infty} (b^{(7)}_{38})_{380} ((G_{39})_{381}, t) = (b^{(7)}_{38})_{382} \)

We now state a more precise theorem about the behaviors at infinity of the solutions of equations 37 to 72

In order that the operator \( A^{(7)} \) transforms the space of sextuples of functions \( G_{i}, T_{i} \) satisfying

GLOBAL EQUATIONS AND ITS CONCOMITANT CONDITIONALITIES into itself

The operator \( A^{(7)} \) is a contraction with respect to the metric

\[
d \left( \left( (G_{39})^{(1)}, (T_{39})^{(1)} \right), \left( (G_{39})^{(2)}, (T_{39})^{(2)} \right) \right) =
\]

\[
\sup_{i} \max \left| G_{i}^{(1)}(t) - G_{i}^{(2)}(t) \right| e^{-\left( (G_{36})^{(7)} \right)_{383} t}, \max \left| T_{i}^{(1)}(t) - T_{i}^{(2)}(t) \right| e^{-\left( (G_{36})^{(7)} \right)_{383} t}
\]

Indeed if we denote

**Definition of** \((G_{39}, (T_{39})^{(1)}, (T_{39})^{(2)}) : \)

\[
\left( (G_{39}), (T_{39}) \right) = A^{(7)}((G_{39}), (T_{39}))
\]

It results

\[
\left| G_{36}^{(1)} - G_{36}^{(2)} \right| \leq \int_{0}^{t} (a_{36})^{(7)} \left| G_{37}^{(1)} - G_{37}^{(2)} \right| e^{-\left( (G_{36})^{(7)} \right)_{384} x_{36}} e^{(G_{36})^{(7)} x_{36}} dx_{36} + \]

\[
\int_{0}^{t} (a_{36})^{(7)} \left| G_{36}^{(2)} - G_{36}^{(1)} \right| e^{-\left( (G_{36})^{(7)} \right)_{384} x_{36}} e^{(G_{36})^{(7)} x_{36}} + \]

\[
(a_{36})^{(7)} (T_{37}^{(1)} - T_{37}^{(2)}) \left| G_{36}^{(1)} - G_{36}^{(2)} \right| e^{-\left( (G_{36})^{(7)} \right)_{384} x_{36}} e^{(G_{36})^{(7)} x_{36}} + \]

\[
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\]
\[ G_{36}^{(2)}(a_{36}^{(\gamma)}(T_{37}^{(1)}, S_{36}^{(36)})) - (a_{36}^{(\gamma)}(T_{37}^{(2)}, S_{36}^{(36)})) \leq e^{-(\mathcal{M}_{36})^{(\gamma)}_{36} e^{(T_{36})^{(36)}} t} ds_{36} \]

Where \( s_{36} \) represents integrand that is integrated over the interval \([0, t]\).

From the hypotheses it follows

\[
\left| (G_{39})^{(1)} - (G_{39})^{(2)} \right| e^{-(\mathcal{M}_{36})^{(\gamma)}} t \leq \frac{1}{(\mathcal{P}_{36})^{(\gamma)}} (a_{36}^{(\gamma)} + (\mathcal{A}_{36})^{(\gamma)} + (\mathcal{P}_{36})^{(\gamma)} (\mathcal{P}_{36})^{(\gamma)} d \left( (G_{39})^{(1)}, (T_{39})^{(1)}; (G_{39})^{(2)}, (T_{39})^{(2)} \right) \]

And analogous inequalities for \( G_i \) and \( T_i \). Taking into account the hypothesis the result follows

**Remark 1:** The fact that we supposed \((a_{36}^{(\gamma)}(T_{37}^{(1)}) \text{ and } (b_{36}^{(\gamma)}(T_{37}^{(2)}) \text{ depending also on } t \text{ can be considered as not conformal with the reality, however we have put this hypothesis, in order that we can postulate condition necessary to prove the uniqueness of the solution bounded by } (P_{36})^{(\gamma)} e^{(\mathcal{M}_{36})^{(\gamma)} t} \text{ and } (Q_{36})^{(\gamma)} e^{(\mathcal{M}_{36})^{(\gamma)} t} \text{ respectively of } \mathbb{R}_+. \)

If instead of proving the existence of the solution on \( \mathbb{R}_+ \), we have to prove it only on a compact then it suffices to consider that \((a_{36}^{(\gamma)} \text{ and } (b_{36}^{(\gamma)}) \text{, } i = 36, 37, 38 \text{ depend only on } T_{37} \text{ and respectively on } (G_{39}) \text{ (and not on } t) \text{ and hypothesis can replaced by a usual Lipschitz condition.}

**Remark 2:** There does not exist any \( G_i(t) = 0 \text{ and } T_i(t) = 0 \)

From CONCATENATED GLOBAL EQUATIONS it results

\[ G_i(t) \geq G_{37} e^{(-\mathcal{M}_{36})^{(\gamma)} (a_{37}^{(\gamma)}(T_{37})^{(36)}; x_{36})} ds_{36} \geq 0 \]

\[ T_i(t) \geq T_{37} e^{(-b_{37}^{(\gamma)}(T_{37}))} > 0 \text{ for } t > 0 \]

**Definition of** \((\mathcal{M}_{36})^{(\gamma)}_1, (\mathcal{M}_{36})^{(\gamma)}_2 \text{ and } (\mathcal{M}_{36})^{(\gamma)}_3 : \)

**Remark 3:** If \( G_{36} \) is bounded, the same property have also \( G_{37} \text{ and } G_{38} \). Indeed if \( G_{36} < (\mathcal{M}_{36})^{(\gamma)} \) it follows \( \frac{dG_{37}}{dt} \leq (\mathcal{M}_{36})^{(\gamma)} - (a_{37}^{(\gamma)}) G_{37} \) and by integrating \( G_{37} \leq (\mathcal{M}_{36})^{(\gamma)}_2 \).

In the same way, one can obtain
If $G_{38}$ or $G_{39}$ is bounded, the same property follows for $G_{36}$, $G_{38}$ and $G_{36}, G_{37}$ respectively.

**Remark 7:** If $G_{36}$ is bounded, from below, the same property holds for $G_{37}$ and $G_{38}$. The proof is analogous with the preceding one. An analogous property is true if $G_{37}$ is bounded from below.

**Remark 5:** If $T_{36}$ is bounded from below and $\lim_{t \to \infty} \left( (b_i''(t)) \left( (G_{39})(t), t \right) = (b_i''(t))^{(T)} \right)$ then $T_{38} \to \infty$.

**Definition of** $(m)^{(T)}$ and $\varepsilon_7$:

Indeed let $t_7$ be so that for $t > t_7$

$$(b_7''(t))^{(T)} - (b_7''(t))^{(G_{39})(t), t} < \varepsilon_7, T_{36}(t) > (m)^{(T)}$$

Then $\frac{dT_{37}}{dt} \geq (a_37)^{(T)}(m)^{(T)} - \varepsilon_7 T_{37}$ which leads to

$$T_{37} \geq \left( \frac{(a_37)^{(T)}(m)^{(T)}}{\varepsilon_7} \right) \frac{1}{1 - e^{-\varepsilon t}} + T_{37}^0 e^{-\varepsilon t}$$

If we take $t$ such that $e^{-\varepsilon t} = \frac{1}{2}$ it results

$$T_{37} \geq \left( \frac{(a_37)^{(T)}(m)^{(T)}}{2} \right)$$

$t = \log \frac{2}{\varepsilon_7}$ By taking now $\varepsilon_7$ sufficiently small one sees that $T_{37}$ is unbounded. The same property holds for $T_{38}$ if $\lim_{t \to \infty} \left( (b_i''(t)) \left( (G_{39})(t), t \right) = (b_i''(t))^{(T)} \right)$

We now state a more precise theorem about the behaviors at infinity of the solutions

$$-(a_2)^{(2)} \leq -(a_{16})^{(2)} + (a_{17})^{(2)} - (a_{16})^{(2)}(T_{17}, t) + (a_{17})^{(2)}(T_{17}, t) \leq -(a_1)^{(2)}$$

$$-(\tau_2)^{(2)} \leq -(b_{16})^{(2)} + (b_{17})^{(2)} - (b_{16})^{(2)}((G_{19}), t) - (b_{17})^{(2)}((G_{19}), t) \leq -(\tau_1)^{(2)}$$

**Definition of** $(v_1)^{(2)}$, $(v_2)^{(2)}$, $(u_1)^{(2)}$, $(u_2)^{(2)}$:

By $(v_1)^{(2)} > 0, (v_2)^{(2)} < 0$ and respectively $(u_1)^{(2)} > 0, (u_2)^{(2)} < 0$ the roots

(a) of the equations $(a_{17})^{(2)}((v)^{(2)})^2 + (a_1)^{(2)}v^{(2)} - (a_{16})^{(2)} = 0$ and

$(b_{16})^{(2)}((u)^{(2)})^2 + (\tau_2)^{(2)}u^{(2)} - (b_{16})^{(2)} = 0$

**Definition of** $(\bar{v}_1)^{(2)}$, $(\bar{v}_2)^{(2)}$, $(\bar{u}_1)^{(2)}$, $(\bar{u}_2)^{(2)}$:

By $(\bar{v}_1)^{(2)} > 0, (\bar{v}_2)^{(2)} < 0$ and respectively $(\bar{u}_1)^{(2)} > 0, (\bar{u}_2)^{(2)} < 0$ the roots of the equations $(a_{17})^{(2)}((v)^{(2)})^2 + (a_1)^{(2)}v^{(2)} - (a_{16})^{(2)} = 0$

and $(b_{16})^{(2)}((u)^{(2)})^2 + (\tau_2)^{(2)}u^{(2)} - (b_{16})^{(2)} = 0$

**Definition of** $(m_1)^{(2)}$, $(m_2)^{(2)}$, $(\mu_1)^{(2)}$, $(\mu_2)^{(2)}$:

(b) If we define $(m_1)^{(2)}$, $(m_2)^{(2)}$, $(\mu_1)^{(2)}$, $(\mu_2)^{(2)}$ by

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\[(m_2)^{(2)} = (v_0)^{(2)}, (m_1)^{(2)} = (v_1)^{(2)}, \text{ if } (v_0)^{(2)} < (v_1)^{(2)}\]
\[(m_2)^{(2)} = (v_1)^{(2)}, (m_1)^{(2)} = (v_0)^{(2)}, \text{ if } (v_1)^{(2)} < (v_0)^{(2)} < (v_1)^{(2)},\]

and \[\left(\frac{v_0}{v_1}\right)^{(2)} = \frac{G_0^{(0)}}{G_1^{(0)}}\]

\[(m_2)^{(2)} = (u_1)^{(2)}, (m_1)^{(2)} = (u_0)^{(2)}, \text{ if } (u_1)^{(2)} < (u_0)^{(2)}\]

and analogously

\[(\mu_2)^{(2)} = (u_0)^{(2)}, (\mu_1)^{(2)} = (u_1)^{(2)}, \text{ if } (u_0)^{(2)} < (u_1)^{(2)}\]

\[(u_1)^{(2)} = (u_0)^{(2)}, (u_2)^{(2)} = (u_0)^{(2)}, \text{ if } (u_1)^{(2)} < (u_0)^{(2)} < (u_1)^{(2)}\]

and \[\left(\frac{u_0}{u_1}\right)^{(2)} = \frac{T_0^{(0)}}{T_1^{(0)}}\]

\[(\mu_2)^{(2)} = (u_1)^{(2)}, (\mu_1)^{(2)} = (u_0)^{(2)}, \text{ if } (u_1)^{(2)} < (u_0)^{(2)}\]

Then the solution satisfies the inequalities

\[G_0^{(0)}e^{((S_1)^{(2)}-(p_{16})^{(2)})t} \leq G_1^{(0)}(t) \leq G_0^{(0)}(S_2)^{(2)}e^{t}\]

\[(p_1)^{(2)}\]

is defined

\[\frac{1}{(m_1)^{(2)}}G_0^{(0)}e^{((S_1)^{(2)}-(p_{16})^{(2)})t} \leq G_1^{(0)}(t) \leq \frac{1}{(m_2)^{(2)}}G_1^{(0)}e^{((S_1)^{(2)})t}\]

\[G_0^{(0)}e^{((S_1)^{(2)}-(p_{16})^{(2)})t} \leq G_1^{(0)}(t) \leq G_0^{(0)}e^{((S_1)^{(2)})t}\]

\[\frac{(\alpha_{16})^{(2)}G_0^{(0)}}{G_1^{(0)}}\left[e^{((S_1)^{(2)}-(p_{16})^{(2)})t} - e^{-(S_2)^{(2)}t}\right] + G_1^{(0)}e^{-(S_2)^{(2)}t} \leq G_1^{(0)}(t) \leq G_1^{(0)}e^{-(a_{16}^{(2)})t}\]

\[T_0^{(0)}e^{((R_1)^{(2)})t} \leq T_1^{(0)}(t) \leq T_0^{(0)}e^{((R_1)^{(2)}+r_{16})^{(2)}t}\]

\[\frac{1}{(\mu_1)^{(2)}}T_0^{(0)}e^{((R_1)^{(2)})t} \leq T_1^{(0)}(t) \leq \frac{1}{(\mu_2)^{(2)}}T_1^{(0)}e^{((R_1)^{(2)}+r_{16})^{(2)}t}\]

\[\frac{(\beta_{16})^{(2)}T_0^{(0)}}{(\mu_2)^{(2)}(r_{16})^{(2)}+(\beta_{16})^{(2)}}\left[e^{((R_1)^{(2)})t} - e^{-(b_{16}^{'(2)})t}\right] + T_1^{(0)}e^{-(b_{16}^{'(2)})t} \leq T_1^{(0)}(t) \leq T_1^{(0)}e^{-(b_{16}^{'(2)})t}\]

\[\frac{(\alpha_{16})^{(2)}T_0^{(0)}}{(\mu_2)^{(2)}(r_{16})^{(2)}+(\alpha_{16})^{(2)}(r_{16})^{(2)}+(\beta_{16})^{(2)}}\left[e^{((R_1)^{(2)}+r_{16})^{(2)}t} - e^{-(b_{16}^{'(2)})t}\right] + T_1^{(0)}e^{-(b_{16}^{'(2)})t}\]

**Definition of** \((S_1)^{(2)}, (S_2)^{(2)}, (R_1)^{(2)}, (R_2)^{(2)}):\)

Where \((S_1)^{(2)} = (\alpha_{16})^{(2)}(m_2)^{(2)} - (a_{16}^{'(2)})^{(2)}\)

\[(S_2)^{(2)} = (a_{16})^{(2)} - (p_{16})^{(2)}\]

\[(R_1)^{(2)} = (b_{16})^{(2)}(\mu_2)^{(1)} - (b_{16}^{'(2)})^{(2)}\]

\[(R_2)^{(2)} = (b_{16})^{(2)} - (r_{16})^{(2)}\]

**Behavior of the solutions**

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If we denote and define

**Definition of** \((\sigma_1)^{(3)}, (\sigma_2)^{(3)}, (\tau_1)^{(3)}, (\tau_2)^{(3)}\):

(a) \(\sigma_1)^{(3)}, (\sigma_2)^{(3)}, (\tau_1)^{(3)}, (\tau_2)^{(3)}\) four constants satisfying

\[-(\sigma_2)^{(3)} \leq -(a_{20})^{(3)} + (a_{21})^{(3)} - (a_{22})^{(3)}(\tau_1)_t + (a_{21})^{(3)}(\tau_2)_t \leq -(\sigma_1)^{(3)}\]

\[-(\tau_2)^{(3)} \leq -(b_{20})^{(3)} + (b_{21})^{(3)} - (b_{22})^{(3)}(\tau_1)_t - (b_{21})^{(3)}(\tau_2)_t \leq -(\tau_1)^{(3)}\]

**Definition of** \(v_1)^{(3)}, (v_2)^{(3)}, (u_1)^{(3)}, (u_2)^{(3)}\):

(b) By \((v_1)^{(3)} > 0, (v_2)^{(3)} < 0\) and respectively \((u_1)^{(3)} > 0, (u_2)^{(3)} < 0\) the roots of the equations

\((a_{21})^{(3)}(v_{(3)})^2 + (\sigma_2)^{(3)}v_{(3)} - (a_{20})^{(3)} = 0\)

and

\((b_{21})^{(3)}(u_{(3)})^2 + (\tau_2)^{(3)}u_{(3)} - (b_{20})^{(3)} = 0\)

and

By \((v_1)^{(3)} > 0, (v_2)^{(3)} < 0\) and respectively \((u_1)^{(3)} > 0, (u_2)^{(3)} < 0\) the roots of the equations

\((a_{21})^{(3)}(v_{(3)})^2 + (\sigma_2)^{(3)}v_{(3)} - (a_{20})^{(3)} = 0\)

and

\((b_{21})^{(3)}(u_{(3)})^2 + (\tau_2)^{(3)}u_{(3)} - (b_{20})^{(3)} = 0\)

**Definition of** \(m_1)^{(3)}, (m_2)^{(3)}, (\mu_1)^{(3)}, (\mu_2)^{(3)}\):

(c) If we define \((m_1)^{(3)}, (m_2)^{(3)}, (\mu_1)^{(3)}, (\mu_2)^{(3)}\) by

\((m_2)^{(3)} = (v_0)^{(3)}, (m_1)^{(3)} = (v_1)^{(3)}\), if \((v_0)^{(3)} < (v_1)^{(3)}\)

\((m_2)^{(3)} = (v_1)^{(3)}, (m_1)^{(3)} = (v_0)^{(3)}\), if \((v_0)^{(3)} < (v_1)^{(3)}\),

and

\(\frac{(v_0)^{(3)}}{v_{(3)}} = \frac{a_{20}}{a_{21}}\)

\((m_2)^{(3)} = (v_1)^{(3)}, (m_1)^{(3)} = (v_0)^{(3)}\), if \((v_0)^{(3)} < (v_1)^{(3)}\)

and analogously

\((\mu_2)^{(3)} = (u_0)^{(3)}, (\mu_1)^{(3)} = (u_1)^{(3)}\), if \((u_0)^{(3)} < (u_1)^{(3)}\)

\((\mu_2)^{(3)} = (u_1)^{(3)}, (\mu_1)^{(3)} = (u_0)^{(3)}\), if \((u_0)^{(3)} < (u_1)^{(3)}\)

and

\((\mu_2)^{(3)} = (u_0)^{(3)}, (\mu_1)^{(3)} = (u_0)^{(3)}\), if \((u_0)^{(3)} < (u_0)^{(3)}\)

Then the solution satisfies the inequalities

\[G_{20}^0e^{((S_1)^{(3)}-(p_{20})^{(3)})t} \leq G_{20}^0e^{(S_1)^{(3)}t}\]

\((p_j)^{(3)}\) is defined

\[\frac{1}{(m_2)^{(3)}}G_{20}^0e^{((S_1)^{(3)}-(p_{20})^{(3)})t} \leq G_{21}^0(t) \leq \frac{1}{(m_2)^{(3)}}G_{20}^0e^{(S_1)^{(3)}t}\]

\[\left(\frac{(a_{20})^0G_{20}^0}{(m_2)^{(3)}((S_1)^{(3)}-(p_{20})^{(3)}-(S_{3})^{(3)})}\right)[e^t((S_1)^{(3)}-(p_{20})^{(3)}t) - e^{-(S_2)^{(3)}t}] + G_{22}^0e^{-(S_2)^{(3)}t} \leq G_{22}^0(t) \leq \]
\[
\frac{(a_22)^{(3)} G_0^{(3)}_{20}}{(m_2)^{(3)} ((s_1)^{(3)} - (a_22)^{(3)})} \left[ e^{(s_1)^{(3)} t} - e^{-(a_22)^{(3)} t} \right] + G_22^{(3)} e^{-(a_22)^{(3)} t} \\
T_20^0 e^{(s_1)^{(3)} t} \leq T_20(t) \leq T_20^0 e^{((s_1)^{(3)} + (r_20)^{(3)}) t}
\]

\[
\frac{1}{(\mu_2)^{(3)}} T_20^0 e^{(s_1)^{(3)} t} \leq T_20(t) \leq \frac{1}{(\mu_2)^{(3)}} T_20^0 e^{((s_1)^{(3)} + (r_20)^{(3)}) t}
\]

\[
\frac{G_22^{(3)} T_20^0}{(b_222)^{(3)} ((s_1)^{(3)} - (b_222)^{(3)})} \left[ e^{(s_1)^{(3)} t} - e^{-(b_222)^{(3)} t} \right] + G_22^{(3)} e^{-(b_222)^{(3)} t} \leq T_22(t) \leq
\]

\[
\frac{G_22^{(3)} T_20^0}{(b_222)^{(3)} ((r_20)^{(3)} + (b_222)^{(3)})} \left[ e^{((r_20)^{(3)} + (b_222)^{(3)}) t} - e^{-(r_20)^{(3)} t} \right] + G_22^{(3)} e^{-(r_20)^{(3)} t}
\]

**Definition of \( (S_1)^{(3)}, (S_2)^{(3)}, (R_1)^{(3)}, (R_2)^{(3)} \):**

Where \( (S_1)^{(3)} = (a_{20})^{(3)} (m_2)^{(3)} - (a_20)^{(3)} \)

\[
(S_2)^{(3)} = (a_{22})^{(3)} - (b_{22})^{(3)}
\]

\[
(R_1)^{(3)} = (b_{20})^{(3)} (\mu_2)^{(3)} - (b_20)^{(3)}
\]

\[
(R_2)^{(3)} = (b_{22})^{(3)} - (r_22)^{(3)}
\]

If we denote and define

**Definition of \((\sigma_1)^{(4)}, (\sigma_2)^{(4)}, (r_1)^{(4)}, (r_2)^{(4)}\):**

\( (\sigma_2)^{(4)} \), \( (\sigma_2)^{(4)}, (r_1)^{(4)}, (r_2)^{(4)} \) four constants satisfying

\(- (\sigma_2)^{(4)} \leq -(a_{24})^{(4)} + (a_{25})^{(4)} - (a_{24})^{(4)} (T_{25}, t) + (a_{25})^{(4)} (T_{25}, t) \leq - (\sigma_1)^{(4)} \)

\(- (r_2)^{(4)} \leq -(b_{24})^{(4)} + (b_{25})^{(4)} - (b_{24})^{(4)} (G_{27}, t) - (b_{25})^{(4)} (G_{27}, t) \leq - (r_1)^{(4)} \)

**Definition of \((v_1)^{(4)}, (v_2)^{(4)}, (u_1)^{(4)}, (u_2)^{(4)}, v^{(4)}, u^{(4)}\):**

\( (v_1)^{(4)} > 0, (v_2)^{(4)} < 0 \) and respectively \( (u_1)^{(4)} > 0, (u_2)^{(4)} < 0 \) the roots of the equations

\[
(a_{25})^{(4)} (v^{(4)})^2 + (\sigma_1)^{(4)} v^{(4)} - (a_{24})^{(4)} = 0
\]

and

\[
(b_{25})^{(4)} (u^{(4)})^2 + (r_1)^{(4)} u^{(4)} - (b_{24})^{(4)} = 0
\]

**Definition of \((\bar{v}_1)^{(4)}, (\bar{v}_2)^{(4)}, (\bar{u}_1)^{(4)}, (\bar{u}_2)^{(4}), \bar{v}^{(4)}, \bar{u}^{(4)}\):**

\( (\bar{v}_1)^{(4)} > 0, (\bar{v}_2)^{(4)} < 0 \) and respectively \( (\bar{u}_1)^{(4)} > 0, (\bar{u}_2)^{(4)} < 0 \) the roots of the equations

\[
(a_{25})^{(4)} (v^{(4)})^2 + (\sigma_2)^{(4)} v^{(4)} - (a_{24})^{(4)} = 0
\]

and

\[
(b_{25})^{(4)} (u^{(4)})^2 + (r_2)^{(4)} u^{(4)} - (b_{24})^{(4)} = 0
\]

**Definition of \((m_1)^{(4)}, (m_2)^{(4)}, (\mu_1)^{(4)}, (\mu_2)^{(4)}, (v_0)^{(4)}\):**

\( (m_2)^{(4)} = (v_0)^{(4)}, (m_1)^{(4)} = (v_1)^{(4)}, \text{ if } (v_0)^{(4)} < (v_1)^{(4)} \)
\((m_2)^{(4)} = (v_4)^{(4)}, (m_1)^{(4)} = (\bar{v}_4)^{(4)}\), if \((v_4)^{(4)} < (v_0)^{(4)} < (\bar{v}_4)^{(4)}\), and
\[
\begin{pmatrix}
(v_0)^{(4)} = \frac{v_{24}^{\mu}}{v_{25}^{\mu}}
\end{pmatrix}
\]

\((m_2)^{(4)} = (v_4)^{(4)}, (m_1)^{(4)} = (v_0)^{(4)}, \text{ if } (v_4)^{(4)} < (v_0)^{(4)}\)

and analogously
\[
\begin{pmatrix}
(\mu_2)^{(4)} = (u_0)^{(4)}, (\mu_1)^{(4)} = (u_1)^{(4)}, \text{ if } (u_0)^{(4)} < (u_1)^{(4)}
\end{pmatrix}
\]

\[
\begin{pmatrix}
(\mu_2)^{(4)} = (u_1)^{(4)}, (\mu_1)^{(4)} = (\bar{u}_1)^{(4)}, \text{ if } (u_1)^{(4)} < (u_0)^{(4)} < (\bar{u}_1)^{(4)}
\end{pmatrix}
\]

\[
(\mu_2)^{(4)} = (u_1)^{(4)}, (\mu_1)^{(4)} = (u_0)^{(4)}, \text{ if } (\bar{u}_1)^{(4)} < (u_0)^{(4})\]

where \((u_1)^{(4)}, (\bar{u}_1)^{(4)}\) are defined respectively

Then the solution satisfies the inequalities
\[
G_{26}^0 e^{-((S_1)^{(4)}-(p_{24})^{(4)})t} \leq G_{24}^0 e^{-((S_2)^{(4)})t} \leq G_{26}^0 e^{-((S_2)^{(4)})t}
\]

where \((p_1)^{(4)}\) is defined

\[
\frac{1}{(m_1)^{(4)}} G_{24}^0 e^{-((S_1)^{(4)}-(p_{24})^{(4)})t} \leq G_{25}^0(t) \leq \frac{1}{(m_2)^{(4)}} G_{24}^0 e^{-((S_2)^{(4)})t}
\]

\[
\begin{pmatrix}
(a_{24})^{(4)} G_{24}^0 e^{-((S_1)^{(4)}-(p_{24})^{(4)})t} + G_{26}^0 e^{-((S_2)^{(4)})t} \leq G_{26}^0(t) \leq G_{26}^0 e^{-((S_2)^{(4)})t}
\end{pmatrix}
\]

\[
\frac{1}{(m_2)^{(4)}} T_{24}^0 e^{-((R_1)^{(4)}+(r_{24})^{(4)})t} \leq T_{24}^0(t) \leq \frac{1}{(m_2)^{(4)}} T_{24}^0 e^{-((R_1)^{(4)}+(r_{24})^{(4)})t}
\]

\[
\begin{pmatrix}
\frac{1}{(m_2)^{(4)}} T_{24}^0 e^{-((R_1)^{(4)}+(r_{24})^{(4)})t} + T_{26}^0 e^{-((b_{26})^{(4)})t} \leq T_{26}^0(t) \leq T_{26}^0 e^{-((b_{26})^{(4)})t}
\end{pmatrix}
\]

\[
\begin{pmatrix}
\frac{1}{(m_2)^{(4)}} T_{24}^0 e^{-((R_1)^{(4)})t} + T_{26}^0 e^{-((b_{26})^{(4)})t} \leq T_{26}^0(t) \leq T_{26}^0 e^{-((b_{26})^{(4)})t}
\end{pmatrix}
\]

**Definition of** \((S_1)^{(4)}, (S_2)^{(4)}, (R_1)^{(4)}, (R_2)^{(4)}\);

**Where**
\[
(S_1)^{(4)} = (a_{24})^{(4)}(m_2)^{(4)} - (a_{24})^{(4)}
\]
\[
(S_2)^{(4)} = (a_{26})^{(4)} - (p_{26})^{(4)}
\]
\[
(R_1)^{(4)} = (b_{24})^{(4)}(\mu_2)^{(4)} - (b_{24})^{(4)}
\]
\[
(R_2)^{(4)} = (b_{26})^{(4)} - (r_{26})^{(4)}
\]

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Behavior of the solutions

If we denote and define

**Definition of \((\sigma_1^{(s)}, \sigma_2^{(s)}, \tau_1^{(s)}, \tau_2^{(s)})\):**

\(\sigma_1^{(s)}, \sigma_2^{(s)}, \tau_1^{(s)}, \tau_2^{(s)}\) four constants satisfying

\[-(\sigma_1^{(s)}) \leq -(a_{28}^{(s)}) + (a_{29}^{(s)}) - (a_{28}^{(s)})(T_{29}, t) + (a_{29}^{(s)})(T_{29}, t) \leq -(\sigma_1^{(s)})\]

\[-(\tau_1^{(s)}) \leq -(b_{28}^{(s)}) + (b_{29}^{(s)}) - (b_{28}^{(s)})(G_{31}, t) - (b_{29}^{(s)})(G_{31}, t) \leq -(\tau_1^{(s)})\]

**Definition of \((v_1^{(s)}, v_2^{(s)}, u_1^{(s)}, u_2^{(s)}, \nu^{(s)}, \mu^{(s)})\):**

\(v_1^{(s)}, v_2^{(s)}, u_1^{(s)}, u_2^{(s)}, \nu^{(s)}, \mu^{(s)}\) the roots of the equations

\[a_{29}^{(s)}(\nu^{(s)})^2 + (\sigma_1^{(s)})\nu^{(s)} - (a_{28}^{(s)}) = 0\]

and

\[a_{29}^{(s)}(\mu^{(s)})^2 + (\tau_1^{(s)})\mu^{(s)} - (b_{28}^{(s)}) = 0\]

**Definition of \((\bar{v}_1^{(s)}, \bar{v}_2^{(s)}, \bar{u}_1^{(s)}, \bar{u}_2^{(s)})\):**

By \((\bar{v}_1^{(s)}) > 0, (\bar{v}_2^{(s)}) < 0\) and respectively \((u_1^{(s)}) > 0, (u_2^{(s)}) < 0\)

the roots of the equations

\[a_{29}^{(s)}(\nu^{(s)})^2 + (\sigma_1^{(s)})\nu^{(s)} - (a_{28}^{(s)}) = 0\]

and

\[a_{29}^{(s)}(\mu^{(s)})^2 + (\tau_1^{(s)})\mu^{(s)} - (b_{28}^{(s)}) = 0\]

**Definition of \((m_1^{(s)}, m_2^{(s)}, \mu_1^{(s)}, \mu_2^{(s)}, \nu_0^{(s)})\):**

If we define \((m_1^{(s)}, m_2^{(s)}, \mu_1^{(s)}, \mu_2^{(s)}, \nu_0^{(s)})\) by

\[m_1^{(s)} = (v_0^{(s)}), m_2^{(s)} = (v_1^{(s)}), \text{ if } (v_0^{(s)}) < (v_1^{(s)})\]

\[m_2^{(s)} = (v_1^{(s)}), m_1^{(s)} = (v_0^{(s)}), \text{ if } (v_1^{(s)}) < (v_0^{(s)}) < (\bar{v}_1^{(s)})\]

and

\[\nu_0^{(s)} = \frac{G_{28}^{0}}{G_{29}^{0}}\]

\[m_2^{(s)} = (v_1^{(s)}), m_1^{(s)} = (v_0^{(s)}), \text{ if } (\bar{v}_1^{(s)}) < (v_0^{(s)})\]

and analogously

\[\mu_2^{(s)} = (u_0^{(s)}), \mu_1^{(s)} = (u_1^{(s)}), \text{ if } (u_0^{(s)}) < (u_1^{(s)})\]

\[\mu_2^{(s)} = (u_1^{(s)}), \mu_1^{(s)} = (u_0^{(s)}), \text{ if } (u_1^{(s)}) < (u_0^{(s)}) < (\bar{u}_1^{(s)})\]

and

\[\nu_0^{(s)} = \frac{G_{28}^{0}}{G_{29}^{0}}\]

\[\mu_2^{(s)} = (u_1^{(s)}), \mu_1^{(s)} = (u_0^{(s)}), \text{ if } (\bar{u}_1^{(s)}) < (u_0^{(s)})\]

Then the solution satisfies the inequalities

\[G_{28}^{0}e^{(s_1^{(s)} - (p_{28})^{(s)})t} \leq G_{28}^{0}t \leq G_{28}^{0}e^{(s_1^{(s)} - (p_{28})^{(s)})t}\]

where \((p_i^{(s)})\) is defined

\[\frac{1}{(m_2)^{(s)}}G_{28}^{0}e^{(s_1^{(s)} - (p_{28})^{(s)})t} \leq G_{28}^{0}t \leq \frac{1}{(m_2)^{(s)}}G_{28}^{0}e^{(s_1^{(s)} - (p_{28})^{(s)})t}\]
\[
\left(\frac{2a(5)G_{50}^{(5)}}{m_{50}^{(5)}(S_{50}^{(5)})-p_{50}^{(5)}(S_{50}^{(5)})}\right) e^{(S_{50}^{(5)}(P_{50}^{(5)})t)} e^{-S_{50}^{(5)}t} + G_{50}^{(5)} e^{-S_{50}^{(5)}t} \leq G_{50}(t) \leq \left(\frac{2a(5)G_{50}^{(5)}}{m_{50}^{(5)}(a_{50})+a_{50}^{(5)}}\right) e^{(S_{50}^{(5)}t)} e^{-a_{50}^{(5)}(S_{50}^{(5)})t} + G_{50}^{(5)} e^{-a_{50}^{(5)}(S_{50}^{(5)})t} \]

\[
T_{20}^{(5)} e^{((R_{1})^{(5)}+r_{28})^{(5)}t} \leq T_{28}(t) \leq T_{20}^{(5)} e^{((R_{1})^{(5)}+r_{28})^{(5)}t} \]

\[
\frac{1}{\mu_{50}^{(5)}} T_{20}^{(5)} e^{((R_{1})^{(5)}+r_{28})^{(5)}t} \leq T_{28}(t) \leq \frac{1}{\mu_{50}^{(5)}} T_{20}^{(5)} e^{((R_{1})^{(5)}+r_{28})^{(5)}t} \]

\[
\frac{(b_{50}^{(5)})^{p_{50}^{(5)}}}{\mu_{50}^{(5)}(R_{1})^{(5)}+b_{50}^{(5)}} e^{(R_{1})^{(5)}t} e^{-b_{50}^{(5)}t} + T_{30}^{(5)} e^{-(b_{50}^{(5)})t} \leq T_{30}(t) \leq \frac{(b_{50}^{(5)})^{p_{50}^{(5)}}}{\mu_{50}^{(5)}(R_{1})^{(5)}+b_{50}^{(5)}} e^{(R_{1})^{(5)}t} e^{-b_{50}^{(5)}t} + T_{30}^{(5)} e^{-(b_{50}^{(5)})t} \]

Definition of \((S_{1})^{(5)}, (S_{2})^{(5)}, (R_{1})^{(5)}, (R_{2})^{(5)}\):

Where \((S_{1})^{(5)} = (a_{28}^{(5)}(m_{2})^{(5)} - (a_{28}^{(5)})^{5})\)

\((S_{2})^{(5)} = (a_{30}^{(5)} - (p_{30}^{(5)})^{5})\)

\((R_{1})^{(5)} = (b_{28}^{(5)}(\mu_{2})^{(5)} - (b_{28}^{(5)})^{5})\)

\((R_{2})^{(5)} = (b_{30}^{(5)} - (r_{30}^{(5)})^{5})\)

Behavior of the solutions

If we denote and define

\[(\sigma_{1})^{(6)}, (\sigma_{2})^{(6)}, (\tau_{1})^{(6)}, (\tau_{2})^{(6)}\]

\[\quad \text{where} \quad (a_{32}^{(6)})^{(5)} \leq (a_{33}^{(6)})^{(5)} \leq (a_{32}^{(6)})^{(5)}(T_{33}, t) + (a_{33}^{(6)})^{(5)}(T_{33}, t) \leq (a_{31}^{(6)})^{(5)} \]

\[\quad (a_{32}^{(6)})^{(5)} \leq (a_{31}^{(6)})^{(5)} \leq (a_{32}^{(6)})^{(5)} + (a_{33}^{(6)})^{(5)}(T_{33}, t) \]

Definition of \((\nu_{1})^{(6)}, (\nu_{2})^{(6)}, (u_{1})^{(6)}, (u_{2})^{(6)}, (\nu^{(6)}, u^{(6)})\):

\[\quad (\tau_{1})^{(6)} < 0, (\tau_{2})^{(6)} > 0 \text{ and respectively } (u_{1})^{(6)} > 0, (u_{2})^{(6)} < 0, \text{ the roots of } \]

\[\quad (a_{32}^{(6)})^{2} + (a_{31}^{(6)})^{2} = 0 \quad \text{and} \quad (b_{32}^{(6)})^{2} + (b_{31}^{(6)})^{2} = 0 \]

Definition of \((\bar{\nu}_{1})^{(6)}, (\bar{u}_{1})^{(6)}, (\bar{\nu}_{2})^{(6)}, (\bar{u}_{2})^{(6)})\):

\[\quad (\tau_{1})^{(6)} < 0, (\tau_{2})^{(6)} > 0 \text{ and respectively } (u_{1})^{(6)} > 0, (u_{2})^{(6)} < 0, \text{ the roots of } \]

\[\quad (a_{32}^{(6)})^{2} + (a_{31}^{(6)})^{2} + (b_{32}^{(6)})^{2} = 0 \quad \text{and} \quad (b_{32}^{(6)})^{2} + (b_{31}^{(6)})^{2} = 0 \]

Definition of \((m_{1})^{(6)}, (m_{2})^{(6)}, (\mu_{1})^{(6)}, (\mu_{2})^{(6)}, (\nu_{0})^{(6)}\):

\[\quad (\tau_{1})^{(6)} > 0, (\tau_{2})^{(6)} < 0 \text{ and respectively } (u_{1})^{(6)} > 0, (u_{2})^{(6)} < 0, \text{ the roots of } \]

\[\quad (a_{32}^{(6)})^{2} + (a_{31}^{(6)})^{2} + (b_{32}^{(6)})^{2} = 0 \quad \text{and} \quad (b_{32}^{(6)})^{2} + (b_{31}^{(6)})^{2} = 0 \]
\[(m_2)^{(6)} = (v_0)^{(6)}, (m_1)^{(6)} = (v_1)^{(6)}, \text{ if } (v_0)^{(6)} < (v_1)^{(6)}\]

\[(m_2)^{(6)} = (v_1)^{(6)}, (m_1)^{(6)} = (\bar{v}_0)^{(6)}, \text{ if } (v_1)^{(6)} < (v_0)^{(6)} < (\bar{v}_1)^{(6)}\]

\[(v_0)^{(6)} = \frac{c^{(6)}_{12}}{c^{(6)}_{14}}\]

\[(m_2)^{(6)} = (v_1)^{(6)}, (m_1)^{(6)} = (v_0)^{(6)}, \text{ if } (\bar{v}_1)^{(6)} < (v_0)^{(6)}\]

and analogously

\[(\mu_2)^{(6)} = (u_0)^{(6)}, (\mu_1)^{(6)} = (u_1)^{(6)}, \text{ if } (u_0)^{(6)} < (u_1)^{(6)}\]

\[(\mu_2)^{(6)} = (u_1)^{(6)}, (\mu_1)^{(6)} = (\bar{u}_0)^{(6)}, \text{ if } (u_1)^{(6)} < (u_0)^{(6)} < (\bar{u}_1)^{(6)}\]

\[(u_0)^{(6)} = \frac{T_0^{(6)}}{T_3^{(6)}}\]

\[(\mu_2)^{(6)} = (u_1)^{(6)}, (\mu_1)^{(6)} = (u_0)^{(6)}, \text{ if } (\bar{u}_1)^{(6)} < (u_0)^{(6)}\]

where \((u_1)^{(6)}, (\bar{u}_1)^{(6)}\) are defined respectively.

Then the solution satisfies the inequalities

\[G_{32}^0 e^{((S_1)^{(6)} - (p_{32})^{(6)})t} \leq G_{32}^0 e^{((S_1)^{(6)})t} \leq G_{32}^0 e^{((S_1)^{(6)} - (p_{32})^{(6)})t}\]

where \((p_j)^{(6)}\) is defined

\[1 \leq \frac{1}{(m_1)^{(6)}} G_{32}^0 e^{((S_1)^{(6)} - (p_{32})^{(6)})t} \leq \frac{1}{(m_2)^{(6)}} G_{32}^0 e^{((S_1)^{(6)} - (p_{32})^{(6)})t}\]

\[\left(\frac{a_{34})^{(6)}}{m_1^{(6)(S_1)^{(6)} - (p_{32})^{(6)}}}\right) e^{((S_1)^{(6)} - (p_{32})^{(6)} - (S_2)^{(6)})t} + G_{34}^0 e^{((S_2)^{(6)})t} \leq G_{34}^0 e^{((S_2)^{(6)} - (p_{32})^{(6)})t}\]

\[T_{32}^0 e^{((R_1)^{(6)})t} \leq T_{32}^0 e^{((R_1)^{(6)} + (r_{32})^{(6)})t}\]

\[\frac{1}{(\mu_1)^{(6)}} T_{32}^0 e^{((R_1)^{(6)} + (r_{32})^{(6)})t} \leq \frac{1}{(\mu_2)^{(6)}} T_{32}^0 e^{((R_1)^{(6)} + (r_{32})^{(6)})t}\]

\[\frac{(b_{34})^{(6)}}{(\mu_1)^{(6)(R_1)^{(6)} - (b_{34})^{(6)}}} \left[ e^{((R_1)^{(6)} - (b_{34})^{(6)})t} + T_{34}^0 e^{-(b_{34})^{(6)}t}\right] \leq T_{34}^0 e^{((R_1)^{(6)} + (r_{32})^{(6)})t}\]

\[\frac{(b_{34})^{(6)}}{(\mu_1)^{(6)(R_1)^{(6)} + (r_{32})^{(6)} + (r_{34})^{(6)}}} \left[ e^{((R_1)^{(6)} + (r_{32})^{(6)})t} + T_{34}^0 e^{-(r_{34})^{(6)}t}\right] \leq T_{34}^0 e^{((R_1)^{(6)} + (r_{32})^{(6)})t}\]

**Definition of** \((S_1)^{(6)}, (S_2)^{(6)}, (R_1)^{(6)}, (R_2)^{(6)}\):

Where \((S_1)^{(6)} = (a_{32})^{(6)}(m_2)^{(6)} - (a_{32})^{(6)}\)

\[(S_2)^{(6)} = (a_{34})^{(6)} - (p_{34})^{(6)}\]

\[(R_1)^{(6)} = (b_{32})^{(6)}(\mu_2)^{(6)} - (b_{32})^{(6)}\]

\[(R_2)^{(6)} = (b_{34})^{(6)} - (r_{34})^{(6)}\]

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If we denote and define

**Definition of \((\sigma_1)^{(7)}, (\sigma_2)^{(7)}, (\tau_1)^{(7)}, (\tau_2)^{(7)}\):**

(m) \((\sigma_1)^{(7)}, (\sigma_2)^{(7)}, (\tau_1)^{(7)}, (\tau_2)^{(7)}\) four constants satisfying

\[-(\sigma_2)^{(7)} \leq -(a_{16}^{(7)}) + (a_{57}^{(7)}) - (a_{56}^{(7)})(T_{37}, t) + (a_{37}^{(7)})(T_{37}, t) \leq -(\sigma_1)^{(7)}\]

\[-(\tau_2)^{(7)} \leq -(b_{16}^{(7)}) + (b_{57}^{(7)}) - (b_{56}^{(7)})(G_{39}, t) - (b_{37}^{(7)})(G_{39}, t) \leq -(\tau_1)^{(7)}\]

**Definition of \((\nu_1)^{(7)}, (\nu_2)^{(7)}, (u_1)^{(7)}, (u_2)^{(7)}, (\rho)^{(7)}, (u)^{(7)}\):**

(n) By \((\nu_1)^{(7)} > 0, (\nu_2)^{(7)} < 0\) and respectively \((u_1)^{(7)} > 0, (u_2)^{(7)} < 0\) the roots of the equations \((a_{37}^{(7)})(\nu)^{(7)})^2 + (\sigma_1)^{(7)}\nu^{(7)} - (a_{36}^{(7)}) = 0\)

and \((b_{37}^{(7)})(u)^{(7)})^2 + (\tau_1)^{(7)}u^{(7)} - (b_{36}^{(7)}) = 0\) and

**Definition of \((\bar{\nu}_1)^{(7)}, (\bar{\nu}_2)^{(7)}, (\bar{u}_1)^{(7)}, (\bar{u}_2)^{(7)}\):**

By \((\bar{\nu}_1)^{(7)} > 0, (\bar{\nu}_2)^{(7)} < 0\) and respectively \((\bar{u}_1)^{(7)} > 0, (\bar{u}_2)^{(7)} < 0\) the roots of the equations \((a_{37}^{(7)})(\nu)^{(7)})^2 + (\sigma_2)^{(7)}\nu^{(7)} - (a_{36}^{(7)}) = 0\)

and \((b_{37}^{(7)})(u)^{(7)})^2 + (\tau_2)^{(7)}u^{(7)} - (b_{36}^{(7)}) = 0\)

**Definition of \((m_1)^{(7)}, (m_2)^{(7)}, (\mu_1)^{(7)}, (\mu_2)^{(7)}, (\nu_0)^{(7)}\) :-**

(o) If we define \((m_1)^{(7)}, (m_2)^{(7)}, (\mu_1)^{(7)}, (\mu_2)^{(7)}\) by

\[(m_2)^{(7)} = (v_0)^{(7)}, (m_1)^{(7)} = (v_1)^{(7)}, \text{ if } (v_0)^{(7)} < (v_1)^{(7)}\]

\[(m_2)^{(7)} = (v_1)^{(7)}, (m_1)^{(7)} = (\bar{v}_1)^{(7)}, \text{ if } (v_1)^{(7)} < (v_0)^{(7)} < (\bar{v}_1)^{(7)},\]

and \((v_0)^{(7)} = \frac{\sigma_{16}}{\sigma_{36}}\)

\[(m_2)^{(7)} = (v_1)^{(7)}, (m_1)^{(7)} = (v_0)^{(7)}, \text{ if } (v_1)^{(7)} < (v_0)^{(7})\]

and analogously

\[(\mu_2)^{(7)} = (u_0)^{(7)}, (\mu_1)^{(7)} = (u_1)^{(7)}, \text{ if } (u_0)^{(7)} < (u_1)^{(7)}\]

\[(\mu_2)^{(7)} = (u_1)^{(7)}, (\mu_1)^{(7)} = (\bar{u}_1)^{(7)}, \text{ if } (u_1)^{(7)} < (u_0)^{(7)} < (\bar{u}_1)^{(7)},\]

and \((u_0)^{(7)} = \frac{\tau_{36}}{\tau_{37}}\)

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$(\mu_2)^{(7)} = (u_1)^{(7)}, (\mu_1)^{(7)} = (u_0)^{(7)}, if \, (\bar{u}_2)^{(7)} < (u_0)^{(7)} \quad \text{where} \quad (u_1)^{(7)}, (\bar{u}_1)^{(7)}$

are defined respectively.

Then the solution satisfies the inequalities

$$G_{36}^0 e^{((S_1)^{(7)}-(P_{36})^{(7)})t} \leq G_{36}(t) \leq G_{36}^0 e^{(S_1)^{(7)}t}$$

where $(p_j)^{(7)}$ is defined.

$$\frac{1}{(m_j)^{(7)}} G_{36}^0 e^{((S_1)^{(7)}-(P_{36})^{(7)})t} \leq G_{36}(t) \leq \frac{1}{(m_j)^{(7)}} G_{36}^0 e^{(S_1)^{(7)}t}$$

$$\frac{(a_{36})^{(7)} T_{36}^0}{(m_j)^{(7)} ((S_1)^{(7)}-(P_{36})^{(7)}-(S_2)^{(7)})} \left[ e^{((S_1)^{(7)}-(P_{36})^{(7)})t} - e^{-(S_2)^{(7)}t} \right] + G_{36}^0 e^{-(S_2)^{(7)}t} \leq G_{36}(t) \leq$$

$$\frac{(a_{36})^{(7)} T_{36}^0}{(m_j)^{(7)} ((S_1)^{(7)}-(P_{36})^{(7)}-(a_{36}^{'(7)}))} \left[ e^{((S_1)^{(7)}-(a_{36}^{'(7)}))t} - e^{-(a_{36}^{'(7)})t} \right] + G_{36}^0 e^{-(a_{36}^{'(7)}t)}$$

$$T_{36}^0 e^{(R_1)^{(7)}t} \leq T_{36}(t) \leq T_{36}^0 e^{((R_1)^{(7)}+(p_{36})^{(7)})t}$$

$$\frac{1}{(\mu_1)^{(7)}} T_{36}^0 e^{(R_1)^{(7)}t} \leq T_{36}(t) \leq \frac{1}{(\mu_2)^{(7)}} T_{36}^0 e^{((R_1)^{(7)}+(p_{36})^{(7)})t}$$

$$\frac{(P_{36})^{(7)} T_{36}^0}{(\mu_1)^{(7)} ((R_1)^{(7)}-(R_{36})^{(7)}+p_{36})^{(7)}} \left[ e^{((R_1)^{(7)}-(R_{36})^{(7)})t} - e^{-(R_{36})^{(7)}t} \right] + T_{36}^0 e^{-(R_{36})^{(7)}t} \leq T_{36}(t) \leq$$

$$\frac{(a_{36})^{(7)} T_{36}^0}{(\mu_2)^{(7)} ((R_1)^{(7)}+(p_{36})^{(7)}+p_{36})^{(7)}} \left[ e^{((R_1)^{(7)}+(p_{36})^{(7)})t} - e^{-(R_{36})^{(7)}t} \right] + T_{36}^0 e^{-(R_{36})^{(7)}t}$$

**Definition of** $(S_1)^{(7)}, (S_2)^{(7)}, (R_1)^{(7)}, (R_2)^{(7)}$: 

Where $(S_1)^{(7)} = (a_{36})^{(7)} (m_2)^{(7)} - (a_{36}^{'(7)})$

$(S_2)^{(7)} = (a_{36})^{(7)} - (p_{36})^{(7)}$
\[ (R_1)^{(\tau)} = (b_{36})^{(\tau)}(\mu_2^{\tau}) - (b'_{36})^{(\tau)} \]
\[ (R_2)^{(\tau)} = (b'_{36})^{(\tau)} - (r_{36})^{(\tau)} \]

From GLOBAL EQUATIONS we obtain

\[
\frac{d\nu^{(\tau)}}{dt} = (a_{36})^{(\tau)} - \left( (a'_{36})^{(\tau)} - (a_{37})^{(\tau)} + (a''_{36})^{(\tau)}(T_{37}, t) \right) -
(a''_{37})^{(\tau)}(T_{37}, t)\nu^{(\tau)} - (a_{37})^{(\tau)}\nu^{(\tau)}
\]

Definition of \( \nu^{(\tau)} \):

\[ \nu^{(\tau)} = \frac{G_3}{G_4} \]

It follows

\[
- \left( (a_{37})^{(\tau)}(\nu^{(\tau)})^2 + (a_{37})^{(\tau)}\nu^{(\tau)} - (a_{36})^{(\tau)} \right) \leq \frac{d\nu^{(\tau)}}{dt} \leq
- \left( (a_{37})^{(\tau)}(\nu^{(\tau)})^2 + (a_{37})^{(\tau)}\nu^{(\tau)} - (a_{36})^{(\tau)} \right)
\]

From which one obtains

Definition of \( (\bar{v}_1)^{(\tau)}, (\nu_0)^{(\tau)} \):

(a) For \( 0 \leq (\nu_0)^{(\tau)} = \frac{G_3}{G_4} \leq (\nu_1)^{(\tau)} < (\bar{v}_1)^{(\tau)} \)

\[
\nu^{(\tau)}(t) \geq \frac{(\nu_3)^{(\tau)}(\nu_2)^{(\tau)}e^{-(a_{37})^{(\tau)}(\nu_1)^{(\tau)}-(\nu_0)^{(\tau)}t}}{1+(C)^{(\tau)}e^{-(a_{37})^{(\tau)}(\nu_1)^{(\tau)}-(\nu_0)^{(\tau)}t}} \quad , \quad (C)^{(\tau)} = \frac{(\nu_1)^{(\tau)}-(\nu_0)^{(\tau)}(\nu_0)^{(\tau)}-(\nu_2)^{(\tau)}}
\]

it follows \( (\nu_0)^{(\tau)} \leq \nu^{(\tau)}(t) \leq (\nu_1)^{(\tau)} \)

In the same manner, we get
\[ v'(t) \leq \frac{(v_2(t) + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t)}{1 + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t} \quad , \quad \frac{(v_1(t) - v_0(t))}{(v_0(t) - v_2(t))} \]

From which we deduce \( (v_0(t)) \leq v'(t) \leq (v_1(t)) \)

(b) If \( 0 < (v_1(t)) < (v_0(t)) = \frac{\phi_0}{\phi_{37}} < (\tilde{v}_1(t)) \) we find like in the previous case,

\[ (v_1(t)) \leq \frac{(v_1(t) - (v_2(t))) e^{-a_3t} (v_1(t) - v_2(t)) t}{1 + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t} \leq v'(t) \leq \]

\[ (v_2(t) + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t)}{1 + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t} \leq (\tilde{v}_1(t)) \]

(c) If \( 0 < (v_1(t)) \leq (v_2(t)) \leq (v_0(t)) = \frac{\phi_0}{\phi_{37}} \) we obtain

\[ (v_1(t)) \leq v'(t) \leq \frac{(v_1(t) - (v_2(t))) e^{-a_3t} (v_1(t) - v_2(t)) t}{1 + (v_1(t) - v_2(t)) e^{-a_3t} (v_1(t) - v_2(t)) t} \leq (v_0(t)) \]

And so with the notation of the first part of condition (c), we have

**Definition of** \( v'(t) \)

\[ (m_2(t)) \leq v'(t) \leq (m_1(t)), \quad \frac{v'(t)}{G_{37}(t)} = \frac{G_{38}(t)}{G_{37}(t)} \]

In a completely analogous way, we obtain

**Definition of** \( u'(t) \)

\[ (\mu_2(t)) \leq u'(t) \leq (\mu_1(t)), \quad \frac{u'(t)}{F_{37}(t)} = \frac{F_{38}(t)}{F_{37}(t)} \]

Now, using this result and replacing it in GLOBAL EQUATIONS we get easily the result stated in the theorem.
Particular case :

If \((a''_{36})^{(7)} = (a''_{37})^{(7)}\), then \((\sigma_1)^{(7)} = (\sigma_2)^{(7)}\) and in this case \((v_1)^{(7)} = (\nu_1)^{(7)}\) if in addition \((v_0)^{(7)} = (v_1)^{(7)}\) then \(v^{(7)}(t) = (v_0)^{(7)}(t)\) and as a consequence \(G_{36}(t) = (v_0)^{(7)}(t)\). This also defines \((v_0)^{(7)}\) for the special case.

Analogously if \((b''_{36})^{(7)} = (b''_{37})^{(7)}\), then \((\tau_1)^{(7)} = (\tau_2)^{(7)}\) and then

\[(u_1)^{(7)} = (\bar{u_1})^{(7)}\] if in addition \((u_0)^{(7)} = (u_1)^{(7)}\) then \(T_{36}(t) = (u_0)^{(7)}(t)\). This is an important consequence of the relation between \((v_1)^{(7)}\) and \((\bar{v}_1)^{(7)}\), and definition of \((u_0)^{(7)}\).

We can prove the following

If \((a''_n)^{(7)}\) and \((b''_n)^{(7)}\) are independent on \(t\), and the conditions

\[a''_{36}(t)a''_{37}(t) - a_{36}(t)a_{37}(t) < 0\]

\[a''_{36}(t)a''_{37}(t) - a_{36}(t)a_{37}(t) + a_{36}(t)p_{36}(t) + a''_{37}(t)p_{37}(t) + p_{36}(t)p_{37}(t) > 0\]

\[b''_{36}(t)b''_{37}(t) - b_{36}(t)b_{37}(t) > 0\]

\[b''_{36}(t)b''_{37}(t) - b_{36}(t)b_{37}(t) - b_{36}(t)r_{37}(t) - b''_{37}(t)r_{37}(t) + r_{36}(t)r_{37}(t) < 0\]

\(\) with \((p_{36})^{(7)}\) and \((r_{37})^{(7)}\) as defined are satisfied, then the system WITH THE SATISFACTION OF THE FOLLOWING PROPERTIES HAS A SOLUTION AS DERIVED BELOW.

\[\]

Particular case :

If \((a''_{36})^{(2)} = (a''_{37})^{(2)}\) then \((\sigma_1)^{(2)} = (\sigma_2)^{(2)}\) and in this case \((v_1)^{(2)} = (\nu_1)^{(2)}\) if in addition \((v_0)^{(2)} = (v_1)^{(2)}\) then \(v^{(2)}(t) = (v_0)^{(2)}(t)\) and as a consequence \(G_{36}(t) = (v_0)^{(2)}(t)G_{17}(t)\).

Analogously if \((b''_{36})^{(2)} = (b''_{37})^{(2)}\), then \((\tau_1)^{(2)} = (\tau_2)^{(2)}\) and then

\[(u_1)^{(2)} = (\bar{u_1})^{(2)}\] if in addition \((u_0)^{(2)} = (u_1)^{(2)}\) then \(T_{16}(t) = (u_0)^{(2)}(t)\). This is an important consequence of the relation between \((v_1)^{(2)}\) and \((\bar{v}_1)^{(2)}\).

From GLOBAL EQUATIONS we obtain

\[\frac{d\nu^{(3)}}{dt} = (a_{20})^{(3)} - \left((a''_{20})^{(3)} - (a''_{21})^{(3)} + (a_{20})^{(3)}(T_{21}, t)\right) - (a''_{21})^{(3)}(T_{23}, t)v^{(3)} - (a_{21})^{(3)}v^{(3)}\]
Definition of $v^{(3)}$ :\[ v^{(3)} = \frac{g_{20}}{g_{21}} \]

It follows
\[- \left( (a_{21})^{(3)} (v^{(3)})^2 + (\sigma_2^{(3)} v^{(3)} - (a_{20})^{(3)} \right) \leq \frac{dv^{(3)}}{dt} \leq \left( (a_{21})^{(3)} (v^{(3)})^2 + (\sigma_1^{(3)} v^{(3)} - (a_{20})^{(3)} \right) \]

From which one obtains

(a) For $0 < (v_0^{(3)}) = \frac{g_{20}}{g_{21}} < (v_1^{(3)}) < (\bar{v}_1^{(3)})$

\[ v^{(3)} (t) = v^{(3)} (0) e^{-\left( (a_{21})^{(3)} (v_1^{(3)}) - (v_0^{(3)}) \right) t} \]

In the same manner, we get

\[ v^{(3)} (t) \leq \frac{(v_{12}^{(3)} + (C^{(3)} (v_{21}^{(3)} - (v_{20}^{(3)}) e^{-\left( (a_{21})^{(3)} (v_1^{(3)}) - (v_0^{(3)}) \right) t} \]

it follows $(v_0^{(3)}) \leq v^{(3)} (t) \leq (v_1^{(3)})$

Definition of $(\bar{v}_1^{(3)})$ :\]

From which we deduce $(v_0^{(3)}) \leq v^{(3)} (t) \leq (\bar{v}_1^{(3)})$

(b) If $0 < (v_1^{(3)}) < (v_0^{(3)}) = \frac{g_{20}}{g_{21}} < (\bar{v}_1^{(3)})$ we find like in the previous case,

\[ (v_1^{(3)}) \leq v^{(3)} (t) \leq \frac{(v_{12}^{(3)} + (C^{(3)} (v_{21}^{(3)} - (v_{20}^{(3)}) e^{-\left( (a_{21})^{(3)} (v_1^{(3)}) - (v_0^{(3)}) \right) t} \]

(c) If $0 < (v_1^{(3)}) \leq (\bar{v}_1^{(3)}) \leq (v_0^{(3)}) = \frac{g_{20}}{g_{21}}$, we obtain

\[ (v_1^{(3)}) \leq v^{(3)} (t) \leq \frac{(v_{12}^{(3)} + (C^{(3)} (v_{21}^{(3)} - (v_{20}^{(3)}) e^{-\left( (a_{21})^{(3)} (v_1^{(3)}) - (v_0^{(3)}) \right) t} \]

And so with the notation of the first part of condition (c), we have

Definition of $v^{(3)} (t)$ :\]

\[ (m_2^{(3)}) \leq v^{(3)} (t) \leq (m_1^{(3)}) \]

In a completely analogous way, we obtain

Definition of $u^{(3)} (t)$ :
\((\mu_2)^{(3)} \leq u^{(3)}(t) \leq (\mu_1)^{(3)}\), \[u^{(3)}(t) = \frac{u_{22}(t)}{u_{21}(t)}\]

Now, using this result and replacing it in \textit{GLOBAL EQUATIONS} we get easily the result stated in the theorem.

Particular case :

If \((a_{20}^{(3)}) = (a_{21}^{(3)})\), then \((\sigma_1)^{(3)} = (\sigma_2)^{(3)}\) and in this case \((v_1)^{(3)} = (v_2)^{(3)}\), if in addition \((v_0)^{(3)} = (v_1)^{(3)}\) then \(v^{(3)}(t) = (v_0)^{(3)}\) and as a consequence \(G_{20}(t) = (v_0)^{(3)}G_{21}(t)\).

Analogously if \((b_{20}^{(3)}) = (b_{21}^{(3)})\), then \((\tau_1)^{(3)} = (\tau_2)^{(3)}\) and then \((u_1)^{(3)} = (u_0)^{(3)}\) if in addition \((u_0)^{(3)} = (u_1)^{(3)}\) then \(T_{20}(t) = (u_0)^{(3)}T_{21}(t)\). This is an important consequence of the relation between \((v_1)^{(3)}\) and \((v_2)^{(3)}\).

\[\begin{align*}
\frac{dv^{(4)}}{dt} &= (a_{24})^{(4)} - ((a_{24})^{(4)}(a_{24})^{(4)} + (a_{24})^{(4)}(T_{25}, t) - (a_{25})^{(4)}(T_{25}, t)v^{(4)} - (a_{25})^{(4)}v^{(4)}
\end{align*}\]

\text{Definition of} \(v^{(4)}\) :
\[v^{(4)} = \frac{G_{24}}{G_{25}}\]

It follows:
\[-((a_{25})^{(4)}(v^{(4)})^2 + (\sigma_2)^{(4)}v^{(4)} - (a_{25})^{(4)} \leq \frac{dv^{(4)}}{dt} \leq -((a_{25})^{(4)}(v^{(4)})^2 + (\sigma_4)^{(4)}v^{(4)} - (a_{25})^{(4)})\]

From which one obtains

\text{Definition of} \((\bar{v}_1)^{(4)}\), \((v_0)^{(4)}\) :

\[\begin{align*}
(d) \quad \text{For} \quad 0 < \frac{(v_0)^{(4)}}{G_{25}} < (v_1)^{(4)} < (\bar{v}_1)^{(4)}
\end{align*}\]

\[\begin{align*}
\left(\frac{(v_1)^{(4)}(v_0)^{(4)}(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}]}{4 + C(4)_{(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}])}}\right)
\end{align*}\]

\[\begin{align*}
(C)^{(4)} &= \frac{(v_1)^{(4)} - (v_0)^{(4)}}{(v_0)^{(4)} - (v_2)^{(4)}}
\end{align*}\]

it follows \(v_0^{(4)} \leq v^{(4)}(t) \leq (v_1)^{(4)}\)

In the same manner, we get

\[\begin{align*}
\left(\frac{(v_1)^{(4)}(v_0)^{(4)}(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}]}{4 + C(4)_{(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}])}}\right)
\end{align*}\]

\[\begin{align*}
(C)^{(4)} &= \frac{(v_1)^{(4)} - (v_0)^{(4)}}{(v_0)^{(4)} - (v_2)^{(4)}}
\end{align*}\]

From which we deduce \(v_0^{(4)} \leq v^{(4)}(t) \leq (\bar{v}_1)^{(4)}\)

\[\begin{align*}
\text{(e) If} \quad 0 < (v_1)^{(4)} < (v_0)^{(4)} = \frac{G_{24}}{G_{25}} < (\bar{v}_1)^{(4)} \text{ we find like in the previous case,}
\end{align*}\]

\[\begin{align*}
(v_1)^{(4)} \leq \frac{(v_1)^{(4)}(v_0)^{(4)}(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}]}{1 + C(4)_{(v_0)^{(4)}[(-a_{25})^{(4)}(v_1)^{(4)} - (v_0)^{(4)}])}} \leq v^{(4)}(t) \leq
\end{align*}\]
\[
\frac{(v_2)^{(4)}(\bar{c})^{(4)}(\bar{v}_2)^{(4)}(\bar{v}_2)^{(4)}e^{-[(a_{25})^{(4)}(\bar{v}_1)^{(4)}-(\bar{v}_2)^{(4)})]^2}}{1+e^{(\bar{c})^{(4)}e^{-[(a_{25})^{(4)}(\bar{v}_1)^{(4)}-(\bar{v}_2)^{(4)})]^2}}} \leq (\bar{v}_1)^{(4)}
\]

(f) If \(0 < (v_1)^{(4)} \leq (\bar{v}_1)^{(4)} \leq \left(\frac{\nu_0}{\nu_0}\right)^{(4)}\), we obtain

\[
(v_1)^{(4)} \leq v^{(4)}(t) \leq \frac{(v_1)^{(4)} + (\bar{v}_1)^{(4)}(\bar{v}_2)^{(4)}e^{-[(a_{25})^{(4)}(\bar{v}_1)^{(4)}-(\bar{v}_2)^{(4)})]^2}}{1+e^{(\bar{c})^{(4)}e^{-[(a_{25})^{(4)}(\bar{v}_1)^{(4)}-(\bar{v}_2)^{(4)})]^2}}} \leq (v_0)^{(4)}
\]

And so with the notation of the first part of condition (c), we have the definition of \(v^{(4)}(t)\):

\[
(m_2)^{(4)} \leq v^{(4)}(t) \leq (m_1)^{(4)}, \quad v^{(4)}(t) = \frac{\nu_{24}(t)}{\nu_{25}(t)}
\]

In a completely analogous way, we obtain the definition of \(u^{(4)}(t)\):

\[
(\mu_2)^{(4)} \leq u^{(4)}(t) \leq (\mu_1)^{(4)}, \quad u^{(4)}(t) = \frac{T_{24}(t)}{T_{25}(t)}
\]

Now, using this result and replacing it in GLOBAL EQUATIONS we get easily the result stated in the theorem.

Particular case:

If \((a_{28}^{(4)} = a_{28}^{(4)}\), then \((\sigma_1)^{(4)} = (\sigma_2)^{(4)}\) and in this case \((v_1)^{(4)} = (\bar{v}_1)^{(4)}\) if in addition \((\nu_0)^{(4)} = (\nu_1)^{(4)}\) then \(v^{(4)}(t) = (v_0)^{(4)}\) and as a consequence \(\nu_{24}(t) = (\nu_0)^{(4)}\nu_{25}(t)\) this also defines \((\nu_0)^{(4)}\) for the special case.

Analogously if \((a_{28}^{(4)} = a_{28}^{(4)}\), then \((\tau_1)^{(4)} = (\tau_2)^{(4)}\) and then \((\nu_1)^{(4)} = (\bar{u}_1)^{(4)}\) if in addition \((\nu_0)^{(4)} = (\nu_1)^{(4)}\) then \(T_{24}(t) = (\nu_0)^{(4)}T_{25}(t)\) This is an important consequence of the relation between \((\nu_1)^{(4)}\) and \((\bar{v}_1)^{(4)}\), and definition of \((\nu_0)^{(4)}\).

From GLOBAL EQUATIONS we obtain

\[
\frac{d\nu^{(5)}}{dt} = (a_{28}^{(5)}) - \left((a_{28}^{(5)}) - (a_{28}^{(5)}) + (a_{28}^{(5)})T_{29}(t)\right) - (a_{28}^{(5)})T_{29}(t)\nu^{(5)} - (a_{28}^{(5)})\nu^{(5)}
\]

Definition of \(v^{(5)}\):

\[
v^{(5)} = \frac{\nu_{28}}{\nu_{24}}
\]

It follows

\[-\left((a_{28}^{(5)})\nu^{(5)}\right)^2 + (\sigma_2)^{(5)}\nu^{(5)} - (a_{28}^{(5)}) \leq \frac{d\nu^{(5)}}{dt} \leq -\left((a_{28}^{(5)})\nu^{(5)}\right)^2 + (\sigma_1)^{(5)}\nu^{(5)} - (a_{28}^{(5)})\]

From which one obtains the definition of \((\bar{v}_1)^{(5)}\), \((\nu_0)^{(5)}\):

\[
(g) \quad \text{For } 0 < \left(\frac{\nu_0}{\nu_{24}}\right)^{(5)} < (v_1)^{(5)} < (\bar{v}_1)^{(5)}
\]
\[ \nu^{(5)}(t) \geq \frac{(v_1^{(5)})^2 + (v_2^{(5)})^2 e^{-\frac{(a_2)^2}{2 \sigma^2}}}{5 + (\tilde{C})^{(5)}} e^{-\frac{(a_2)^2}{2 \sigma^2}} \], \quad (\tilde{C})^{(5)} = \frac{(v_1^{(5)})^2 - (v_2^{(5)})^2}{(v_0^{(5)})^2 - (v_2^{(5)})^2}

it follows \((v_0^{(5)})^2 \leq \nu^{(5)}(t) \leq (v_1^{(5)})^2\)

In the same manner, we get

\[ \nu^{(5)}(t) \leq \frac{(v_2^{(5)})^2 + (v_1^{(5)})^2 e^{-\frac{(a_2)^2}{2 \sigma^2}}}{5 + (\tilde{C})^{(5)}} e^{-\frac{(a_2)^2}{2 \sigma^2}} \], \quad (\tilde{C})^{(5)} = \frac{(v_1^{(5)})^2 - (v_2^{(5)})^2}{(v_0^{(5)})^2 - (v_2^{(5)})^2}

From which we deduce \((v_0^{(5)})^2 \leq \nu^{(5)}(t) \leq (v_2^{(5)})^2\)

(h) If \(0 < (v_1^{(5)})^2 < (v_0^{(5)})^2 = \frac{\sigma^2}{2 \sigma^2} < (v_2^{(5)})^2\) we find like in the previous case,

\[ (v_1^{(5)})^2 \leq \frac{(v_2^{(5)})^2 + (v_1^{(5)})^2 e^{-\frac{(a_2)^2}{2 \sigma^2}}}{1 + (\tilde{C})^{(5)}} e^{-\frac{(a_2)^2}{2 \sigma^2}} \leq \nu^{(5)}(t) \leq \frac{(v_1^{(5)})^2 + (v_2^{(5)})^2 e^{-\frac{(a_2)^2}{2 \sigma^2}}}{1 + (\tilde{C})^{(5)}} e^{-\frac{(a_2)^2}{2 \sigma^2}} \]

(i) If \(0 < (v_1^{(5)})^2 \leq (v_2^{(5)})^2 \leq \frac{\sigma^2}{2 \sigma^2} < (v_2^{(5)})^2\), we obtain

\[ (v_1^{(5)})^2 \leq \nu^{(5)}(t) \leq \frac{(v_2^{(5)})^2 + (v_1^{(5)})^2 e^{-\frac{(a_2)^2}{2 \sigma^2}}}{1 + (\tilde{C})^{(5)}} e^{-\frac{(a_2)^2}{2 \sigma^2}} \]

And so with the notation of the first part of condition (c), we have

**Definition of** \(\nu^{(5)}(t)\) :

\[ (m_2^{(5)})^2 \leq \nu^{(5)}(t) \leq (m_1^{(5)})^2, \quad \nu^{(5)}(t) = \frac{\sigma^2}{2 \sigma^2} \]

In a completely analogous way, we obtain

**Definition of** \(u^{(5)}(t)\) :

\[ (\mu_2^{(5)})^2 \leq u^{(5)}(t) \leq (\mu_1^{(5)})^2, \quad u^{(5)}(t) = \frac{T_{2\sigma^2}}{T_{2\sigma^2}} \]

Now, using this result and replacing it in **GLOBAL EQUATIONS** we get easily the result stated in the theorem.

**Particular case** :

If \((a_2^{(5)})^2 = (a_2^{(5)})^2\), then \((\sigma_1^{(5)})^2 = (\sigma_2^{(5)})^2\) and in this case \((v_1^{(5)})^2 = (v_2^{(5)})^2\) if in addition \((v_0^{(5)})^2 = (v_2^{(5)})^2\) then \(\nu^{(5)}(t) = (v_0^{(5)})^2\) and as a consequence \(T_{2\sigma^2}(t) = (v_0^{(5)})^2 T_{2\sigma^2}(t)\) **this also defines** \(v^{(5)}(t)\) **for the special case**.

Analogously if \((b_2^{(5)})^2 = (b_2^{(5)})^2\), then \((\tau_1^{(5)})^2 = (\tau_2^{(5)})^2\) and then \((u_1^{(5)})^2 = (u_2^{(5)})^2\) if in addition \((u_0^{(5)})^2 = (u_2^{(5)})^2\) then \(T_{2\sigma^2}(t) = (u_0^{(5)})^2 T_{2\sigma^2}(t)\) This is an important consequence of the relation between \((v_1^{(5)})^2\) and \((v_2^{(5)})^2\), **and definition of** \(u^{(5)}(t)\).

we obtain

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\[
\frac{dv^{(6)}}{dt} = (a^{(6)}_{22}) - \left( (a^{(6)}_{22}) - (a^{(6)}_{33}) + (a^{(6)}_{44}) \right) - (a^{(6)}_{55}) \nu^{(6)} - (a^{(6)}_{66}) \nu^{(6)}
\]

**Definition of \( \nu^{(6)} \):**

\[
\nu^{(6)} = \frac{d^2 \xi}{d\eta^2}
\]

It follows

\[
- \left( (a^{(6)}_{33}) \nu^{(6)} \right)^2 + (\sigma^2_{(6)} \nu^{(6)} - (a^{(6)}_{33}) \nu^{(6)}) \leq \frac{dv^{(6)}}{dt} \leq - \left( (a^{(6)}_{33}) \nu^{(6)} \right)^2 + (\sigma^2_{(6)} \nu^{(6)} - (a^{(6)}_{33}) \nu^{(6)})
\]

From which one obtains

**Definition of \( \bar{\nu}^{(6)}, (v_0)^{(6)} \):**

\[(j)\]

For \( \bar{\nu}^{(6)} \), we get

\[
\bar{\nu}^{(6)}(t) \geq \frac{(v_1)^{(6)} \bar{\nu}_2^{(6)}}{1 + (\bar{\nu}_1)^{(6)}}, \quad (C)_{(6)} = \frac{(v_1)^{(6)} - (v_0)^{(6)}}{(v_0)^{(6)} - (v_2)^{(6)}}
\]

it follows \( (v_0)^{(6)} \leq \nu^{(6)}(t) \leq (v_1)^{(6)} \)

In the same manner, we get

\[
\nu^{(6)}(t) \leq \frac{(v_1)^{(6)} \bar{\nu}_2^{(6)}}{1 + (\bar{\nu}_1)^{(6)}}, \quad (C)_{(6)} = \frac{(v_1)^{(6)} - (v_0)^{(6)}}{(v_0)^{(6)} - (v_2)^{(6)}}
\]

From which we deduce \( (v_0)^{(6)} \leq \nu^{(6)}(t) \leq (v_1)^{(6)} \)

\[(k)\]

If \( (v_1)^{(6)} \leq (v_0)^{(6)} \leq \bar{\nu}^{(6)} \), we find like in the previous case,

\[
\bar{\nu}^{(6)}(t) \leq \frac{(v_1)^{(6)} \bar{\nu}_2^{(6)}}{1 + (\bar{\nu}_1)^{(6)}}, \quad (C)_{(6)} = \frac{(v_1)^{(6)} - (v_0)^{(6)}}{(v_0)^{(6)} - (v_2)^{(6)}}
\]

\[(l)\]

If \( (v_1)^{(6)} \leq \bar{\nu}^{(6)} \leq (v_0)^{(6)} \leq \bar{\nu}^{(6)} \), we obtain

\[
(v_1)^{(6)} \leq \nu^{(6)}(t) \leq \bar{\nu}^{(6)}(t) \leq \frac{(v_1)^{(6)} \bar{\nu}_2^{(6)}}{1 + (\bar{\nu}_1)^{(6)}}, \quad (C)_{(6)} = \frac{(v_1)^{(6)} - (v_0)^{(6)}}{(v_0)^{(6)} - (v_2)^{(6)}}
\]

And so with the notation of the first part of condition (c), we have

**Definition of \( \nu^{(6)}(t) \):**

\[(m_2)^{(6)} \leq \nu^{(6)}(t) \leq (m_1)^{(6)} , \quad \nu^{(6)}(t) = \frac{d^2 \xi}{d\eta^2}(t)
\]

In a completely analogous way, we obtain
Definition of $u^{(6)}(t)$:

$$(\mu_2)^{(6)} \leq u^{(6)}(t) \leq (\mu_1)^{(6)}, \quad u^{(6)}(t) = \frac{T_{32}(t)}{T_{33}(t)}$$

Now, using this result and replacing it in GLOBAL EQUATIONS we get easily the result stated in the theorem.

**Particular case:**

If $(a''_{32})^{(6)} = (a''_{33})^{(6)}$, then $(\sigma_1)^{(6)} = (\sigma_2)^{(6)}$ and in this case $(v_1)^{(6)} = (\bar{v}_1)^{(6)}$ if in addition $(v_0)^{(6)} = (v_2)^{(6)}$ then $v^{(6)}(t) = (v_0)^{(6)}$ and as a consequence $\hat{u}_{32}(t) = (v_0)^{(6)}\hat{u}_{33}(t)$ this also defines $(v_0)^{(6)}$ for the special case.

Analogously if $(b''_{32})^{(6)} = (b''_{33})^{(6)}$, then $(\tau_1)^{(6)} = (\tau_2)^{(6)}$ and then $(u_1)^{(6)} = (\bar{u}_1)^{(6)}$ if in addition $(u_0)^{(6)} = (u_2)^{(6)}$ then $T_{32}(t) = (u_0)^{(6)}T_{33}(t)$ This is an important consequence of the relation between $(v_1)^{(6)}$ and $(\bar{v}_1)^{(6)}$, and definition of $(u_0)^{(6)}$.

**Behavior of the solutions**

If we denote and define

**Definition of** $(\sigma_1)^{(7)}, (\sigma_2)^{(7)}, (\tau_1)^{(7)}, (\tau_2)^{(7})$:

- $(p)$ $(\sigma_1)^{(7)}, (\sigma_2)^{(7)}, (\tau_1)^{(7)}, (\tau_2)^{(7})$ four constants satisfying

$$-(\sigma_2)^{(7)} \leq -(a'_{36})^{(7)} + (a_{37})^{(7)} - (a_{36})^{(7)}(T_{37}, t) + (a_{37})^{(7)}(T_{37}, t) \leq -(\sigma_1)^{(7)}$$

$$-(\tau_2)^{(7)} \leq -(b'_{36})^{(7)} + (b_{37})^{(7)} - (b_{36})^{(7)}(G_{39}, t) - (b_{37})^{(7)}(G_{39}, t) \leq -(\tau_1)^{(7)}$$

**Definition of** $(v_1)^{(7)}, (v_2)^{(7)}, (u_1)^{(7)}, (u_2)^{(7)}, v^{(7)}, u^{(7)}$:

- $(q)$ By $(v_1)^{(7)} > 0, (v_2)^{(7)} < 0$ and respectively $(u_1)^{(7)} > 0, (u_2)^{(7)} < 0$ the roots of the equations $(a_{37})^{(7)}(v^{(7)})^2 + (\sigma_1)^{(7)}v^{(7)} - (a_{36})^{(7)} = 0$

and $(b_{37})^{(7)}(u^{(7)})^2 + (\tau_1)^{(7)}u^{(7)} - (b_{36})^{(7)} = 0$

**Definition of** $(\bar{v}_1)^{(7)}, (\bar{v}_2)^{(7)}, (\bar{u}_1)^{(7)}, (\bar{u}_2)^{(7})$:

By $(\bar{v}_1)^{(7)} > 0, (\bar{v}_2)^{(7)} < 0$ and respectively $(\bar{u}_1)^{(7)} > 0, (\bar{u}_2)^{(7)} < 0$ the roots of the equations $(a_{37})^{(7)}(v^{(7)})^2 + (\sigma_2)^{(7)}v^{(7)} - (a_{36})^{(7)} = 0$
and \((b_{37})^{(r)}(u^{(r)})^2 + (\tau_2)^{(r)}u^{(r)} - (b_{36})^{(r)} = 0\)

**Definition of \((m_2)^{(r)}, (m_2)^{(r)}, (\mu_1)^{(r)}, (\mu_2)^{(r)}, (v_0)^{(r)}\):**

\(r\) If we define \((m_2)^{(r)}, (m_2)^{(r)}, (\mu_1)^{(r)}, (\mu_2)^{(r)}\) by

\((m_2)^{(r)} = (v_0)^{(r)}, (m_1)^{(r)} = (v_1)^{(r)}, \text{ if } (v_0)^{(r)} < (v_1)^{(r)}\)

\((m_2)^{(r)} = (v_1)^{(r)}, (m_1)^{(r)} = (\bar{v}_1)^{(r)}, \text{ if } (v_1)^{(r)} < (v_0)^{(r)} < (\bar{v}_1)^{(r)},\)

\((m_2)^{(r)} = (v_1)^{(r)}, (m_1)^{(r)} = (v_0)^{(r)}, \text{ if } (\bar{v}_1)^{(r)} < (v_0)^{(r)}\)

and analogously

\((\mu_2)^{(r)} = (u_0)^{(r)}, (\mu_1)^{(r)} = (u_1)^{(r)}, \text{ if } (u_0)^{(r)} < (u_1)^{(r)}\)

\((\mu_2)^{(r)} = (u_1)^{(r)}, (\mu_1)^{(r)} = (\bar{u}_1)^{(r)}, \text{ if } (u_1)^{(r)} < (u_0)^{(r)} < (\bar{u}_1)^{(r)},\)

\((\mu_2)^{(r)} = (u_1)^{(r)}, (\mu_1)^{(r)} = (u_0)^{(r)}, \text{ if } (\bar{u}_1)^{(r)} < (u_0)^{(r)}\)

are defined by 59 and 67 respectively

Then the solution of GLOBAL EQUATIONS satisfies the inequalities

\[G_{36}^0e^{((S_1)^{(r)} - (p_{36})^{(r)})t} \leq G_{36}(t) \leq G_{36}^0e^{(S_1)^{(r)}t}\]

where \((p_{36})^{(r)}\) is defined
\[
\frac{1}{(m_1)^{(7)}} G_{36}^{0} e^{((S_1)^{(7)}-(p_{36})^{(7)})t} \leq G_{37}^{0} t \leq \frac{1}{(m_2)^{(7)}} G_{36}^{0} e^{((S_1)^{(7)})t}
\]

\[
G_{38}^{0} e^{-(S_2)^{(7)}t} + G_{38}^{0} e^{-(a_{38})^{(7)}t} \leq G_{38}^{0} t \leq \frac{(a_{38})^{(7)}e^{0}}{(m_1)^{(7)}} \left[ e^{((S_1)^{(7)}-(p_{36})^{(7)})t} - e^{-(S_2)^{(7)}t} \right] + G_{38}^{0} e^{-(a_{38})^{(7)}t}
\]

\[
T_{36}^{0} e^{(R_1)^{(7)}t} \leq T_{36}^{0} t \leq T_{36}^{0} e^{((R_1)^{(7)}+(r_{36})^{(7)})t}
\]

\[
\frac{1}{(\mu_1)^{(7)}} T_{36}^{0} e^{(R_1)^{(7)}t} \leq T_{36}^{0} t \leq \frac{1}{(\mu_2)^{(7)}} T_{36}^{0} e^{((R_1)^{(7)}+(r_{36})^{(7)})t}
\]

\[
G_{38}^{0} e^{-(b_{38})^{(7)}t} + G_{38}^{0} e^{-(b_{38})^{(7)}t} \leq T_{38}^{0} t \leq \frac{(a_{38})^{(7)}T_{38}^{0}}{(\mu_1)^{(7)}(R_1)^{(7)}+(r_{38})^{(7)}+(R_2)^{(7)}t)} e^{((R_1)^{(7)}+(r_{38})^{(7)})t} - e^{-(b_{38})^{(7)}t} + T_{38}^{0} e^{-(R_2)^{(7)}t}
\]

**Definition of \((S_1)^{(7)}, (S_2)^{(7)}, (R_1)^{(7)}, (R_2)^{(7)}\):-**

Where \((S_1)^{(7)} = (a_{36})^{(7)}(m_2)^{(7)} - (a_{36})^{(7)}\)

\((S_2)^{(7)} = (a_{38})^{(7)} - (p_{38})^{(7)}\)

\((R_1)^{(7)} = (b_{36})^{(7)}(\mu_2)^{(7)} - (b_{38})^{(7)}\)

\((R_2)^{(7)} = (b_{38})^{(7)} - (r_{38})^{(7)}\)

From CONCATENATED GLOBAL EQUATIONS we obtain

\[
\frac{dv^{(7)}}{dt} = (a_{36})^{(7)} - \left( (a_{36})^{(7)} - (a_{37})^{(7)} + (a_{36})^{(7)}T_{37}, t \right) - \left( a_{37}^{(7)}T_{37}, t \right)v^{(7)} - (a_{37})^{(7)}v^{(7)}
\]

**Definition of \(v^{(7)}\):-**

\[
v^{(7)} = \frac{a_{36}}{a_{37}}
\]

It follows

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\[-\left( (a_{37})^{(7)}(v^{(7)})^2 + (\sigma_2)^{(7)}y^{(7)} - (a_{36})^{(7)} \right) \leq \frac{dv^{(7)}}{dt} \leq \]
\[-\left( (a_{37})^{(7)}(v^{(7)})^2 + (\sigma_1)^{(7)}y^{(7)} - (a_{36})^{(7)} \right) \]

From which one obtains

**Definition of** \( (\bar{v}_2)^{(7)}, (v_0)^{(7)} \): 

(m) For \( 0 < (v_0)^{(7)} = \frac{\partial u}{\partial y} < (v_1)^{(7)} < (\bar{v}_2)^{(7)} \)

\[ v^{(7)}(t) \geq \frac{(v_2)^{(7)} + (C)^{(7)}(v_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_0)^{(7)})]t}}{1 + (C)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_0)^{(7)})]t}} \]

\[ C^{(7)} = \frac{(v_1)^{(7)} - (v_0)^{(7)}}{(v_2)^{(7)} - (v_2)^{(7)}} \]

it follows \( (v_0)^{(7)} \leq v^{(7)}(t) \leq (v_1)^{(7)} \)

In the same manner, we get

\[ v^{(7)}(t) \leq \frac{(v_2)^{(7)} + (\bar{v}_2)^{(7)}(\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}}{1 + (\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}} \]

\[ C^{(7)} = \frac{(v_1)^{(7)} - (v_0)^{(7)}}{(v_2)^{(7)} - (v_2)^{(7)}} \]

From which we deduce \( (v_0)^{(7)} \leq v^{(7)}(t) \leq (v_1)^{(7)} \)

(n) If \( 0 < (v_1)^{(7)} < (v_0)^{(7)} = \frac{\partial u}{\partial y} < (\bar{v}_1)^{(7)} \) we find like in the previous case,

\[ (v_1)^{(7)} \leq \frac{(v_2)^{(7)} + (\bar{v}_2)^{(7)}(\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}}{1 + (\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}} \leq v^{(7)}(t) \leq \]

\[ \frac{(v_2)^{(7)} + (\bar{v}_2)^{(7)}(\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}}{1 + (\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}} \leq (\bar{v}_1)^{(7)} \]

(o) If \( 0 < (v_1)^{(7)} < (\bar{v}_2)^{(7)} < (v_0)^{(7)} = \frac{\partial u}{\partial y} \), we obtain

\[ (v_1)^{(7)} \leq v^{(7)}(t) \leq \frac{(v_2)^{(7)} + (\bar{v}_2)^{(7)}(\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}}{1 + (\bar{v}_2)^{(7)}e^{-[(a_{37})^{(7)}(v_1)^{(7)} - (v_2)^{(7)})]t}} \leq (v_0)^{(7)} \]

And so with the notation of the first part of condition (c), we have

**Definition of** \( v^{(7)}(t) \): 

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(\mu_2(7) \leq u(7)(t) \leq \mu_1(7)),$$ where $$u(7)(t) = \frac{\gamma_3(t)}{\gamma_3(t)}$$

In a completely analogous way, we obtain

Definition of $$u(7)(t) :-$$

Now, using this result and replacing it in CONCATENATED GLOBAL EQUATIONS we get easily the result stated in the theorem.

**Particular case :**

If $$\sigma_3(7) = (\tilde{a}_3(7))$$ and in this case $$\sigma_1(7) = (\tilde{\sigma}_1(7))$$ if in addition $$\nu_0(7) = (\tilde{v}_0(7))$$ then $$u(7)(t) = (\tilde{v}_0(7))$$ and as a consequence $$G_{36}(t) = (\nu_0(7))G_{37}(t)$$ this also defines $$v_0(7)$$ for the special case.

Analogously if $$\tilde{\sigma}_3(7) = (\tilde{b}_3(7))$$, then $$\tau_1(7) = (\tilde{\tau}_1(7))$$ and then

$$u(7) = (\tilde{\nu}_1(7))$$ if in addition $$u_0(7) = (\tilde{u}_1(7))$$ then $$T_{36}(t) = (\nu_0(7))T_{37}(t)$$ This is an important consequence of the relation between $$v_1(7)$$ and $$(\tilde{\sigma}_1(7))$$, and definition of $$u_0(7)$$.

\[
(b_{14})^{(1)}T_{13} - [(b_{14}^{(1)}^{(1)}) - (b_{14}^{(1)})^{(1)}(G)]T_{14} = 0 \\
(b_{15})^{(1)}T_{14} - [(b_{15}^{(1)}^{(1)}) - (b_{15}^{(1)})^{(1)}(G)]T_{15} = 0
\]

has a unique positive solution, which is an equilibrium solution for the system

\[
(a_{16})^{(2)}G_{17} - [(a_{16}^{(2)}^{(2)}) + (a_{16}^{(2)})^{(2)}(T_{17})]G_{16} = 0 \\
(a_{17})^{(2)}G_{16} - [(a_{17}^{(2)}^{(2)}) + (a_{17}^{(2)})^{(2)}(T_{17})]G_{17} = 0 \\
(a_{18})^{(2)}G_{17} - [(a_{18}^{(2)}^{(2)}) + (a_{18}^{(2)})^{(2)}(T_{17})]G_{18} = 0 \\
(b_{16})^{(2)}T_{17} - [(b_{16}^{(2)})^{(2)} - (b_{16}^{(2)})^{(2)}(G_{19})]T_{16} = 0 \\
(b_{17})^{(2)}T_{16} - [(b_{17}^{(2)})^{(2)} - (b_{17}^{(2)})^{(2)}(G_{19})]T_{17} = 0 \\
(b_{18})^{(2)}T_{17} - [(b_{18}^{(2)})^{(2)} - (b_{18}^{(2)})^{(2)}(G_{19})]T_{18} = 0
\]

has a unique positive solution, which is an equilibrium solution for

\[
(a_{20})^{(3)}G_{21} - [(a_{20}^{(3)}^{(3)}) + (a_{20}^{(3)})^{(3)}(T_{21})]G_{20} = 0
\]
(a_{21})^3 G_{20} - [(a'_{21})^3 + (a''_{21})^3 (T'_{21})] G_{21} = 0

(a_{22})^3 G_{21} - [(a'_{22})^3 + (a''_{22})^3 (T'_{21})] G_{22} = 0

(b_{20})^3 T_{21} - [(b'_{20})^3 - (b''_{20})^3 (G_{223})] T_{20} = 0

(b_{21})^3 T_{20} - [(b'_{21})^3 - (b''_{21})^3 (G_{223})] T_{21} = 0

(b_{22})^3 T_{21} - [(b'_{22})^3 - (b''_{22})^3 (G_{223})] T_{22} = 0

has a unique positive solution, which is an equilibrium solution

(a_{24})^4 G_{25} - [(a'_{24})^4 + (a''_{24})^4 (T'_{25})] G_{24} = 0

(a_{25})^4 G_{24} - [(a'_{25})^4 + (a''_{25})^4 (T'_{25})] G_{25} = 0

(a_{26})^4 G_{25} - [(a'_{26})^4 + (a''_{26})^4 (T'_{25})] G_{26} = 0

(b_{24})^4 T_{25} - [(b'_{24})^4 - (b''_{24})^4 (G_{223})] T_{24} = 0

(b_{25})^4 T_{24} - [(b'_{25})^4 - (b''_{25})^4 (G_{223})] T_{25} = 0

(b_{26})^4 T_{25} - [(b'_{26})^4 - (b''_{26})^4 (G_{223})] T_{26} = 0

has a unique positive solution, which is an equilibrium solution for the system

(a_{28})^5 G_{29} - [(a'_{28})^5 + (a''_{28})^5 (T'_{29})] G_{28} = 0

(a_{29})^5 G_{28} - [(a'_{29})^5 + (a''_{29})^5 (T'_{29})] G_{29} = 0

(a_{30})^5 G_{29} - [(a'_{30})^5 + (a''_{30})^5 (T'_{29})] G_{30} = 0

(b_{28})^5 T_{29} - [(b'_{28})^5 - (b''_{28})^5 (G_{31})] T_{28} = 0

(b_{29})^5 T_{28} - [(b'_{29})^5 - (b''_{29})^5 (G_{31})] T_{29} = 0

(b_{30})^5 T_{29} - [(b'_{30})^5 - (b''_{30})^5 (G_{31})] T_{30} = 0

has a unique positive solution, which is an equilibrium solution for the system

(a_{32})^6 G_{33} - [(a'_{32})^6 + (a''_{32})^6 (T'_{33})] G_{32} = 0

(a_{33})^6 G_{32} - [(a'_{33})^6 + (a''_{33})^6 (T'_{33})] G_{33} = 0

(a_{34})^6 G_{33} - [(a'_{34})^6 + (a''_{34})^6 (T'_{33})] G_{34} = 0

(b_{32})^6 T_{33} - [(b'_{32})^6 - (b''_{32})^6 (G_{35})] T_{32} = 0
has a unique positive solution, which is an equilibrium solution for the system

\[
(a_{36})^{(7)}g_{37} - \left[ (a_{36}')^{(7)} + (a_{36}'')^{(7)}(T_{37}) \right]g_{36} = 0
\]

\[
(a_{37})^{(7)}g_{36} - \left[ (a_{37}')^{(7)} + (a_{37}'')^{(7)}(T_{37}) \right]g_{37} = 0
\]

\[
(a_{38})^{(7)}g_{37} - \left[ (a_{38}')^{(7)} + (a_{38}'')^{(7)}(T_{37}) \right]g_{38} = 0
\]

\[
(b_{36})^{(7)}T_{37} - \left[ (b_{36}')^{(7)} - (b_{36}'')^{(7)}(G_{39}) \right]T_{36} = 0
\]

\[
(b_{37})^{(7)}T_{36} - \left[ (b_{37}')^{(7)} - (b_{37}'')^{(7)}(G_{39}) \right]T_{37} = 0
\]

\[
(b_{38})^{(7)}T_{37} - \left[ (b_{38}')^{(7)} - (b_{38}'')^{(7)}(G_{39}) \right]T_{38} = 0
\]

has a unique positive solution, which is an equilibrium solution for the system

(a) Indeed the first two equations have a nontrivial solution \( G_{36}, G_{37} \) if

\[
F(T_{39}) = (a_{36}')^{(7)}(a_{37}')^{(7)} - (a_{36})^{(7)}(a_{37})^{(7)} + (a_{36}')^{(7)}(a_{37}')^{(7)}(T_{37}) + (a_{36})^{(7)}(a_{37}')^{(7)}(T_{37}) +
\]

\[
(a_{36}')^{(7)}(T_{37})(a_{37}')^{(7)}(T_{37}) = 0
\]

**Definition and uniqueness of \( T_{37} \):**

After hypothesis \( f(0) < 0, f(\infty) > 0 \) and the functions \((a_i')^{(7)}(T_{37})\) being increasing, it follows that there exists a unique \( T_{37} \) for which \( f(T_{37}) = 0 \). With this value, we obtain from the three first equations

\[
G_{36} = \frac{(a_{36})^{(7)}g_{37}}{[(a_{36}')^{(7)} + (a_{36}'')^{(7)}(T_{37})]}, \quad G_{38} = \frac{(a_{38})^{(7)}g_{37}}{[(a_{38}')^{(7)} + (a_{38}'')^{(7)}(T_{37})]}
\]

(e) By the same argument, the equations (SOLUTIONAL) admit solutions \( G_{36}, G_{37} \) if

\[
\varphi(G_{39}) = (b_{36}')^{(7)}(b_{37}')^{(7)} - (b_{36})^{(7)}(b_{37})^{(7)} -
\]
\[ \left( b_{36}^{(5)}(T_{36}^{5})^{(7)}(G_{39}) + (b_{37}^{(5)}(b_{38}^{(5)}(G_{39}) + (b_{39}^{(5)}(G_{39}) = 0 \right) \]

Where the \((G_{39})(G_{36}, G_{37}, G_{38}, G_{39})\) must be replaced by their values from 96. It is easy to see that \(\varphi\) is a decreasing function in \(G_{37}\), taking into account the hypothesis \(\varphi(0) > 0, \varphi(\infty) < 0\) it follows that there exists a unique \(G_{37}^*\) such that \(\varphi(G_{37}^*) = 0\).

Finally we obtain the unique solution of the system:

\[
G_{36}^* = \frac{(a_{36})^{(1)}(G_{37}^*)}{\left[a_{36}^{(1)}(a_{36}^{(1)}(T_{37}^{*}))\right]}, \quad G_{38}^* = \frac{(a_{38})^{(1)}(G_{39}^*)}{\left[a_{38}^{(1)}(a_{38}^{(1)}(T_{37}^{*}))\right]},
\]

\[
T_{36}^* = \frac{(b_{36})^{(7)}(T_{37}^*)}{\left[\left(b_{36}^{(7)}(b_{36}^{(7)}(G_{39}))\right)\right]}, \quad T_{38}^* = \frac{(b_{38})^{(7)}(T_{37}^*)}{\left[\left(b_{38}^{(7)}(b_{38}^{(7)}(G_{39}))\right)\right]}.
\]

**Definition and uniqueness of \((T_{31}^*)^*\):**

After hypothesis \(f(0) < 0, f(\infty) > 0\) and the functions \((a_i^{(1)}(T_{31}^*))\) being increasing, it follows that there exists a unique \(T_{31}^*\) for which \(f(T_{31}^*) = 0\). With this value, we obtain from the three first equations:

\[
G_{20} = \frac{(a_{20})^{(3)}(G_{21})}{\left[(a_{20})^{(3)} + (a_{20})^{(3)}(T_{21})\right]}, \quad G_{22} = \frac{(a_{22})^{(3)}(G_{21})}{\left[(a_{22})^{(3)} + (a_{22})^{(3)}(T_{21})\right]}
\]

**Definition and uniqueness of \((T_{35}^*)^*\):**

After hypothesis \(f(0) < 0, f(\infty) > 0\) and the functions \((a_i^{(1)}(T_{35}))\) being increasing, it follows that there exists a unique \(T_{35}^*\) for which \(f(T_{35}^*) = 0\). With this value, we obtain from the three first equations:

\[
G_{24} = \frac{(a_{24})^{(4)}(G_{25})}{\left[(a_{24})^{(4)} + (a_{24})^{(4)}(T_{25})\right]}, \quad G_{26} = \frac{(a_{26})^{(4)}(G_{25})}{\left[(a_{26})^{(4)} + (a_{26})^{(4)}(T_{25})\right]}
\]

**Definition and uniqueness of \((T_{29}^*)^*\):**

After hypothesis \(f(0) < 0, f(\infty) > 0\) and the functions \((a_i^{(1)}(T_{29}))\) being increasing, it follows that there exists a unique \(T_{29}^*\) for which \(f(T_{29}^*) = 0\). With this value, we obtain from the three first equations:

\[
G_{28} = \frac{(a_{28})^{(5)}(G_{29})}{\left[(a_{28})^{(5)} + (a_{28})^{(5)}(T_{29})\right]}, \quad G_{30} = \frac{(a_{30})^{(5)}(G_{29})}{\left[(a_{30})^{(5)} + (a_{30})^{(5)}(T_{29})\right]}
\]

**Definition and uniqueness of \((T_{33}^*)^*\):**

After hypothesis \(f(0) < 0, f(\infty) > 0\) and the functions \((a_i^{(1)}(T_{33}))\) being increasing, it follows that there exists a unique \(T_{33}^*\) for which \(f(T_{33}^*) = 0\). With this value, we obtain from the three first equations:
\[ G_{42} = \frac{(a_{42})^6}{(a_{22})^6 + (a_{22})^6}, \quad G_{34} = \frac{(a_{44})^6}{(a_{24})^6 + (a_{24})^6} \]

(f) By the same argument, the equations 92, 93 admit solutions \( G_{13}, G_{14} \) if
\[
\varphi(G) = (b_{13}^{(1)})^2(b_{14}^{(1)})^2 - (b_{13}^{(1)})^2(b_{14}^{(1)})^2 - \\
\left[(b_{13}^{(2)})^2(b_{14}^{(2)})^2(G) + (b_{14}^{(2)})^2(b_{13}^{(2)})^2(G)\right] + (b_{13}^{(2)})^2(G) = 0
\]

Where in \( G(G_{13}, G_{14}, G_{15}, G_{16}, G_{17}) \), \( G_{13}, G_{15} \) must be replaced by their values from 96. It is easy to see that \( \varphi \) is a decreasing function in \( G_{14} \) taking into account the hypothesis \( \varphi(0) > 0, \varphi(\infty) < 0 \) it follows that there exists a unique \( G_{14}^* \) such that \( \varphi(G_{14}^*) = 0 \)

(g) By the same argument, the equations 92, 93 admit solutions \( G_{16}, G_{17} \) if
\[
\varphi(G_{19}) = (b_{16}^{(2)})^2(b_{17}^{(2)})^2 - (b_{16}^{(2)})^2(b_{17}^{(2)})^2 - \\
\left[(b_{16}^{(2)})^2(b_{17}^{(2)})^2(G_{19}) + (b_{17}^{(2)})^2(b_{16}^{(2)})^2(G_{19})\right] + (b_{16}^{(2)})^2(G_{19}) = 0
\]

Where in \( G(G_{19}, G_{16}, G_{17}, G_{18}) \), \( G_{16}, G_{18} \) must be replaced by their values from 96. It is easy to see that \( \varphi \) is a decreasing function in \( G_{17} \) taking into account the hypothesis \( \varphi(0) > 0, \varphi(\infty) < 0 \) it follows that there exists a unique \( G_{14}^* \) such that \( \varphi(G_{19}^*) = 0 \)

(a) By the same argument, the concatenated equations admit solutions \( G_{20}, G_{21} \) if
\[
\varphi(G_{23}) = (b_{20}^{(3)})^2(b_{21}^{(3)})^2 - (b_{20}^{(3)})^2(b_{21}^{(3)})^2 - \\
\left[(b_{20}^{(3)})^2(b_{21}^{(3)})^2(G_{23}) + (b_{21}^{(3)})^2(b_{20}^{(3)})^2(G_{23})\right] + (b_{20}^{(3)})^2(G_{23}) = 0
\]

Where in \( G(G_{23}, G_{21}, G_{22}, G_{20}, G_{22}) \), \( G_{20}, G_{22} \) must be replaced by their values from 96. It is easy to see that \( \varphi \) is a decreasing function in \( G_{21} \) taking into account the hypothesis \( \varphi(0) > 0, \varphi(\infty) < 0 \) it follows that there exists a unique \( G_{21}^* \) such that \( \varphi(G_{23}^*) = 0 \)

(b) By the same argument, the equations of modules admit solutions \( G_{24}, G_{25} \) if
\[
\varphi(G_{27}) = (b_{24}^{(4)})^2(b_{25}^{(4)})^2 - (b_{24}^{(4)})^2(b_{25}^{(4)})^2 - \\
\left[(b_{24}^{(4)})^2(b_{25}^{(4)})^2(G_{27}) + (b_{25}^{(4)})^2(b_{24}^{(4)})^2(G_{27})\right] + (b_{24}^{(4)})^2(G_{27}) = 0
\]

Where in \( G(G_{27}, G_{24}, G_{25}, G_{26}) \), \( G_{24}, G_{26} \) must be replaced by their values from 96. It is easy to see that \( \varphi \) is a decreasing function in \( G_{25} \) taking into account the hypothesis \( \varphi(0) > 0, \varphi(\infty) < 0 \) it follows that there exists a unique \( G_{25}^* \) such that \( \varphi(G_{27}^*) = 0 \)

(c) By the same argument, the equations (modules) admit solutions \( G_{28}, G_{29} \) if
\[
\varphi(G_{31}) = (b_{28}^{(5)})^2(b_{29}^{(5)})^2 - (b_{28}^{(5)})^2(b_{29}^{(5)})^2 - \\
\left[(b_{28}^{(5)})^2(b_{29}^{(5)})^2(G_{31}) + (b_{29}^{(5)})^2(b_{28}^{(5)})^2(G_{31})\right] + (b_{28}^{(5)})^2(G_{31}) = 0
\]

Where in \( G(G_{31}, G_{28}, G_{29}, G_{30}) \), \( G_{28}, G_{30} \) must be replaced by their values from 96. It is easy to see that \( \varphi \) is a decreasing function in \( G_{29} \) taking into account the hypothesis \( \varphi(0) > 0, \varphi(\infty) < 0 \) it follows that there exists a unique \( G_{29}^* \) such that \( \varphi(G_{31}^*) = 0 \)
By the same argument, the equations (modules) admit solutions $G_{32}, G_{33}$ if

$$
\varphi(G_{33}) = (b_{32}^{(6)}(b_{33}^{(6)} - (b_{32}^{(6)}(b_{33}^{(6)} - \left[ (b_{32}^{(6)}(b_{33}^{(6)}(G_{33}) + (b_{33}^{(6)}(b_{33}^{(6)}(G_{33}) + (b_{33}^{(6)}(b_{33}^{(6)}(G_{33}) = 0
$$

Where in $(G_{32}, G_{33}, G_{34})$, $G_{32}, G_{34}$ must be replaced by their values It is easy to see that $\varphi$ is a decreasing function in $G_{33}$ taking into account the hypothesis $\varphi(0) > 0, \varphi(\infty) < 0$ it follows that there exists a unique $G_{33}$ such that $\varphi(G^{*}) = 0$

Finally we obtain the unique solution of 89 to 94

$$
G_{14}^{*} \text{ given by } \varphi(G^{(4)}_{14}) = 0, T_{14}^{*} \text{ given by } f(T_{14}^{*}) = 0 \text{ and } \varphi(G^{(4)}_{14}) = 0, T_{14}^{*} \text{ given by } f(T_{14}^{*}) = 0 \text{ and }
$$

Finally we obtain the unique solution

$$
G_{17}^{*} \text{ given by } \varphi((G_{19})^{*}) = 0, T_{17}^{*} \text{ given by } f(T_{17}^{*}) = 0 \text{ and }
$$

Obviously, these values represent an equilibrium solution

Finally we obtain the unique solution

$$
G_{21}^{*} \text{ given by } \varphi((G_{23})^{*}) = 0, T_{21}^{*} \text{ given by } f(T_{21}^{*}) = 0 \text{ and }
$$

Obviously, these values represent an equilibrium solution

Finally we obtain the unique solution

$$
G_{25}^{*} \text{ given by } \varphi(G_{25}) = 0, T_{25}^{*} \text{ given by } f(T_{25}^{*}) = 0 \text{ and }
$$

Obviously, these values represent an equilibrium solution
Obviously, these values represent an equilibrium solution

Finally we obtain the unique solution

\[ G_{29}^* = \frac{(a_{28})^{(5)} T_{29}}{(a_{28})^{(5)} + (b_{28})^{(3)} (T_{29})}, \quad G_{30}^* = \frac{(a_{30})^{(5)} T_{29}}{(a_{30})^{(5)} + (a_{30})^{(5)} (T_{29})} \]

\[ T_{28}^* = \frac{(b_{28})^{(3)} T_{28}}{(b_{28})^{(3)} - (b_{28})^{(3)} (G_{28})}, \quad T_{30}^* = \frac{(b_{30})^{(3)} T_{30}}{(b_{30})^{(3)} - (b_{30})^{(3)} (G_{30})} \]

Obviously, these values represent an equilibrium solution

Finally we obtain the unique solution

\[ G_{32}^* = \frac{(a_{32})^{(6)} T_{32}}{(a_{32})^{(6)} + (b_{32})^{(6)} (T_{32})}, \quad G_{34}^* = \frac{(a_{34})^{(6)} T_{34}}{(a_{34})^{(6)} + (a_{34})^{(6)} (T_{34})} \]

\[ T_{32}^* = \frac{(b_{32})^{(6)} T_{32}}{(b_{32})^{(6)} - (b_{32})^{(6)} (G_{32})}, \quad T_{34}^* = \frac{(b_{34})^{(6)} T_{34}}{(b_{34})^{(6)} - (b_{34})^{(6)} (G_{34})} \]

Obviously, these values represent an equilibrium solution

**ASYMPTOTIC STABILITY ANALYSIS**

**Theorem 4:** If the conditions of the previous theorem are satisfied and if the functions \((a''(t))^{(1)} \) and \((b''(t))^{(1)} \) Belong to \(C^{(1)}(\mathbb{R}_+)\) then the above equilibrium point is asymptotically stable.

**Proof:** Denote

Definition of \(G_{i}, T_{i} \):

\[ G_i = G_i^* + G_i, \quad T_i = T_i^* + T_i \]

\[ \frac{\partial (a''(t))^{(1)}}{\partial T_{14}} (T_{14}) = (q_{13})^{(1)}, \quad \frac{\partial (b''(t))^{(1)}}{\partial G_{j}} (G^*) = s_{ij} \]

Then taking into account equations (global) and neglecting the terms of power 2, we obtain

\[ \frac{dG_{13}}{dt} = -(a'_{13})^{(1)} + (p_{13})^{(1)} G_{13} + (a_{13})^{(1)} G_{14} - (q_{13})^{(1)} G_{13}^* T_{14} \]

\[ \frac{dG_{14}}{dt} = -(a'_{14})^{(1)} + (p_{14})^{(1)} G_{14} + (a_{14})^{(1)} G_{13} - (q_{14})^{(1)} G_{14}^* T_{14} \]

\[ \frac{dG_{15}}{dt} = -(a'_{15})^{(1)} + (p_{15})^{(1)} G_{15} + (a_{15})^{(1)} G_{14} - (q_{15})^{(1)} G_{15}^* T_{14} \]

\[ \frac{dT_{13}}{dt} = -(b'_{13})^{(1)} - (r_{13})^{(1)} T_{13} + (b_{13})^{(1)} T_{14} + \sum_{j=13}^{15} s_{(13)(j)} T_{14} G_{j} \]

\[ \frac{dT_{14}}{dt} = -(b'_{14})^{(1)} - (r_{14})^{(1)} T_{14} + (b_{14})^{(1)} T_{13} + \sum_{j=13}^{15} s_{(14)(j)} T_{13} G_{j} \]

\[ \frac{dT_{15}}{dt} = -(b'_{15})^{(1)} - (r_{15})^{(1)} T_{15} + (b_{15})^{(1)} T_{14} + \sum_{j=13}^{15} s_{(15)(j)} T_{14} G_{j} \]

If the conditions of the previous theorem are satisfied and if the functions \((a''(t))^{(2)} \) and \((b''(t))^{(2)} \)
Belong to $C^{(2)}(\mathbb{R}_{+})$ then the above equilibrium point is asymptotically stable.

Denote

\[ G_i = G_i^* + G_i , \quad T_i = T_i^* + T_i \]

\[
\frac{\partial (a_{ij}^{(2)})}{\partial T_i} (T_{17}^*) = (q_{17})^{(2)} , \quad \frac{\partial (b_{ij}^{(2)})}{\partial G_j} (G_{19}^*) = s_{ij}
\]

taking into account equations (global) and neglecting the terms of power 2, we obtain

\[
\frac{dG_{16}}{dt} = -((a_{16}')^{(2)} + (p_{16}')^{(2)}) G_{16} + (a_{16})^{(2)} G_{17} - (q_{16})^{(2)} G_{16}^* T_{17}
\]

\[
\frac{dG_{17}}{dt} = -((a_{17}')^{(2)} + (p_{17}')^{(2)}) G_{17} + (a_{17})^{(2)} G_{16} - (q_{17})^{(2)} G_{17}^* T_{17}
\]

\[
\frac{dG_{18}}{dt} = -((a_{18}')^{(2)} + (p_{18}')^{(2)}) G_{18} + (a_{18})^{(2)} G_{17} - (q_{18})^{(2)} G_{18}^* T_{17}
\]

\[
\frac{dT_{16}}{dt} = -((b_{16}')^{(2)} - (r_{16}')^{(2)}) T_{16} + (b_{16})^{(2)} T_{17} + \sum_{j=10}^{18} s_{(16)(j)} T_{16} G_j
\]

\[
\frac{dT_{17}}{dt} = -((b_{17}')^{(2)} - (r_{17}')^{(2)}) T_{17} + (b_{17})^{(2)} T_{16} + \sum_{j=10}^{18} s_{(17)(j)} T_{17} G_j
\]

\[
\frac{dT_{18}}{dt} = -((b_{18}')^{(2)} - (r_{18}')^{(2)}) T_{18} + (b_{18})^{(2)} T_{17} + \sum_{j=10}^{18} s_{(18)(j)} T_{18} G_j
\]

If the conditions of the previous theorem are satisfied and if the functions $(a_{ij}')^{(3)}$ and $(b_{ij}')^{(3)}$ belong to $C^{(3)}(\mathbb{R}_{+})$ then the above equilibrium point is asymptotically stable.

Denote

\[ G_i = G_i^* + G_i , \quad T_i = T_i^* + T_i \]

\[
\frac{\partial (a_{21}^{(3)})}{\partial T_2} (T_{21}^*) = (q_{21})^{(3)} , \quad \frac{\partial (b_{ij}^{(3)})}{\partial G_j} (G_{23}^*) = s_{ij}
\]

Then taking into account equations (global) and neglecting the terms of power 2, we obtain

\[
\frac{dG_{20}}{dt} = -((a_{20}')^{(3)} + (p_{20}')^{(3)}) G_{20} + (a_{20})^{(3)} G_{21} - (q_{20})^{(3)} G_{20}^* T_{21}
\]

\[
\frac{dG_{21}}{dt} = -((a_{21}')^{(3)} + (p_{21}')^{(3)}) G_{21} + (a_{21})^{(3)} G_{20} - (q_{21})^{(3)} G_{21}^* T_{21}
\]

\[
\frac{dG_{22}}{dt} = -((a_{22}')^{(3)} + (p_{22}')^{(3)}) G_{22} + (a_{22})^{(3)} G_{21} - (q_{22})^{(3)} G_{22}^* T_{21}
\]

\[
\frac{dT_{20}}{dt} = -((b_{20}')^{(3)} - (r_{20}')^{(3)}) T_{20} + (b_{20})^{(3)} T_{21} + \sum_{j=20}^{22} s_{(20)(j)} T_{20} G_j
\]

\[
\frac{dT_{21}}{dt} = -((b_{21}')^{(3)} - (r_{21}')^{(3)}) T_{21} + (b_{21})^{(3)} T_{20} + \sum_{j=20}^{22} s_{(21)(j)} T_{21} G_j
\]
If the conditions of the previous theorem are satisfied and if the functions \((a''(t))^4\) and \((b''(t))^4\) Belong to \(C^4([\mathbb{R}_+])\) then the above equilibrium point is asymptotically stable

Denote

**Definition of \(G_i, T_i\):**

\[ G_i = G_i^r + G_i^l, \quad T_i = T_i^r + T_i^l \]

\[ \frac{\partial (a''(t))^4}{\partial T_{25}} (T_{25}^*) = (q_{25})^4, \quad \frac{\partial (b''(t))^4}{\partial G_j} ((G_{27})^*) = s_{ij} \]

Then taking into account equations (global) and neglecting the terms of power 2, we obtain

\[ \frac{dG_{24}}{dt} = -(a_{24}^{(4)}) + (p_{24}^{(4)})G_{24} + (a_{24}^{(4)})G_{25} - (q_{24})^4 G_{24}^* T_{25} \]

\[ \frac{dG_{25}}{dt} = -(a_{25}^{(4)}) + (p_{25}^{(4)})G_{25} + (a_{25}^{(4)})G_{24} - (q_{25})^4 G_{25}^* T_{25} \]

\[ \frac{dG_{26}}{dt} = -(a_{26}^{(4)}) + (p_{26}^{(4)})G_{26} + (a_{26}^{(4)})G_{25} - (q_{26})^4 G_{26}^* T_{25} \]

\[ \frac{dT_{24}}{dt} = -(b_{24}^{(4)} - (r_{24})^{(4)})T_{24} + (b_{24}^{(4)})T_{25} + \sum_{j=24}^{26} (s_{24}(j)T_{24}G_j) \]

\[ \frac{dT_{25}}{dt} = -(b_{25}^{(4)} - (r_{25})^{(4)})T_{25} + (b_{25}^{(4)})T_{24} + \sum_{j=24}^{26} (s_{25}(j)T_{25}G_j) \]

\[ \frac{dT_{26}}{dt} = -(b_{26}^{(4)} - (r_{26})^{(4)})T_{26} + (b_{26}^{(4)})T_{25} + \sum_{j=24}^{26} (s_{26}(j)T_{26}G_j) \]

If the conditions of the previous theorem are satisfied and if the functions \((a''(t))^{(5)}\) and \((b''(t))^{(5)}\) Belong to \(C^{(5)}([\mathbb{R}_+])\) then the above equilibrium point is asymptotically stable

Denote

**Definition of \(G_i, T_i\):**

\[ G_i = G_i^r + G_i^l, \quad T_i = T_i^r + T_i^l \]

\[ \frac{\partial (a''(t))^{(5)}}{\partial T_{29}} (T_{29}^*) = (q_{29})^{(5)}, \quad \frac{\partial (b''(t))^{(5)}}{\partial G_j} ((G_{31})^*) = s_{ij} \]

Then taking into account equations (global) and neglecting the terms of power 2, we obtain

\[ \frac{dG_{28}}{dt} = -(a_{28}^{(5)}) + (p_{28}^{(5)})G_{28} + (a_{28}^{(5)})G_{29} - (q_{28})^{(5)} G_{28}^* T_{29} \]

\[ \frac{dG_{29}}{dt} = -(a_{29}^{(5)}) + (p_{29}^{(5)})G_{29} + (a_{29}^{(5)})G_{28} - (q_{29})^{(5)} G_{29}^* T_{29} \]

\[ \frac{dG_{30}}{dt} = -(a_{30}^{(5)}) + (p_{30}^{(5)})G_{30} + (a_{30}^{(5)})G_{29} - (q_{30})^{(5)} G_{30}^* T_{29} \]
If the conditions of the previous theorem are satisfied and if the functions \( (a')^6 \) and \( (b'')^6 \) Belong to \( C^6(\mathbb{R}_+) \) then the above equilibrium point is asymptotically stable.

Denote

Definition of \( G_i, T_i : \)

\[
G_i = G_i^* + G_i, \quad T_i = T^*_i + T_i
\]

\[
\frac{\partial (a''(6))}{\partial \tau^*_3} (T^*_3) = (q_{33})^6, \quad \frac{\partial (b''(6))}{\partial \gamma^*_j} (G^*_3) = s_{ij}
\]

Then taking into account equations (global) and neglecting the terms of power 2, we obtain

\[
\frac{dG_{32}}{dt} = -((a'_{32})^6 + (p_{32})^6)G_{32} + (a_{32})^6G_{33} - (q_{32})^6G_{32}^*T_{33}
\]

\[
\frac{dG_{33}}{dt} = -((a'_{33})^6 + (p_{33})^6)G_{33} + (a_{33})^6G_{32} - (q_{33})^6G_{33}^*T_{33}
\]

\[
\frac{dG_{34}}{dt} = -((a'_{34})^6 + (p_{34})^6)G_{34} + (a_{34})^6G_{33} - (q_{34})^6G_{34}^*T_{33}
\]

\[
\frac{dT_{32}}{dt} = -((b'_{32})^6 - (r_{32})^6)T_{32} + (b_{32})^6T_{33} + \sum_{j=32}^{34} (s_{32}(j)T^*_j G_j)
\]

\[
\frac{dT_{33}}{dt} = -((b'_{33})^6 - (r_{33})^6)T_{33} + (b_{33})^6T_{34} + \sum_{j=32}^{34} (s_{33}(j)T^*_j G_j)
\]

\[
\frac{dT_{34}}{dt} = -((b'_{34})^6 - (r_{34})^6)T_{34} + (b_{34})^6T_{33} + \sum_{j=32}^{34} (s_{34}(j)T^*_j G_j)
\]

Obviously, these values represent an equilibrium solution of 79,20,36,22,23,

If the conditions of the previous theorem are satisfied and if the functions \( (a''(7)) \) and \( (b'(7)) \) Belong to \( C^7(\mathbb{R}_+) \) then the above equilibrium point is asymptotically stable.

Proof: Denote

Definition of \( G_i, T_i : \)

\[
G_i = G_i^* + G_i, \quad T_i = T^*_i + T_i
\]
Then taking into account equations (SOLUTIONAL) and neglecting the terms of power 2, we obtain

\[
\begin{align*}
\frac{\partial (a''_{j})}{\partial T_{j}} (T_{j}) &= (q_{j}) (G_{j})^{*} = s_{ij} \\
\frac{dG_{36}}{dt} &= -(a_{36}^{(7)} + p_{36}^{(7)}) G_{36} + (a_{36}^{(7)} G_{37} - (q_{36})^{(7)} G_{36} T_{37} \\
\frac{dG_{37}}{dt} &= -(a_{37}^{(7)} + p_{37}^{(7)}) G_{37} + (a_{37}^{(7)} G_{36} - (q_{37})^{(7)} G_{37} T_{37} \\
\frac{dG_{38}}{dt} &= -(a_{38}^{(7)} + p_{38}^{(7)}) G_{38} + (a_{38}^{(7)} G_{37} - (q_{38})^{(7)} G_{38} T_{37} \\
\frac{dT_{36}}{dt} &= -(b_{36}^{(7)} - (r_{36})^{(7)}) T_{36} + (b_{36}^{(7)} T_{37} + \sum_{j=36}^{38} (s_{36})^{(7)} T_{36} G_{j} \\
\frac{dT_{37}}{dt} &= -(b_{37}^{(7)} - (r_{37})^{(7)}) T_{37} + (b_{37}^{(7)} T_{36} + \sum_{j=36}^{38} (s_{37})^{(7)} T_{37} G_{j} \\
\frac{dT_{38}}{dt} &= -(b_{38}^{(7)} - (r_{38})^{(7)}) T_{38} + (b_{38}^{(7)} T_{37} + \sum_{j=36}^{38} (s_{38})^{(7)} T_{38} G_{j} \\
\end{align*}
\]

2.

The characteristic equation of this system is

\[
\begin{align*}
&\left( (\lambda)^{(1)} + (b_{15}^{(1)}) - (r_{15})^{(1)} \right) \left( (\lambda)^{(1)} + (a_{15}^{(1)}) + (p_{15})^{(1)} \right) \\
&\left( (\lambda)^{(1)} + (a_{13}^{(1)}) + (p_{13})^{(1)} (q_{14})^{(1)} G_{14} + (a_{14})^{(1)} (q_{13})^{(1)} G_{13} \right) \\
&\left( (\lambda)^{(1)} + (b_{13}^{(1)}) - (r_{13})^{(1)} \right) s_{(14),(14)} T_{14} + (b_{14})^{(1)} s_{(13),(14)} T_{14}^{*} \\
&+ \left( (\lambda)^{(1)} + (a_{14}^{(1)}) + (p_{14})^{(1)} (q_{13})^{(1)} G_{13} + (a_{13})^{(1)} (q_{14})^{(1)} G_{14} \right) \\
&\left( (\lambda)^{(1)} + (b_{13}^{(1)}) - (r_{13})^{(1)} \right) s_{(14),(13)} T_{14} + (b_{14})^{(1)} s_{(13),(13)} T_{13}^{*} \\
&\left( (\lambda)^{(1)} + (a_{13}^{(1)}) + (a_{14}^{(1)}) + (p_{13})^{(1)} + (p_{14})^{(1)} \right) \left( (\lambda)^{(1)} \right) \\
&\left( (\lambda)^{(1)} + (b_{13}^{(1)}) + (b_{14}^{(1)}) - (r_{13})^{(1)} + (r_{14})^{(1)} \right) \left( (\lambda)^{(1)} \right)
\end{align*}
\]
\[
\begin{align*}
+ & \left( (\lambda)^{(1)} \right)^2 + \left( (a_{13}^{(1)}) + (a_{14}^{(1)}) + (p_{13}^{(1)}) + (p_{14}^{(1)}) \right) (\lambda)^{(1)} (q_{15}^{(1)}) G_{15} \\
+ & \left( (\lambda)^{(1)} + (a_{13}^{(1)}) + (p_{13}^{(1)}) (a_{12}^{(1)}) (q_{14}^{(1)}) G_{14} + (a_{14}^{(1)}) (a_{15}^{(1)}) (q_{13}^{(1)}) G_{13} \right) \\
\left( (\lambda)^{(1)} + (b_{13}^{(1)}) + (r_{13}^{(1)}) \right) s_{(14),(15)} T_{14}^{**} + (b_{14}^{(1)}) s_{(13),(15)} T_{13}^{**} \right) = 0 \\
+ & \left( (\lambda)^{(2)} + (b_{19}^{(2)}) - (r_{19}^{(2)}) \right) \left( (\lambda)^{(2)} + (a_{18}^{(2)}) + (p_{18}^{(2)}) \right) \\
\left[ \left( (\lambda)^{(2)} + (a_{16}^{(2)}) + (p_{16}^{(2)}) \right) \left( q_{17}^{(2)} G_{17}^{*} + (a_{17}^{(2)}) (q_{16}^{(2)}) G_{16}^{*} \right) \right] \\
\left( (\lambda)^{(2)} + (b_{16}^{(2)}) - (r_{16}^{(2)}) \right) s_{(17),(16)} T_{17}^{*} + (b_{17}^{(2)}) s_{(16),(16)} T_{16}^{*} \\
\left( (\lambda)^{(2)} + (b_{16}^{(2)}) - (r_{16}^{(2)}) \right) s_{(17),(16)} T_{17}^{*} + (b_{17}^{(2)}) s_{(16),(16)} T_{16}^{*} \\
\left[ \left( (\lambda)^{(2)} \right)^2 + \left( (a_{16}^{(2)}) + (a_{17}^{(2)}) + (p_{16}^{(2)}) + (p_{17}^{(2)}) \right) (\lambda)^{(2)} \right] \\
\left( (\lambda)^{(2)} \right)^2 + \left( (b_{16}^{(2)}) + (b_{17}^{(2)}) - (r_{16}^{(2)}) + (r_{17}^{(2)}) \right) (\lambda)^{(2)} \right) \\
+ \left( (\lambda)^{(2)} \right)^2 + \left( (a_{16}^{(2)}) + (a_{17}^{(2)}) + (p_{16}^{(2)}) + (p_{17}^{(2)}) \right) (q_{18}^{(2)}) G_{18} \\
+ \left( (\lambda)^{(2)} + (a_{16}^{(2)}) + (q_{17}^{(2)}) (a_{17}^{(2)}) G_{17}^{*} + (a_{17}^{(2)}) (a_{16}^{(2)}) (q_{16}^{(2)}) G_{16}^{*} \right) \\
\left( (\lambda)^{(2)} + (b_{16}^{(2)}) - (r_{16}^{(2)}) \right) s_{(17),(16)} T_{17}^{*} + (b_{17}^{(2)}) s_{(16),(16)} T_{16}^{*} \right) = 0 \\
+ \left( (\lambda)^{(3)} + (b_{22}^{(3)}) - (r_{22}^{(3)}) \right) \left( (\lambda)^{(3)} + (a_{22}^{(3)}) + (p_{22}^{(3)}) \right) \\
\left[ \left( (\lambda)^{(3)} + (a_{20}^{(3)}) + (p_{20}^{(3)}) \right) \left( q_{21}^{(3)} G_{21}^{*} + (a_{21}^{(3)}) (q_{20}^{(3)}) G_{20}^{*} \right) \right] \\
\left( (\lambda)^{(3)} + (b_{20}^{(3)}) - (r_{20}^{(3)}) \right) s_{(21),(21)} T_{21}^{*} + (b_{21}^{(3)}) s_{(20),(21)} T_{21}^{*} \\
+ \left( (\lambda)^{(3)} + (a_{21}^{(3)}) + (p_{21}^{(3)}) \right) (q_{20}^{(3)}) G_{20}^{*} + (a_{20}^{(3)}) (q_{21}^{(3)}) G_{21}^{*} \\
\right)
\end{align*}
\]
\[
\left( (\lambda)^{(3)} + (b_20)^{(3)} - (r_20)^{(3)} \right) s_{(21),(20)} T_{21}^* + (b_{21})^{(3)} s_{(20),(20)} T_{20}^*
\]
\[
\left( (\lambda)^{(3)} \right)^2 + \left( (a_20)^{(3)} + (a_{21})^{(3)} + (p_{20})^{(3)} + (p_{21})^{(3)} \right) (\lambda)^{(3)}
\]
\[
\left( (\lambda)^{(3)} \right)^2 + \left( (b_20)^{(3)} + (b_{21})^{(3)} - (r_20)^{(3)} + (r_{21})^{(3)} \right) (\lambda)^{(3)}
\]
\[
+ \left( (\lambda)^{(3)} \right)^2 + \left( (a_20)^{(3)} + (a_{21})^{(3)} + (p_{20})^{(3)} + (p_{21})^{(3)} \right) (\lambda)^{(3)} \right) q_{22} (q_{23}) G_{22}
\]
\[
+ (\lambda)^{(3)} + (a_{20}^{(3)} + (p_{20})^{(3)} \right) ((a_22)^{(3)}(a_{23})^{(3)}G_{21}^* + (a_{22})^{(3)}(a_{23})^{(3)}(q_{22})^{(3)} G_{20}^*)
\]
\[
\left( (\lambda)^{(3)} + (b_20)^{(3)} - (r_20)^{(3)} \right) s_{(21),(22)} T_{21}^* + (b_{21})^{(3)} s_{(20),(22)} T_{20}^* \right) = 0
\]

+ 
\[
(\lambda)^{(4)} + (b_20)^{(4)} - (r_20)^{(4)} \right) \left( (\lambda)^{(4)} + (a_{26})^{(4)} + (p_{26})^{(4)} \right)
\]
\[
\left[ \left( (\lambda)^{(4)} + (a_{24})^{(4)} + (p_{24})^{(4)} \right) (q_{24})^{(4)} G_{25}^* + (a_{25})^{(4)} (q_{24})^{(4)} G_{24}^* \right]
\]
\[
\left( (\lambda)^{(4)} + (b_24)^{(4)} - (r_24)^{(4)} \right) s_{(25),(25)} T_{25}^* + (b_{25})^{(4)} s_{(24),(25)} T_{25}^* \right)
\]
\[
+ \left( (\lambda)^{(4)} + (a_{25})^{(4)} + (p_{25})^{(4)} \right) (q_{24})^{(4)} G_{24}^* + (a_{24})^{(4)} (q_{25})^{(4)} G_{25}^* \right)
\]
\[
\left( (\lambda)^{(4)} + (b_24)^{(4)} - (r_24)^{(4)} \right) s_{(25),(24)} T_{25}^* + (b_{25})^{(4)} s_{(24),(24)} T_{24}^* \right)
\]
\[
\left( (\lambda)^{(4)} \right)^2 + \left( (a_{24})^{(4)} + (a_{25})^{(4)} + (p_{24})^{(4)} + (p_{25})^{(4)} \right) (\lambda)^{(4)}
\]
\[
\left( (\lambda)^{(4)} \right)^2 + \left( (b_{24})^{(4)} + (b_{25})^{(4)} - (r_{24})^{(4)} + (r_{25})^{(4)} \right) (\lambda)^{(4)}
\]
\[
+ \left( (\lambda)^{(4)} \right)^2 + \left( (a_{24})^{(4)} + (a_{25})^{(4)} + (p_{24})^{(4)} + (p_{25})^{(4)} \right) (\lambda)^{(4)} \right) q_{26} (q_{24})^{(4)} G_{26}
\]
\[
+ (\lambda)^{(4)} + (a_{24})^{(4)} + (p_{24})^{(4)} \right) ((a_{26})^{(4)}(q_{25})^{(4)} G_{25}^* + (a_{25})^{(4)}(a_{26})^{(4)}(q_{24})^{(4)} G_{24}^*)
\]
\[
\left( (\lambda)^{(4)} + (b_24)^{(4)} - (r_24)^{(4)} \right) s_{(25),(20)} T_{25}^* + (b_{25})^{(4)} s_{(24),(20)} T_{24}^* \right) = 0
\]

+ 
\[
(\lambda)^{(5)} + (b_{30})^{(5)} - (r_{30})^{(5)} \right) \left( (\lambda)^{(5)} + (a_{30})^{(5)} + (p_{30})^{(5)} \right)
\]
\[
\left[ (\lambda)^{(5)} + (a_{28}^{(5)}) + (p_{28}^{(5)}) (q_{29}^{(5)}) G_{29}^{*} + (a_{29}^{(5)}) (q_{29}^{(5)}) G_{28}^{*} \right] \\
\left[ (\lambda)^{(5)} + (b_{28}^{(5)}) - (r_{28}^{(5)}) s_{(29),(29)} \right] T_{29}^{*} + (b_{29}^{(5)}) s_{(29),(29)} T_{29}^{*} \\
+ \left[ (\lambda)^{(5)} + (a_{29}^{(5)}) + (p_{29}^{(5)}) (q_{29}^{(5)}) G_{28}^{*} + (a_{29}^{(5)}) (q_{29}^{(5)}) G_{29}^{*} \right] \\
\left[ (\lambda)^{(5)} + (b_{29}^{(5)}) - (r_{29}^{(5)}) s_{(29),(29)} \right] T_{29}^{*} + (b_{29}^{(5)}) s_{(29),(29)} T_{29}^{*} \\
\left[ (\lambda)^{(5)} + (a_{28}^{(5)}) + (a_{29}^{(5)}) + (p_{28}^{(5)}) + (p_{29}^{(5)}) (\lambda)^{(5)} \right] \\
\left[ (\lambda)^{(5)} + (b_{28}^{(5)}) + (b_{29}^{(5)}) - (r_{28}^{(5)}) + (r_{29}^{(5)}) (\lambda)^{(5)} \right] \\
+ \left[ (\lambda)^{(5)} + (a_{28}^{(5)}) + (a_{29}^{(5)}) + (p_{28}^{(5)}) + (p_{29}^{(5)}) (\lambda)^{(5)} \right] (q_{30}^{(5)}) G_{30} \\
+ \left[ (\lambda)^{(5)} + (a_{28}^{(5)}) + (p_{28}^{(5)}) \right] (a_{30}^{(5)}) (q_{29}^{(5)}) G_{29}^{*} + (a_{29}^{(5)}) (a_{30}^{(5)}) (q_{28}^{(5)}) G_{28}^{*} \\
\left[ (\lambda)^{(5)} + (b_{28}^{(5)}) - (r_{28}^{(5)}) s_{(29),(30)} \right] T_{29}^{*} + (b_{29}^{(5)}) s_{(29),(30)} T_{29}^{*} = 0 \\
+ \\
\left[ (\lambda)^{(6)} + (b_{34}^{(6)}) - (r_{34}^{(6)}) \right] \left[ (\lambda)^{(6)} + (a_{34}^{(6)}) + (p_{34}^{(6)}) \right] \\
\left[ (\lambda)^{(6)} + (a_{32}^{(6)}) + (p_{32}^{(6)}) \right] (q_{33}^{(6)}) G_{33}^{*} + (a_{33}^{(6)}) (q_{32}^{(6)}) G_{32}^{*} \\
\left[ (\lambda)^{(6)} + (b_{32}^{(6)}) - (r_{32}^{(6)}) s_{(33),(33)} \right] T_{33}^{*} + (b_{33}^{(6)}) s_{(32),(33)} T_{33}^{*} \\
+ \left[ (\lambda)^{(6)} + (a_{33}^{(6)}) + (p_{33}^{(6)}) \right] (q_{32}^{(6)}) G_{32}^{*} + (a_{32}^{(6)}) (q_{33}^{(6)}) G_{33}^{*} \\
\left[ (\lambda)^{(6)} + (b_{32}^{(6)}) - (r_{32}^{(6)}) s_{(33),(33)} \right] T_{33}^{*} + (b_{33}^{(6)}) s_{(32),(32)} T_{33}^{*} \\
\left[ (\lambda)^{(6)} + (a_{33}^{(6)}) + (a_{33}^{(6)}) + (p_{32}^{(6)}) + (p_{33}^{(6)}) (\lambda)^{(6)} \right] \\
\left[ (\lambda)^{(6)} + (b_{32}^{(6)}) + (b_{33}^{(6)}) - (r_{32}^{(6)}) + (r_{33}^{(6)}) (\lambda)^{(6)} \right] \\
+ \left[ (\lambda)^{(6)} + (a_{33}^{(6)}) + (p_{33}^{(6)}) \right] \left[ (a_{34}^{(6)}) \right] (q_{33}^{(6)}) G_{33}^{*} + (a_{33}^{(6)}) (a_{34}^{(6)}) (q_{32}^{(6)}) G_{32}^{*} \\
\left[ (\lambda)^{(6)} + (a_{32}^{(6)}) + (p_{32}^{(6)}) \right] \left[ (a_{34}^{(6)}) \right] (q_{33}^{(6)}) G_{33}^{*} + (a_{33}^{(6)}) (a_{34}^{(6)}) (q_{32}^{(6)}) G_{32}^{*} \\
\right] \\
\]
\[
\left( (\lambda)^{(6)} + (b_{32}^{(6)}) (r_{32}^{(6)}) \right) s_{(33),(34)} T_{33}^{**} + (b_{33}^{(6)}) s_{(32),(34)} T_{32}^{**} = 0
\]

\[
\left( (\lambda)^{(7)} + (b_{38}^{(7)}) (r_{38}^{(7)}) \right) ((\lambda)^{(7)} + (a_{38}^{(7)}) + (p_{38}^{(7)}) \right)
\]

\[
\left( (\lambda)^{(7)} + (a_{36}^{(7)}) + (p_{36}^{(7)}) \right) q_{37}^{(7)} G_{37} + (a_{37}^{(7)}) (q_{36}^{(7)} G_{36}^{*})
\]

\[
\left( (\lambda)^{(7)} + (b_{36}^{(7)}) (r_{36}^{(7)}) \right) s_{(37),(36)} T_{37}^{*} + (b_{37}^{(7)}) (r_{37}^{(7)}) s_{(36),(37)} T_{36}^{*}
\]

\[
\left( (\lambda)^{(7)} \right)^2 + \left( (a_{36}^{(7)}) + (a_{37}^{(7)}) + (p_{36}^{(7)}) + (p_{37}^{(7)}) - (\lambda)^{(7)} \right)
\]

\[
\left( (\lambda)^{(7)} \right)^2 + \left( (b_{36}^{(7)}) + (b_{37}^{(7)}) - (r_{36}^{(7)}) + (r_{37}^{(7)}) - (\lambda)^{(7)} \right)
\]

\[
\left( (\lambda)^{(7)} \right)^2 + \left( (a_{36}^{(7)}) + (a_{37}^{(7)}) + (p_{36}^{(7)}) + (p_{37}^{(7)}) - (\lambda)^{(7)} \right) q_{38}^{(7)} G_{38}
\]

\[
\left( \left( (\lambda)^{(7)} + (b_{36}^{(7)}) (r_{36}^{(7)}) \right) s_{(37),(36)} T_{37}^{*} + (b_{37}^{(7)}) \right) s_{(36),(37)} T_{36}^{*} = 0
\]

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(9)^a^b^c^ Einstein, A. (1905), "Ist die Trägheit eines Körpers von seinem Energieinhalt abhängig?", *Annalen der Physik* 18:
639 Bibcode 1905AnP...323..639E, DOI:10.1002/andp.19053231314. See also the English translation.


(13)^^ Note that the relativistic mass, in contrast to the rest mass \( m_0 \), is not a relativistic invariant, and that the velocity \( v \) is not a Minkowski four-vector, in contrast to the quantity \( \gamma = \frac{1}{\sqrt{1-v^2/c^2}} \), where \( \gamma \) is the differential of the proper time. However, the energy-momentum four-vector \( \mathbf{p} = \gamma m \mathbf{v} \) is a genuine Minkowski four-vector, and the intrinsic origin of the square-root in the definition of the relativistic mass is the distinction between \( dt \) and \( d\tau \).


(20)^^ [2] Cockcroft-Walton experiment

(21)^a^b^c^ Conversions used: 1956 International (Steam) Table (IT) values where one calorie
≡ 4.1868 J and one BTU ≡ 1055.05585262 J. Weapons designers’ conversion value of one gram TNT
≡ 1000 calories used.

(22)^ Assuming the dam is generating at its peak capacity of 6.809 MW.

(23)^ Assuming a 90/10 alloy of Pt/Ir by weight, a \( C_p \) of 25.9 for Pt and 25.1 for Ir, a Pt-dominated average \( C_p \) of 25.8, 5.134 moles of metal, and 132 J.K\(^{-1}\) for the prototype. A variation of ±1.5 picograms is of course, much smaller than the actual uncertainty in the mass of the international prototype, which are ±2 micrograms.

(24)^ [3] Article on Earth rotation energy. Divided by \( c^2 \).

(25)^ Earth’s gravitational self-energy is \( 4.6 \times 10^{10} \) that of Earth’s total mass, or 2.7 trillion metric tons. Citation: The Apache Point Observatory Lunar Laser-Ranging Operation (APOLLO), T. W. Murphy, Jr. et al. University of Washington, Dept. of Physics (132 kB PDF, here.).

(26)^ There is usually more than one possible way to define a field energy, because any field can be made to couple to gravity in many different ways. By general scaling arguments, the correct answer at everyday distances, which are long compared to the quantum gravity scale, should be minimal coupling, which means that no powers of the curvature tensor appear. Any non-minimal couplings, along with other higher order terms, are presumably only determined by a theory of quantum gravity, and within string theory, they only start to contribute to experiments at the string scale.


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