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STRUCTURAL EQUIVALENCE BETWEEN ELECTRICAL CIRCUITS VIA NEUTROSOPHIC NANO TOPOLOGY INDUCED BY DIGRAPHS IN GRAPH THEORY

P. Vijetha

PG and Research Department of Mathematics, Theivanai Ammal College for Women (Autonomous), Villupuram-605 602, Tamil Nadu, India.

Ms. R. Suganya

Assistant Professor, PG and Research Department of Mathematics, Theivanai Ammal College for Women (Autonomous), Villupuram-605 602, Tamil Nadu, India.

ABSTRACT: The main objective of this study is to prove the structural equivalence of the two neutrosophic nano graphs in graph theory without coding and using assumption. The beauty of using neutrosophic nano topology in approximation is achieved via approximation for qualitative identical, isomorphism, number of incident degree, eccentricity, vertex induced subgraph, edge induced subgraph and matching. By certain nano equivalence relation. We are just formalizing the structural equivalence of basic circuit of the LED light from the neutrosophic nano graphs and their corresponding graphs in graph theory.

KEYWORD: Isomorphism, Subgraph, Matching, Identical, Equivalence, Degree, Neutrosophic nano topology, Neutrosophic nano isomorphism, Neutrosophic nano homeomorphism.

1. INTRODUCTION:

The graph theory was introduced by great Swiss Mathematician Leonhard Euler, whose famous 1736 paper, “The Seven Bridges of Konigsberg”, was the first treatise on the subject. The graph theory is ultimately the study of relations, which can abstract anything from city layouts to computer data. Graph theory provides a helpful tool to quantify and simplify the many moving parts of dynamic systems. And it is used to find shortest path in road or a network. Were In Google maps, various locations are represented as vertices or nodes and the roads are represented as edges and graph theory is used to find the shortest path between two nodes.

There are several application of graph theory in some areas of Physics, Chemistry, Communication Science and Computer technology and our daily life. A graph (resp., directed graph or digraph), G=(V(G),E(G)) consists of a vertex set V(G) and an edge set E(G) of un-ordered (resp., ordered) pairs of element of V(G).

The neutrosophic set was introduced by Smarandache [13] as a generalization of intuitionistic fuzzy set. In 2017 Arafa Nasef and Abdu AI Fattah AI Atik introduces some properties on nano topology induced by graphs, AASCIT Journal of Nano science [4]. Entropy based Single Valued Neutrosophic Digraph and its applications, Neutrosophic Sets and Systems was introduced by Kalyan Sinha and Pinaki Majumda in 2018 [6]. Lupianez, F.G., introduced On Neutrosophic sets and topology in 2008 [8]. Neutrosophic closed set and neutrosophic continuous functions, Neutrosophic Sets Systems was introduced by Salama, A.A., Samarandache, F., and Valeri in 2014 [10]. In 2018 Lellis Thivagar, M., Jafari, S., Sudhadevi, v., and Antonysamy v., introduces A novel approach to nano topology via neutrosophic sets, Neutrosophic sets and systems [7]. Smarandache, F., introduced A unifying eld in logics neutrosophic probability, set and logic in 1999 [11]. Neutrosophic set and neutrosophic topological spaces, was introduced by Salama, A.A., and Alblowi, S.A., in 2012 [9]

2. PRELIMINARIES:

Definition 2.1. Let X is a space of points, x$\in X$.A neutrosophic set A in X is defined by a truth-membership function T_A (x), an indeterminacy-membership function I_A (x) and a falsity-membership function F_A (x). T_A (x), I_A (x) and F_A (x) are real standard or real nonstandard subsets of]-0, 1+ [. That is, T_A (x):X→]-0,1+[,I_A (x):X→]-0,1+[and F_A (x):X→]-0,1+[. There is no restriction on the sum of T_A (x), I_A (x) and F_A (x), so 0- ≤sup(x) + sup x≤ 3+.

Definition 2.2. Let U be a non-empty finite set of objects called the universe and R be an equivalence relation on U named as the indiscernibility relation. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U, R) is said to be the approximation space. Let$X \subseteq U$.

- The lower approximation of X with respect to R is the set of all objects, which can be for certain classified as X with respect to R and it is denoted by $L_R(X)$. That is, $L_R(X) = U_{x\in u}\{R(x): R(x) \subseteq X\}$,where R(x) denotes the equivalence class determined by x.
- The upper approximation of X with respect to R is the set of all objects, which can be possibly classified as X with respect to R and it is denoted by $U_R(X)$. That is, $U_R(X) = U_{x\in u}\{R(x): R(x) \cap X \neq \emptyset\}$
- The boundary region of X with respect to R is the set of all objects, which can be classified neither as X nor as not –X with respect to R and it is denoted by $B_R(X)$.That is $B_R(X) = U_R(X) - L_R(X)$.

Definition 2.3. Let U be the universe, R be an equivalence relation on U and T_R(X)= {U,$\emptyset$, L_R(X),U_R(X),B_R(X)} where X$\subseteq U$. Then by the Property T_R(X) satisfies the following axioms:

- U and $\emptyset \in T_R$(X),
- The union of the elements of any sub collection of $T_R(X)$ is in T_R(X).
- The intersection of the elements of any finite sub collection of $T_R(X)$ is in$T_R(X)$..

That is, T_R(X) is a topology on U called the nano topology on U with respect to X. We call (U, $T_R(X)$)as the nano topological space. The elements of $T_R(X)$are called as nano open sets.

Definition 2.4.A neutrosophic topology in a nonempty set χ is a family $\Im$ of neutrosophic sets in χ satisfying the following axioms:

- 0_N, $1_N \in \Im$;
- $\mathcal{A} \cap \mathcal{B} \in \Im$ for any $\mathcal{A}, \mathcal{B} \in \Im$;
- $\cup (\mathcal{A})_i$ for any arbitrary family $(\mathcal{A})_i$:i$\in J \subseteq \Im$.

Definition 2.5. Let $\mathcal{G}$ and $\mathcal{G}'$ be any two graphs. They are isomorphic if there exit a neutrosophic nano homeomorphism $\varphi: [\mathcal{V}(\mathcal{G}), \tau\mathcal{V}(\mathcal{H}))] \to [\mathcal{V}(\mathcal{G}), \tau(f\mathcal{V}(\mathcal{H}))]$for every subgraph $\mathcal{H} of\ \mathcal{G}$.

Definition 2.6. If $\mathcal{G}$ is a directed graph and u, v$\in \mathcal{V}$, then: u is in-vertex of v if$\overline{uv} \in \mathcal{E}(\mathcal{G})$. u is out-vertex of v if $\overline{vu} \in \mathcal{E}(\mathcal{G})$ the in-degree of a vertex v is the number of vertices u such that $\overline{vu} \in \mathcal{E}(\mathcal{G})$ throughout this paper the word graph means directed simple graph.

3. Identifying Structural Equivalence between LED light via Graph Theory:

Definition 3.1. Two graphs G and H are identical (i.e., G=H) if V (G) = V (H), E (G) = E (H) and$\Psi_G = \Psi_H$. If two graphs are identical then they can clearly represented by identical diagrams.

Definition 3.2. Two graphs G and H are said to be isomorphism (G≅H). If there are bisections

$\theta: V(G) \to V(H)$. And$\theta: E(G) \to E(H)$. Such that $\Psi_G(e)$ =UV if and only if $\Psi_H(\phi(e)) = \theta(u)\theta(v)$, such that a pair $(\theta: \phi)$ of mappings is called an isomorphism between G and H.

Definition 3.3.The eccentricity of a vertex v in a graph G is nothing but maximum number of edges it is having with one another vertices through the shortest path. (i.e.) E (v) = max d (v,v_i). It is denoted by E (v).

Definition 3.4. Suppose that V' is a non empty subset f V. The subgraph of G whose vertex set is V' and whose edge set is the set of those edges of G that have both end in V' is called the vertex induced subgraph of G induced by V' and it is denoted by G[V'] is an vertex induced subgraph of G.

Definition 3.5. Suppose that E' is a non empty subset of E. The subgraph of G whose vertex set is the set of ends in E' and whose edge set inE' is called the Edge induced subgraph of G induced by E' and is denoted by G[E'].

Definition 3.6.A subset M of E is called a matching in G. If its elements are links and no two are adjacent in G; the two ends of an edge in is said to be matched under M.

Algorithm

Step: 1 Taken two differential electrical circuits of LED light denoted by E1 and E2.

Step: 2 Convert the electrical circuits E1 and E2 to N_{g1} andN_{g2}.

Step: 3 Check whether N_{g1} and N_{g2} are homeomorphism corresponding neutrosophic nano topologies induced from their vertices.

Step: 4 Check whether N_{g1} is isomorphic to N_{g2}.

Step: 5 Otherwise, we conclude that both the electrical circuits are entirely different.

Remark3.7. Using the above algorithm to check that two electrical circuits are structurally equivalent.

Step: 1 Consider the following basic circuit of the LED light. Using the above algorithm, we can prove whether these two circuits have functional similarities via graph theory induced by the above definitions of Identical, Isomorphism, Number of incident degree, Eccentricity, Vertex induced subgraph, Edge induced subgraph and Matching (figure 1).

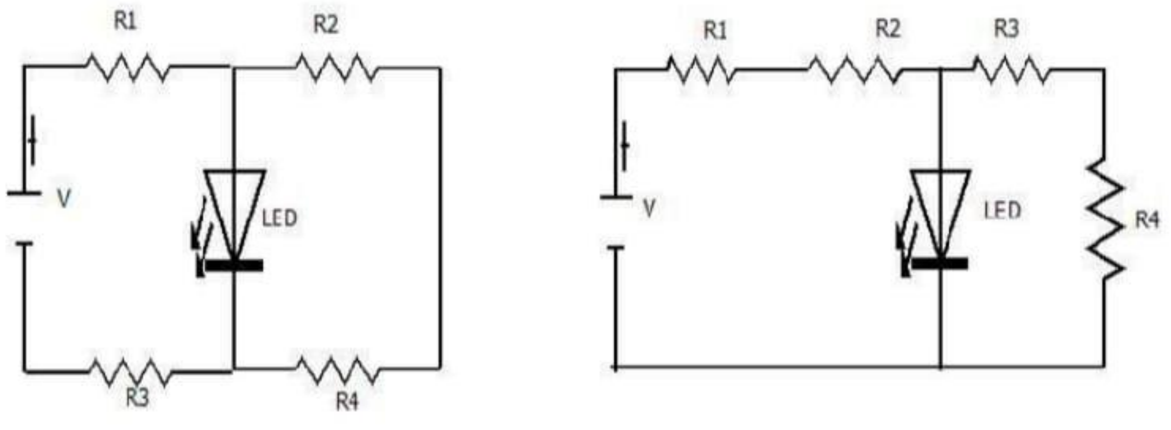
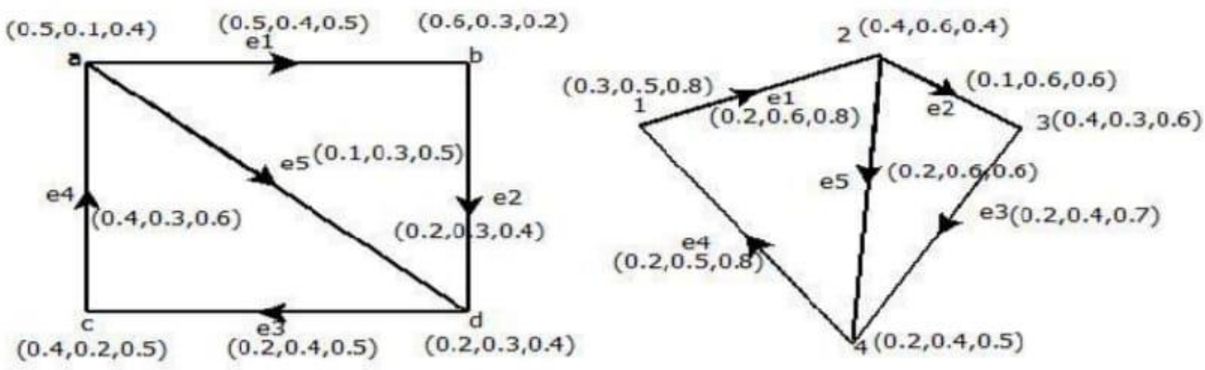


Figure 1

E1 E2

Step: 2 convert the basic circuits E1 and E2 into neutrosophic nano graphs N_{g1} and N_{g2} respectively (figure 2).



NG1 Figure 2 NG2

Step: 3 Let N_{g1} and N_{g2} are two neutrosophic nano graphs.

- Then by the definition of 3.1 we define,

V (G) =V (H) $\Longrightarrow$ V (N_{g1}) = 4 = V (N_{g2}).

E (G) = E (H) $\Longrightarrow$ E (N_{g1}) = 5 = E (N_{g2}).

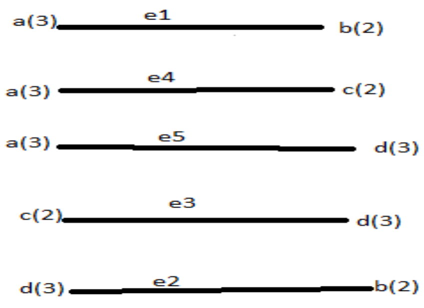
We conclude that the two graphs are identical.

- Then by the definition of 3.2 we define,

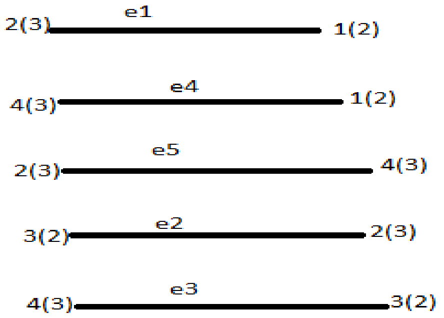
Number of vertices, V (N_{g1}) = V (N_{g2}) = 4.

Number of edges, E (N_{g1}) = E (N_{g2}) = 5.

Then the two graphs are Isomorphism to each other. And we can able to find the number of incident degree to the two graphs.



IN Ng1



IN Ng2

From the two graphs we get the equal number of incident degree.

- By the definition of 3.3, E(v) = max d(v,v_i).

IN Ng1	IN Ng2
d(a, b) = 1	d(1, 2) = 1
d(a, d) = 2	d(1, 3) = 2
d(a, c) = 1	d(1, 4) = 1

Therefore the maximum distance is 2. The eccentricity of the two graphs is 2.

- Then by the definition of 3.4,

Total no. of sub graphs Ng1={a, b, c, d}	Total no. of sub graphs Ng2= {1, 2, 3, 4}
V'={a, b, d}	V'={1, 2, 4}
V'={a, c, d}	V'={2, 3, 4}

Therefore the total number of vertex induced sub graphs is 2.

- Then by the definition of 3.5,

Total no. of sub graphs Ng1={a, b, c, d}	Total no. of sub graphs Ng2=1, 2, 3, 4}
E'={(a, d)}	E'={(1, 2)}
E'={(a, b)}	E'={(2, 3)}

E'={(c, d)}	E'={(1,4)}
E'={(b, c)}	E'={(3,4)}
E'={(a, b), (a, d)}	E'={(1, 2), (2, 3)}
E'={(c, d), (b, c)}	E'={(1, 4), (3, 4)}
E'={(a, b), (b, c), (a, c)}	E'={(1, 2), (2, 4), (1, 4)}
E'={(a, d), (c, d), (a, c)}	E'={(2, 3), (3, 4), (2, 4)}
E'={(a, b), (b, c), (a, c), (c, d)}	E'={(1, 2), (1, 4), (2, 4), (3,4)}
E'={(a, b), (b, c), (a, c), (a, d)}	E'={(1, 2), (2, 4), (1, 4), (1, 3)}
E'={(a, b), (a, d), (a, c), (c, d)}	E'={(1, 2), (1,4), (1,3), (3, 4)}
E'={(a, c), (c, d), (a, d), (b, d)}	E'={(1, 3), (3, 4), (1,4), (2, 4)}

Therefore the total number of edge induced sub graphs is 12.
Note: All induced sub graph is a sub graph but all sub graph is not induced sub graph.
E= {a, b, c, d} ; V={e_1, e_2, e_3, e_4, e_5}

- By the definition of 3.6, any two edges are not adjacent.

In $N_{g1} \implies$ E = {a, b, c, d}; V = {e_1, e_2, e_3, e_4, e_5}

In $N_{g2} \implies$ E = {1, 2, 3, 4} ; V = {e_1, e_2, e_3, e_4, e_5}

Number of Matching in N_{g1}	Number of Matching in N_{g2}
$M_1 = \{e_1, e_3\}$	$M_1 = \{e_1, e_3\}$
$M_2 = \{e_2, e_4\}$	$M_2 = \{e_2, e_4\}$

Therefore the total number of matching is 2.

Step: 4 *observation:* If the graph are isomorphism, which are structural equivalence. Using the above structural equivalence technique, we can check whether two circuits are equivalent and we can also extend our theory to many products.

CONCLUSION:

The purpose of the present to prove the structural equivalence between the two electrical circuits in Graph Theory. The graph structure will be an important base for modification of knowledge extraction and processing. By means of structural equivalence on neutrosophic nano topology induced by graph we have framed an algorithm for detecting patent infringement suit. At last we conclude that the both circuits are structurally equal by the above.

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