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Independent Domination Number and Chromatic Number of a Fuzzy Graph

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Abstract: *Let $G(V,\sigma,\mu)$ be a simple undirected fuzzy graph. A subset S of V is called a dominating set in G if every vertex in V-S is effectively adjacent to at least one vertex in S. A dominating set S of V is said to be a Independent dominating set if no two vertex in S is adjacent. The independent domination number of a fuzzy graph $G(V,\sigma,\mu)$ is denoted by γ_{fi} (G) which is the smallest cardinality of a independent dominating set of G. The minimum number of colours required to colour all the vertices such that adjacent vertices do not receive the same colour is the chromatic number χ(G). For any fuzzy graph G a complete fuzzy sub graph of G is called a clique of G. In this paper we find an upper bound for the sum of the independent domination and chromatic number in fuzzy graphs and characterize the corresponding extremal fuzzy graphs.*

Keywords: *Fuzzy independent Domination Number, Chromatic Number, fuzzy graph, Clique*

1. Introduction

Let $G(V,\sigma,\mu)$ be simple undirected fuzzy graph. The degree of any vertex u in G is the number of edges incident with u and is denoted by d(u). The minimum and maximum degree of a vertex is denoted by δ(G) and Δ(G) respectively, P_n denotes the path on n vertices. The vertex connectivity κ(G) of a fuzzy graph G is the minimum number of vertices whose removal results in a disconnected fuzzy graph. The chromatic number χ is defined to be the minimum number of colours required to colour all the vertices such that adjacent vertices do not receive the same colour. For any fuzzy graph G a complete sub fuzzy graph of G is called a clique of G. The number of vertices in a largest clique of G is called the clique number of G.

Let G(V,E) be a simple undirected fuzzy graph. A subset S of V is called a dominating set in G if every vertex in V-S is effectively adjacent to at least one vertex in S. A dominating set S of V is said to be a independent dominating set if no two vertex in S is adjacent. The independent domination number, denoted by γ_{fi} (G) is the smallest cardinality of a independent dominating set of a fuzzy graph G. The minimum number of colours required to colour all the vertices such that adjacent vertices do not receive the same colour is the chromatic number χ(G). For any fuzzy graph G a complete sub fuzzy graph of G is called a clique of G.

If X is collection of objects denoted generically by x, then a Fuzzy set $\tilde{A}$ is X is a set of ordered pairs: $\tilde{A} = \{(x, \mu_{\tilde{A}}(x))/x \in X\}$, $\mu_{\tilde{A}}(x)$ is called the membership function of x in $\tilde{A}$ that maps X to the membership space M (when M contains only the two points 0 and 1). Let E be the (crisp) set of nodes. A fuzzy graph is then defined by,

$\tilde{G}(x_i,x_j) = \{((x_i,x_j), \mu_{\tilde{G}}(x_i,x_j)/(x_i,x_j) \in E \times E\}$. $\tilde{H}(x_i,x_j)$ is a Fuzzy Sub graph of $\tilde{G}(x_i,x_j)$ if $\mu_{\tilde{H}}(x_i,x_j) \le \mu_{\tilde{G}}(x_i,x_j)\ \forall (x_i,x_j) \in E \times E$, $\tilde{H}(x_i,x_j)$ is a spanning fuzzy sub graph of $\tilde{G}(x_i, x_j)$ if the node set of $\tilde{H}(x_i, x_j)$ and $\tilde{G}(x_i, x_j)$ are equal, that is if they differ only in their arc weights.

Several authors have studied the problem of obtaining an upper bound for the sum of a domination parameter and a fuzzy graph theoretic parameter and characterized the corresponding extremal fuzzy graphs. In [8], Paulraj Joseph J and Arumugam S proved that $\gamma + \kappa \leq$p. In[9], Paulraj Joseph J and Arumugam S proved that γ_c (G)+ $\chi \leq$ p+1. They also characterized the class of fuzzy graphs for which the upper bound is attained. They also proved similar results for γ and γ_t . In[5], Mahadevan G introduced the concept the complementary perfect domination number γ_{cp} and proved that γ_{cp}(G)+ $\chi \leq$ 2n-2, and characterized the corresponding extermal graphs. In[16], S.Vimala and J.S.Sathya proved that γ_t (G)+χ(G)=2n-5. They also characterised the class of graphs for which the upper bound is attained. In this paper we obtain sharp upper bound for the sum of the independent domination number and chromatic number and characterize the corresponding extremal fuzzy graphs. We use the following previous results.

Theorem 1.1 [1]: For any connected fuzzy graph G, γ_{fi} (G) $\leq n$

Theorem 1.2 [2]: For any connected fuzzy graph G, χ(G)$\leq$ Δ(G)+1.

2. Main Results

Theorem 2.1: For any connected strong fuzzy graph G, γ_{fi} (G)+ χ(G)$\leq$2n and the equality holds if and only if G$\cong$$K_1$

Proof: γ_{fi} (G)+χ(G) $\leq$ n+Δ+1=n+(n-1)+1$\leq$2n. If γ_{fi}(G)+χ(G)=2n the only possible case is γ_{fi}(G)=n and χ(G)=n, Since χ(G)=n, G=K_n , But for K_n, γ_{fi} (G)=1, so that G$\cong$$K_1$. Conversely if G is isomorphic to K_1, then for K_1, γ_{fi} $(G) = 1, and \ \chi(G) = 1\gamma_{fi}$ (G)+χ(G)=2. Hence the proof.

Theorem 2.2: For any connected strong fuzzy graph G, γ_{fi} (G)+χ(G)=2n-1 if and only if G$\cong$$K_2$

Proof: If G is isomorphic to K_2, then for K_2 , γ_{fi} $(G) = 1, and \ \chi(G) = 2$.γ_{fri}(G)+χ(G)=2n-1=3. Conversely assume that γ_{fi} (G)+χ(G)=2n-1. This is possible only if γ_{fi} (G)=n and χ(G)=n-1 (or) γ_{fi} (G) = n-1 and χ(G) = n.

Case (i) Let γ_{fi} (G)=n and χ(G)=n-1.

Since χ(G)= n-1, G contains a clique K on n-1 vertices. Let x be a vertex of G-K_{n-1}. Since G is connected the vertex x is adjacent to one vertex u_i for some i in K_{n-1} {u_i} is γ_{fi} – set, so that γ_{fi} (G)=1, we have n=1. Then $\chi = 0$, Which is a contradiction. Hence no fuzzy graph exists.

Case (ii) Let γ_{fi} (G)=n-1 and χ(G)=n

Since χ(G)=n, G=K_n , But for K_n , γ_{fi} (G)=1, so that n=2, χ =2 Hence G$\cong$$K_2$.

Theorem 2.3: For any connected strong fuzzy graph G, γ_{fi} (G)+χ(G)=2n-2 if and only if G$\cong$$K_3$

Proof: Let G be isomorphic to K_3, then for K_3 , γ_{fi} $(G) = 1, and \ \chi(G) = 3$.$\gamma_{fi}$ (G)+χ(G)=2n-2=4. Conversely **a**ssume that γ_{fi} (G)+χ(G)=2n-2. This is possible only if γ_{fi} (G)=n and χ(G)=n-2 (or) γ_{fi} (G)=n-1 and χ(G)=n-1 (or) γ_{fi} (G)=n-2 and χ(G)=n.

Case (i) Let γ_{fi} (G)=n and χ(G)=n-2.

Since χ (G)= n-2, G contains a clique K on n-2 vertices. Let S={x,y}∈G-K_{n-2}. Then $< S >= K_2$ or $\overline{K_2}$

Subcase (a) Let $< S >= K_2$ Since G is connected, x is adjacent to some u_i of K_{n-2}. Then {y,u_i} for some i is γ_{fi} - set, so that γ_{fi} (G)=2 and hence n=2. But χ(G)=n-2=0.Which is a contradiction. Hence no fuzzy graph exists.

Subcase (b) Let $< S >= \overline{K_2}$ Since G is connected, x is adjacent to some u_i of K_{n-2}. Then y is adjacent to the same u_i of $K_{n-2.}$ Then {u_i} γ_{fi} - set, so that γ_{fi} (G)=1 and hence n=1. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists, (or) y is adjacent to u_j of K_{n-2} for i≠j. In this case {y,u_i} γ_{fi} - set, so that γ_{fi} (G)=2 and hence n=2. But χ(G)=n-2=0. Which is a contradiction. Hence no fuzzy graph exists.

Case (ii) Let γ_{fi} (G)=n-1 and χ(G)=n-1.

Since χ (G)=n-1, G contains a clique K on n-1 vertices. Let x be a vertex of G-K_{n-1}. Since G is connected, x is adjacent to one vertex u_i for some i in K_{n-1}, so that {u_i} is γ_{fi} – set, so that γ_{fi} (G)=1, we have n=2. Then $\chi = 1$, which is for totally disconnected graph. Which is a contradiction. Hence no fuzzy graphs exists.

Case (iii) Let γ_{fi} (G)=n-2 and χ(G)=n

Since χ(G)=n, G=K_n , But for K_n , γ_{fi} (G) = 1,so that n=3, χ = 3 Hence G≅$K_{3.}$ Hence the proof.

Theorem 2.4: For any connected strong fuzzy graph G, γ_{fi} (G)+ χ(G)=2n-3 if and only if G≅ P_3, K_4

Proof: Let G be isomorphic to P_3, γ_{fi} $(G) = 1, and \ \chi(G) = 2.$ γ_{fi} (G)+χ(G)=2n-3=3. Let G be isomorphic to K_4, then for K_4, γ_{fi} $(G) = 1, and \ \chi(G) = 4$ γ_{fi} (G)+χ(G)=2n-3=5. Conversely assume that γ_{fi} (G)+ χ(G)=2n-3. This is possible only if γ_{fi} (G)=n and χ(G)=n-3 (or) γ_{fi} (G)=n-1 and χ(G)=n-2 (or) γ_{fi} (G)=n-2 and χ(G)=n-1(or) γ_{fi} (G)=n-3 and χ(G)=n.

Case (i) Let γ_{fi} (G)=n and χ(G)=n-3.

Since χ (G)= n-3, G contains a clique K on n-3 vertices. Let S={x,y,z}∈ G-K_{n-3}. Then $< S >= K_3$, $\overline{K_3}$, K_2∪K_1,P_3

Subcase (i) Let $< S >= K_3$. Since G is connected, x is adjacent to some u_i of K_{n-3}. Then {x,u_i} is γ_{fi} - set, so that γ_{fi} (G)=2 and hence n=2. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists.

Subcase (ii) Let $< S >= \overline{K_3}$ Since G is connected, one of the vertices of K_{n-3} say u_i is adjacent to all the vertices of S or two vertices of S or one vertex of S. If u_i for some i is adjacent to all the vertices of S, then {u_i} is a γ_{fi}-set of G, so thatγ_{fi} (G)=1 and hence n=1. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists. Since G is connected u_i for some i is adjacent to two vertices of S say x and y and z is adjacent to u_j for i≠j in K_{n-3}, then {z,u_i} is γ_{fi} - set of G, so that γ_{fi} (G)=2 and hence n=2. But χ(G)=n-3=negative value. Which is a contradiction. Hence no fuzzy graph exists. If u_i for some i is adjacent to x and u_j is adjacent to y and u_k is adjacent to z, for i≠j≠k in K_{n-3} then {x,y,u_k} is a γ_{fi} -set of G. So that γ_{fi} (G)=3 and hence n=3. But χ(G)=0 Which is a contradiction. Hence no fuzzy graph exists.

Subcase (iii) Let $< S >= P_3 = \{x, y, z\}$. Since G is connected, x(or equivalently z) is adjacent to u_i for some i in K_{n-3}. Then $\{z,u_i\}$ is a γ_{fi} -set of G. so that γ_{fi} (G)=2 and hence n=2. But χ(G)=n-3=negative value. Which is a contradiction. Hence no fuzzy graph exists. If u_i is adjacent to y then $\{y,u_j\}$ for some i≠j is a γ_{fi} -set of G. so that γ_{fi} (G)=2 and hence n=2. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists.

Subcase (iv) Let $< S >= K_2 \cup K_1$ Let xy be the edge and z be the isolated vertex of $K_2 \cup K_1$ Since G is connected, there exists a u_i in K_{n-3} is adjacent to x and z. Then $\{y,u_i\}$ is a γ_{fi} -set of G, so that γ_{fi}(G)=2 and hence n=2. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists. If z is adjacent to u_j for some i≠j then $\{y,u_j\}$ for some i≠j is a γ_{fi} -set of G, so that γ_{fi} (G)=2 and hence n=2. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists.

Case (ii) Let γ_{fi}(G)=n-1 and χ(G)=n-2.

Since χ(G)=n-2, G contains a clique K on n-2 vertices. Let S={x,y}∈G-K_{n-2}. Then $< S >= K_2$ or $\overline{K_2}$

Subcase (a) Let $< S >= K_2$ Since G is connected, x(or equivalently y) is adjacent to some u_i of K_{n-2}. Then $\{y,u_i\}$ for some i is γ_{fi} - set, so that γ_{fi}(G)=2 and hence n=3. But χ(G)=n-2=1 for which G is totally disconnected, which is a contradiction. Hence no fuzzy graph exists.

Subcase (b) Let $< S >= \overline{K_2}$ Since G is connected, x is adjacent to some u_i of K_{n-2}. Then y is adjacent to the same u_i of $K_{n-2.}$ Then $\{u_i\}$ for some i is γ_{fi} - set, so that γ_{fi}(G)=1 and hence n=2. But χ(G)=n-2=0.Which is a contradiction. Hence no fuzzy graph exists. Otherwise x is adjacent to u_i of K_{n-2} for some i and y is adjacent to u_j of K_{n-2} for i≠j. Then $\{y,u_i\}$ for some i is γ_{fi} - set, so that γ_{fi} (G)=2 and hence n=3. But χ(G)=n-2=1. Which is for totally disconnected graph. Which is a contradiction. In this case also no fuzzy graph exists.

Case (iii) Let γ_{fi} (G)=n-2 and χ(G)=n-1.

Since χ(G)=n-1, G contains a clique K on n-1 vertices. Let x be a vertex of K_{n-1}. Since G is connected the vertex x is adjacent to one vertex u_i for some i in K_{n-1} so that $\{u_i\}$ γ_{fi} -set of G γ_{fi}(G)=1, we have n=3 and $\chi = 2$ .Then K=K_2. If x is adjacent to u_i, then $G \cong P_3$.

Case (iv) Let γ_{fi} (G)=n-3 and χ(G)=n

Since χ(G)=n, G=K_n, But for K_n, γ_{fi}(G)=1, so that n=4, $\chi = 4$ Hence G≅$K_{4.}$ Hence the proof.

Theorem 2.5: For any connected strong fuzzy graph G, γ_{fi} (G)+χ(G)=2n-4 and the equality holds if and only if G≅K_3(P_2),P_4,K_5.

Proof: If G is any one of the fuzzy graphs in the theorem, then it can be verified that γ_{fi} (G)+ χ(G)=2n-4.Conversely assume that γ_{fi} (G)+χ(G)=2n-4. This is possible only if γ_{fi} (G)=n and χ(G)=n-4 (or) γ_{fi} (G)=n-1 and χ(G)=n-3 (or) γ_{fi} (G)=n-2 and χ(G)=n-2 (or) γ_{fi} (G)=n-3 and χ(G)=n-1 (or) γ_{fi} (G)=n-4 and χ(G)=n.

Case (i) Let γ_{fi}(G)=n and χ(G)=n-4.

Since χ(G)=n-4, G contains a clique K on n-4 vertices. Let S = {v_1, v_2, v_3, v_4}∈G-K_{n-4}. Then the induced sub fuzzy graph <S> has the following possible cases K_4,$\overline{K}_4$,P_4,C_4,P_3UK_1, K_2UK_2, K_3UK_1, $K_{1,3}$, K_4-e, C_3(1,0,0), K_2U$\overline{K}_2$

In all the above cases, it can be verified that no new fuzzy graphs exists.

Case(ii) Let γ_{fi} (G)=n-1 and χ(G)=n-3.

Since χ(G)=n-3, G contains a clique K on n-3 vertices. Let S={x,y,z}∈G-K_{n-3}. Then <S>=K_3 ,$\overline{K_3}$, K_2∪K_1,P_3

Subcase (i) Let $< S >= K_3$. Since G is connected, x is adjacent to some u_i of K_{n-3}. Then {z,u_i} is γ_{fi}- set, so that γ_{fi}(G)=2 and hence n=3. But χ(G)=n-3=0. Which is a contradiction. Hence no fuzzy graph exists.

Subcase (ii) Let $< S >= \overline{K_3}$ Since G is connected, one of the vertices of K_{n-3} say u_i is adjacent to all the vertices of S or two vertices of S or one vertex of S. If u_i for some i is adjacent to all the vertices of S, then {u_i} for some i in K_{n-3} is γ_{fi} -set of G. so that γ_{fi} (G)=1 and hence n=2. But χ(G)=negative value. Which is a contradiction. Hence no fuzzy graph exists. If u_i for some i is adjacent to two vertices of S say x and y then G is connected, z is adjacent to u_j for i≠j in K_{n-3}, then {z,u_i} is γ_{fi} -set of G. so that γ_{fi} (G)=2 and hence n=3. But χ(G)=0. Which is a contradiction. Hence no fuzzy graph exists. If u_i for some i is adjacent to x and u_j is adjacent to y and u_k is adjacent to z, then {y,z,u_i } is γ_{fi}-set of G. so that γ_{fi}(G)=3 and hence n=4. χ(G)=1. Which is a contradiction. Hence no fuzzy graph exists.

Subcase (iii) Let $< S >= P_3 = \{x, y, z\}$. Since G is connected, x(or equivalently z) is adjacent to u_i for some i in K_{n-3}. Then {y,u_i} is γ_{fi} -set of G. so that γ_{fi} (G)=2 and hence n=3. But χ(G)=n-3=0. Which is a contradiction. Hence no fuzzy graph exists. If u_i is adjacent to y then {y,u_j,}for some i≠j is γ_{fi} -set of G. so that γ_{fi} (G)=2 and hence n=3. But χ(G)=n-3=0. Which is a contradiction. Hence no fuzzy graph exists.

Subcase (iv) Let $< S >= K_2 \cup K_1$ Let xy be the edge and z be a isolated vertex of $K_2 \cup K_1$ Since G is connected, there exists a u_i in K_{n-3} is adjacent to x and z also adjacent to same u_i Then {y,u_i} is a γ_{fi} -set of G. So that γ_{fi} (G)=2 and hence n=3. But χ(G)=0. Which is a contradiction. Hence no fuzzy graph exists. If z is adjacent to u_j for some i≠j then {y,u_j} is a γ_{fi} -set of G. So that γ_{fi} (G)=2 and hence n=3. But χ(G)=n-3=0. Which is a contradiction. Hence no fuzzy graph exists.

Case (iii) Let γ_{fi}(G)=n-2 and χ(G)=n-2.

Since χ (G)= n-2, G contains a clique K on n-2 vertices. Let S={x,y}∈G-K_{n-2}. Then $< S >= K_2$ or $\overline{K_2}$

Subcase (a) Let $< S >= K_2$. Since G is connected, x(or equivalently y) is adjacent to some u_i of K_{n-2}. Then {y,u_i} is γ_{fi}- set, so that γ_{fi} (G)=2 and hence n=4. But χ(G)=n-2=2. Then G≅P_4.

Subcase (b) Let $< S >= \overline{K_2}$, since G is connected, x is adjacent to some u_i of K_{n-2}. Then y is adjacent to the same u_i of $K_{n-2.}$ Then {u_i} is γ_{fi}- set, so that γ_{fi}(G)=1 and hence n=3. But χ(G)=n-2=1, which is for totally disconnected graph. Which is a contradiction Hence no fuzzy graph exists, or y is adjacent to u_j of K_{n-2} for i≠j. In this {y,u_i} is γ_{fi}- set, so that γ_{fi}(G)=2 and hence n=4. But χ(G)=2. So that K_{n-2}=$K_{2.}$ Then G≅P_4.

Case (iv) Let γ_{fi}(G)=n-3 and χ(G)=n-1.

Since χ (G)= n-1, G contains a clique K on n-1 vertices. Let x be a vertex of G-K_{n-1}. Since G is connected the vertex x is adjacent to one vertex u_i for some i in K_{n-1}, then $\{u_i\}$ is γ_{fi} - set of G so that γ_{fi}(G) = 1, we have n=4 and χ=3. Then K_{n-1}=K_3 Let u_1,u_2,u_3 be the vertices of K_3. Then x must be adjacent to only one vertex of G-K_3. Without loss of generality let x be adjacent to u_1, then $G \cong K_3(P_2)$.

Case (v) Let γ_{fi}(G)=n-4 and χ(G)=n

Since χ(G)=n, G=K_n, But for K_n, γ_{fi}(G)=1, so that n=5, $\chi = 5$. Hence G≅K_5. Hence the proof.

3. Conclusion

In this paper, upper bound of the sum of fuzzy independent domination and chromatic number is proved. In future this result can be extended to various domination parameters. The structure of the graphs had been given in this paper can be used in models and networks. The authors have obtained similar results with large cases of fuzzy graphs for which γ_{fi}(G)+χ(G)=2n-5, γ_{fi}(G)+χ(G)=2n-6, γ_{fi}(G)+χ(G)=2n-7,γ_{fi}(G)+χ(G)=2n-8

References

[1] Hanary F and Teresa W. Haynes,(2000), Double Domination in graphs, ARC Combinatoria 55, pp. 201-213

[2] Haynes, Teresa W.(2001): Paired domination in graphs, Congr. Number 150 John N. Mordeson, Premchand S. Nair, Fuzzy graphs and Fuzzy Hypergraphs, Physica-Verlag, Heidelberg, 2001.

[3] Kaufmann.A., (1975), Introduction to the theory of Fuzzy Subsets, Academic Press, Newyork.

[4] Mahadevan G,(2005): On domination theory and related concepts in graphs, Ph.D. thesis, Manonmaniam Sundaranar University,Tirunelveli,India.

[5] Mahadevan G, Selvam A, (2008): On independent domination number and chromatic number of a graph, Acta Ciencia Indica, preprint

[6] Nagoor Gani A. and Malarvizhi J. Isomorphism on Fuzzy Graphs, International Journal of Computational and Mathematical Sciences 2:4 2008

[7] Nagoor Gani A. and Chandrasekaran V. T. A first look on Fuzzy Graph Theory, Allied Publishers Pvt Ltd ,New Delhi, 2010

[8] Paulraj Joseph J. and Arumugam S.(1992): Domination and connectivity in graphs, International Journal of Management and systems, 8 No.3: 233-236.

[9] Paulraj Joseph J. and Arumugam S.(1997): Domination and colouring in graphs. International Journal of Management and Systems, Vol.8 No.1, 37-44.

[10] Paulraj Joseph J, Mahadevan G, Selvam A (2004). On Complementary Perfect domination number of a graph, Acta Ciencia India, vol. XXXIM, No.2,847(2006).

[11] Rosenfield,A., Fuzzy graphs In: Zadeh, L.A., Fu, K.S., Shimura, M.(Eds), Fuzzy sets and their applications(Academic Press, New York)

[12] Somasundaram .A, Somasundaram S., 1998, Domination in Fuzzy Graphs – I, Pattern Recognition Letters, 19, pp-787-791.

[13] Somasundaram.A, (2004), Domination in Fuzzy Graphs – II, Journal of Fuzzy Mathematics, 20.

[14] Stojmenovic I., Seddigh M., Zunic J., Dominating sets and neighbour elimination-based broad-casting algorithms in wireless networks, IEEE Transactions on Parallel and Distributed Systems 13 (2002) 14-25.

[15] Teresa W. Haynes, Stephen T. Hedemiemi and Peter J. Slater (1998), fundamentals of Domination in graphs, Marcel Dekker, Newyork.

[16] Vimala S, Sathya J.S, "Graphs whose sum of Chromatic number and Total domination equals to 2n-5 for any n>4", Proceedings of the Heber International Conference on Applications of Mathematics and statistics, Tiruchirappalli pp 375-381

[17] Vimala S, Sathya J.S, "Total Domination Number and Chromatic Number of a Fuzzy Graph", International Journal of Computer Applications (0975 – 8887) Volume 52– No.3, August 2012

[18] Vimala S, Sathya J.S, "Connected point set domination of fuzzy graphs", International Journal of Mathematics and Soft Computing, Volume-2, No-2 (2012),75-78

[19] Vimala S, Sathya J.S, "Some results on point set domination of fuzzy graphs", Cybernetics and Information Technologies , Volume 13, No 2 2013 Print ISSN: 1311-9702; Online ISSN: 1314-4081 Bulgarian Academy Of Sciences, Sofia -2013.

[20] Vimala S, Sathya J.S, "The Global Connected Domination in Fuzzy Graphs", Paripex-Indian Journal of research, Volume 12, Issue: 12, 2013, ISSN - 2250-1991

[21] Vimala S, Sathya J.S, "Efficient Domination number and Chromatic number of a Fuzzy Graph", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 3, March 2014, ISSN: 2319-8753

[22] Zadeh,L.A.(1971), Similarity Relations and Fuzzy Ordering, Information sciences, 3(2),pp.177-200.