Fuzzy Soft Bi-partite Graph and Its Application in Employee Selection for An Organisation

K. Malathy, S. Meenakshi

Abstract--- Fuzzy sets and soft sets are two different tools for representing uncertainty and vagueness. A fuzzy soft set is a mapping from parameter set to the fuzzy subsets of universe. Fuzzy soft set theory provides a parameterized point of view for uncertainty modeling and soft computing model. In this paper we discuss the notions of fuzzy soft bi-partite graph, Size and degree of fuzzy softbi-partite graph and investigating the application of Fuzzy soft Bi-partite graph in Employee selection for an Organisation.

Keywords--- Fuzzy soft graph, fuzzy soft bi-partite graph, and size and degree of fuzzy soft bi-partite graph.

I. INTRODUCTION

The origin of the graph theory started with the Konignberg bridge problem in 1735.This problem led to the concept of the Eulerian graph. Euler studied the Konignberg bridge problem and constructed a structure that solves the problem that is referred to as an Eulerian graph. In 1840 Mobius proposed the idea of a complete graph and a bipartite graph and kuratowski proved that they are planar by means of recreational problems.

Currently, concept of graph theory is highly utilized by computer science applications, especially in area of research, including data mining image segmentation, clustering and networking. The Introduction of fuzzy set by Zadehin 1965 [3] greatly changed the face of science and Technology.Fuzzy sets paved the way for a new method of philosophy thinking, "Fuzzy logic" Which is now an essential concept in artificial intelligence. The most important features of a fuzzy set is that it consists of a class of objects that satisfy a certain property or several properties .In 1999 Molodtsov introduced the concept of soft set theory to solve imprecise problem in the field of engineering, social science, economics, medical science and environment. In recent times, a number of research studies contributed into fuzzification of soft set theory. As a result many researches were more active doing research of soft set.

In 1999, Molodtsov [7] [6] introduced the concept of soft set theory to solve imprecise problems in the field of engineering, social science, economics, medical science and environment. Molodtsov applied this theory to several directions such as smoothness of function, game theory, operation research, probability and measurement theory. In recent times, a number of research studies contributed into fuzzy of soft set theory. As a result, many researchers were more active doing research on soft set. In 2001 Majietal initiated the concept of fuzzy soft sets which is a combination of fuzzy set and soft set. In 1975 Rosenfeld introduced the concept of fuzzy graph theory. [8].M.Akram and S Nawaz [2] introduced fuzzy soft graphs in the year 2015.

Sumitmohinta and T K samanta [5] also introduced fuzzy soft graphs independently

In this paper we discuss the notions of fuzzy soft bi-partite graph, Size and degree of fuzzy softbi-partite graph and investigating the application of Fuzzy soft Bi-partite graph in Employee selection for an Organisation.

II. PRELIMINARIES

Definition 2.1

Let U be an initial universe set and E be the set of parameters. Let $A \subset E$, A pair (F,A) is called **fuzzy soft set** over U where F is a mapping given by $F : A \to I^U$where I^Udenotes the collection of all fuzzy subsets of U.

Definition 2.2

Let V be a nonempty finite set and$\sigma : V \to [0,1]$. Again, let $\mu : V\ X\ V \to [0,1]$such that$\mu(x,y) \leq \sigma(x) \wedge \sigma(y)$for all $(x,y) \in V \times V$.

Then the pair $G = (\sigma, \mu)$is called a fuzzy graph over the set V. Here σ and μ are respectively called fuzzy vertex and fuzzy edge of the fuzzy graph$G = (\sigma, \mu)$.[4]

Definition 2.3

The degree of any vertex $\sigma(x_i)$of a fuzzy graph is sum of degree of membership of all those edges which are incident on a vertex $\sigma(x_i)$ and is denoted by deg $(\sigma(x_i))$.

Definition 2.4

Let $G = (\sigma, \mu)$ be a fuzzy graph. The Order of $G = (\sigma, \mu)$is defined as $O(G) = \sum_{u \in V} \sigma(u)$

and the size of $G = (\sigma, \mu)$ is defined as $S(G) = \sum_{u,v \in V} \mu(u,v)$.

Definition 2.5

A graph $G = (V(G), E(G)$ is said to be Bi-partiteif and only if there exists a partition$V(G) = V_1 \cup V_2(G)$and $V_1 \cap V_2 = \emptyset$.

Hence all edges share a vertex from both set V_1 and $V_2$and there are no edges formed between two vertices in the set V_1 and there are no edges formed between the two vertices in V_2.

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Definition 2.6

A fuzzy graph $G = (\sigma, \rho)$ is said be a fuzzy Bi-partite graph. If the vertex set V is petitioned into two disjoint union of two vertex sets V_1 and V_2 such that for all $x, y \in V_1$or for all $x, y \in V_2$, $\rho(x,y) = \frac{1}{2}[\mu(x) \wedge \mu(y)]$. This fuzzy Bi-partite graph can be denoted by $G(V_1, V_2, \mu, \rho)$.

Definition 2.7

Let $V = \{x_1, x_2, \ldots \ldots x_n\}$ (non-empty set), E (parameters set) and A ⊆ E. Also let

(i) $\rho: A \to F(V)$ (Collection of all fuzzy subsets in V)

$$e \mapsto \rho(e) = \rho_e(\text{say})$$

and $\rho_e : V \to [0,1]$

$$x_i \mapsto \rho_e(x_i)$$

(A, ρ) is a Fuzzy soft vertex

(ii) $\mu: A \to F(V \times V))$ (Collection of all fuzzy subsets in V×V)

$e \mapsto \mu(e) = \mu_e$(say)

and $\mu_e : V \times V \to [0,1]$

$$(x_i, x_j) \mapsto \mu_e(x_i, x_j)$$

(A, μ) is a Fuzzy soft edge.

Then$(A, \rho), (A, \mu)$is called fuzzy soft graph if and only if$\mu_e(x_i, x_j) \leq \rho_e(x_i) \wedge \rho_e(x_j)\ \forall\ e \in A$ and $\forall i, j = 1,2, \ldots ., n$and this fuzzy soft graph is denoted by $G_{A,V}$.[1]

Definition 2.8

Let $G_{A,V} = ((A, \rho), (A, \mu))$is said be a fuzzy soft graph. Then the order of $G_{A,V}$ is defined as

$$O(G_{A,V}) = \sum_{e \in A} \sum_{x_i \in V} \rho_e(x_i)$$and the size of$G_{A,V}$is defined as

$$S(G_{A,V}) = \sum_{e \in A} \sum_{x_i x_j \in V} \mu_e(x_i, x_j)$$

Definition 2.9

Let $G_{A,V} = ((A, \rho), (A, \mu))$is said be a fuzzy soft graph. Then the degree of vertex u is defined as

$$d_{G_{A,V}}(u) = \sum_{e \in A} \sum_{v \in V, u \neq v} \mu_e(u, v)$$

III. FUZZY SOFT BI-PARTITE GRAPH

Definition 3.1

A fuzzy soft graph $G_{A,V} = ((A, \rho), (A, \mu))$ is said be a fuzzy soft Bi-partite graph. If the vertex set V is petitioned into two disjoint vertex pair and $\mu_e(x_i, y_j) = \rho_e(x_i) \wedge (y_j)$ for all $x_i \in v_i$ and$y_j \in v_j$

Definition 3.2

If a fuzzy soft graph $G_{A,V} = ((A, \rho), (A, \mu))$ is said be a fuzzy soft Bi-partite graph,then Size of Fuzzy soft bipartite graph is

$$S\left(G_{A,v_i \cup v_j}\right) = \sum_{e \in A} \sum_{x_i y_j \in v_i \cup v_j} \mu_e(x_i, y_j).$$[9]

Example

Consider a fuzzy soft graph$G_{A,V}$, where $V = v_i \cup v_j = \{a_1, a_2, a_3, b_1, b_2, b_3\}$ and $E = \{e_1, e_2, e_3\}$. Here $G_{A,V}$described by table and$\mu_e(a_i, b_j) = 0$ for all $(a_i, b_j) \in v_i \times v_j$\

$\{(a_1, b_1), (a_1, b_2), (a_2, b_1), (a_2, b_2), (a_2, b_3), (a_3, b_2), (a_3, b_3)$ and for all $e \in E$

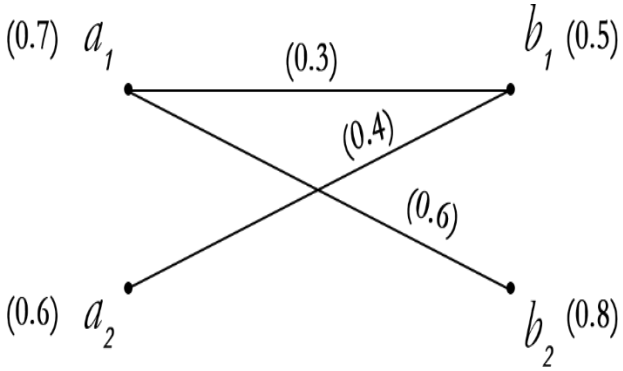
Tabular representation of fuzzy soft bi partite graph

ρ	a_1	a_2	a_3	b_1	b_2	b_3
e_1	0.7	0.6	0	0.5	0.8	0
e_2	0.8	0.9	1.0	0	0.8	0.6
e_3	0	0.6	0.5	0.6	0.8	0.7

Table 3.1

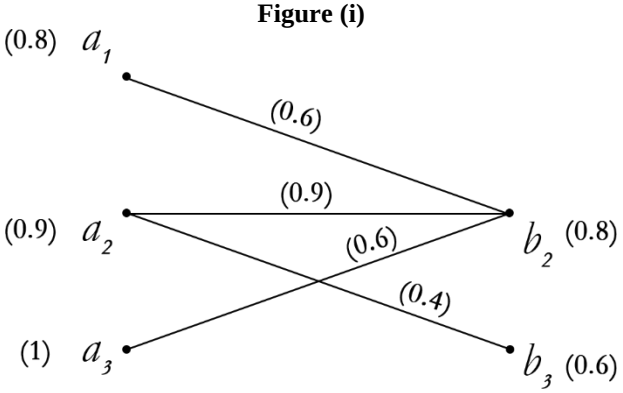
μ	a_1, b_1	a_1, b_2	a_2, b_1	a_2, b_2	a_2, b_3	a_3, b_2	a_3, b_3
e_1	0.3	0.6	0.4	0	0	0	0
e_2	0	0.6	0	0.9	0.4	0.6	0
e_3	0	0	0.4	0.5	0	0.3	0.3

Fuzzy soft bi-partite graph$G_{A,V}$



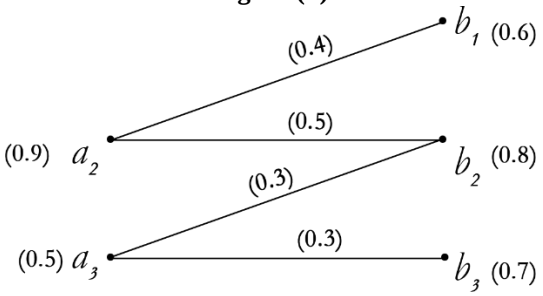
Corresponding to parametere_1, $F(e_1)$

Figure (i)



Corresponding to parameter e_2, $F(e_2)$

Figure (ii)



Corresponding to parameter e_3, $F(e_3)$

Figure (iii)

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The size of Fuzzy soft bi-partite graph $G_{A,V}$ is

S(F(e_1))=$\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_1(a_i,b_j)$
= 0.3+0.6+0.4 = 1.3

S(F(e_2))=$\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_2(a_i,b_j)$
=0.6+0.7+0.4+0.6 = 2.3

S(F(e_3))=$\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_3(a_i,b_j)$
=0.4+0.5+0.3+0.3 = 1.5

S($G_{A,v_i\cup v_j}$) = $\Sigma_{e\in A}\Sigma_{a_ib_j\,\varepsilon\, v_i\cup v_j}\mu_e(a_i,b_j)$
=(0.3+0.6+0.4)+(0.6+0.7+0.4+0.6)
+(0.4+0.5+0.3+0.3)
= 1.3+2.3+1.5
= 5.1

The degree of the vertices

$d_{G_{A,v_i\cup v_j}}(a_1)$ = 1.5

$d_{G_{A,v_i\cup v_j}}(a_2)$ = 2.1

$d_{G_{A,v_i\cup v_j}}(a_3)$ = 1.5

$d_{G_{A,v_i\cup v_j}}(b_1)$ = 1.1

$d_{G_{A,v_i\cup v_j}}(b_2)$ = 2.4

$d_{G_{A,v_i\cup v_j}}(b_3)$ = 1.3

IV. APPLICATION OF FUZZY SOFT BI-PARTITE GRAPHS IN EMPLOYEE SELECTION FOR AN ORGANISATION

In order to achieve the company goals, the employee plays an important role in any organisation.

Hiring the right employee is a challenging process. Hiring the wrong employee is expensive, costly to your work environment, and time-consuming. Hiring the right employee, on the other hand, pays you back in employee productivity, a successful employment relationship, and a positive impact on your total work environment.

On the other hand, the right company is the one with a strong supportive culture, the opportunities for upward mobility, the education and training available to employees. People want to know which companies are the best place to work and what makes them great.

Here, by using fuzzy soft bi partite graph a research is carried out. The objective of the research is to find most preferable Software companies and the Employee and also to find the best match between the Software companies and the Employee

Let us consider software companies and Employee as two sets of disjoint vertex sets and their qualities required for matching as parameters and the preference between the software companies and Employee as edges.

Let $V = V_i \cup V_j = \{V_i : (a_1,a_2,a_3,a_4,a_5), V_j : (b_1,b_2,b_3,b_4,b_5)\}$are set of all two disjoint vertices and $A = \{e_1,e_2,e_3,e_4,e_5\}$ are parameter set.

Identified qualities of Software Companies as follows:

a_1 –Good Salary and Friendly work environment

a_2–Career Growth and Onsite offer

a_3–Professional bosses and Good Salary

a_4–Career Growth and Friendly work environment

a_5– Onsite offer and Friendly work environment

Identified qualities of Employees as follows:

b_1– Programming skills, and Ability to obtain and process information

b_2–Ability to communicate verbally with people inside and outside an organization, and Programming skills

b_3 – Programming skills and Ability to create and/or edit written reports

b_4 – Programming skills and Ability to work in a team

b_5–Ability to communicate verbally with people inside and outside an organization, and Ability to work in a team

And the parameters are

$e_1 = \{Company - Good\ Salary, Employee - Programming\ Skill\}$

$e_2 = \{Company - Good\ Salary, Employee - Ability\ to\ work\ in\ team\}$

$e_3 = \{Company - Career\ Growth, Employee - Programming\ Skill\}$

$e_4 = \{Company - Onsite\ Offer, Employee - Ability\ to\ work\ in\ team\}$

$e_5 = \{Company - Good\ Salary, Employee - Good\ Communication\}$

Tabular representation of fuzzy soft bi partite graph

μ	a_1b_1	a_1b_2	a_1b_3	a_1b_4	a_1b_5	a_2b_1	a_2b_2	a_2b_3	a_2b_4	a_2b_5	a_3b_1	a_3b_2	a_3b_3
e_1	0.1	0.2	0.2	0.2	0	0	0	0	0	0	0.2	0.1	0.1
e_2	0	0	0	0.2	0.3	0	0	0	0	0	0	0	0
e_3	0	0	0	0	0	0.3	0.3	0.2	0.2	0	0	0	0
e_4	0	0	0	0	0	0	0	0	0.4	0.4	0	0	0
e_5	0	0.3	0	0	0.2	0	0	0	0	0	0	0.4	0

Table 4.1

μ	a_3b_1	a_3b_2	a_4b_1	a_4b_2	a_4b_3	a_4b_4	a_4b_5	a_5b_1	a_5b_2	a_5b_3	a_5b_4	a_5b_5
e_1	0.3	0	0	0	0	0	0	0	0	0	0	0
e_2	0.2	0.4	0	0	0	0	0	0	0	0	0	0
e_3	0	0	0.1	0.3	0.1	0.4	0	0	0	0	0	0
e_4	0	0	0	0	0	0	0	0	0	0	0.2	0.4
e_5	0	0.2	0	0	0	0	0	0	0	0	0	0

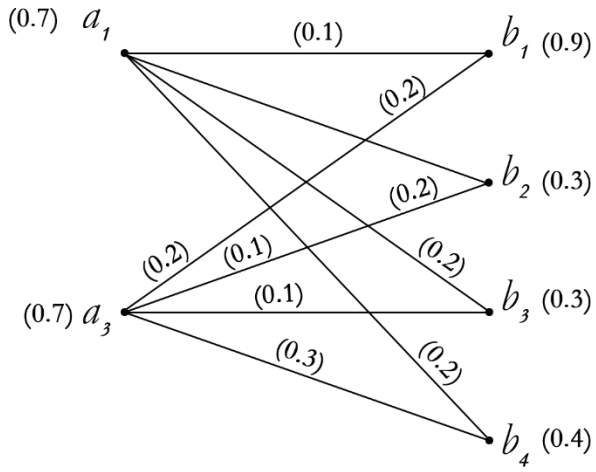
Table 4.2

ρ	a_1	a_2	a_3	a_4	a_5
e_1	0.7	0	0.7	0	0
e_2	0.5	0	0.4	0	0
e_3	0	1.0	0	0.9	0
e_4	0	0.8	0	0	0.6
e_5	0.5	0	0.6	0	0

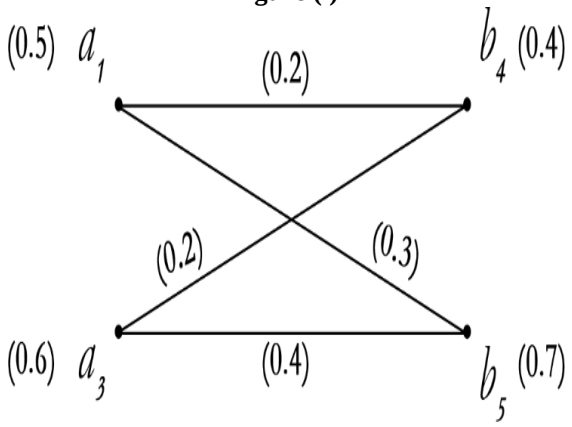
Table 4.3

ρ	b_1	b_2	b_3	b_4	b_5
e_1	0.9	0.3	0.3	0.4	0
e_2	0	0	0	0.4	0.7
e_3	0.4	0.6	0.3	0.6	0
e_4	0	0	0	0.6	0.8
e_5	0	0.7	0	0	0.4

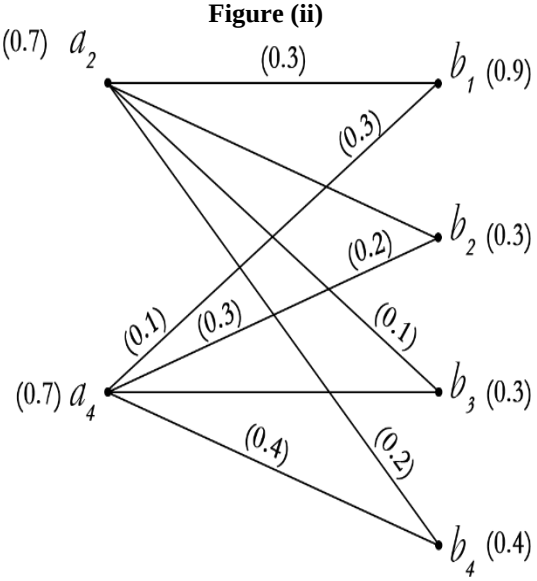
Fuzzy soft bi-partite graph $G_{A,V}$



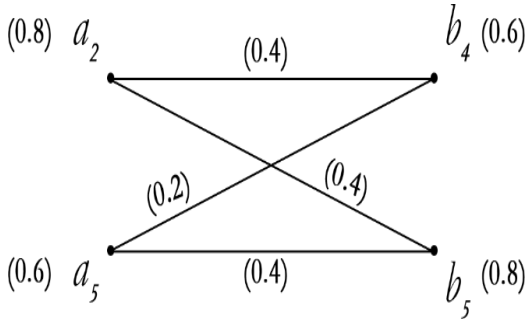
Corresponding to parameter e_1, $F(e_1)$
Figure (i)



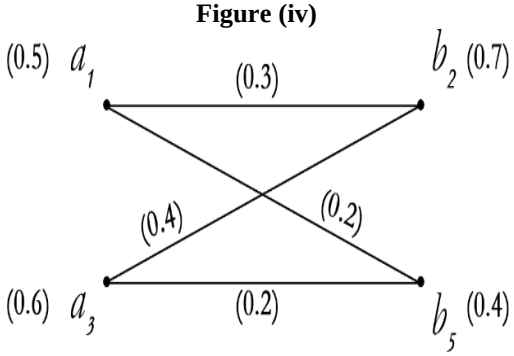
Corresponding to parameter e_2, $F(e_2)$
Figure (ii)



Corresponding to parameter e_3, $F(e_3)$
Figure (iii)



Corresponding to parameter e_4, $F(e_4)$
Figure (iv)



Corresponding to parameter e_5, $F(e_5)$
Figure (v)

The size of each parameterized graphs is calculated below

$S(F(e_1))=\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_1(a_i,b_j)$
= 0.1+0.2+0.2+0.2+0.2+0.1+0.1+0.3 =1.4

$S(F(e_2))=\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_2(a_i,b_j)$
=0.2+0.3 +0.2+0.4 =1.1

$S(F(e_3))=\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_3(a_i,b_j)$
=0.3+0.3+0.2+0.2+0.1+0.3+0.1+0.4 =1.9

$S(F(e_4))=\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_4(a_i,b_j)$
=0.4+0.4+0.2+0.4 =1.4

$S(F(e_5))=\Sigma_{a_ib_j\varepsilon v_i\cup v_j}\mu e_5(a_i,b_j)$
=0.3+0.2+0.4+0.2 =1.1

From the above discussion the following fact is revealed:"Most of the Software Companies recruited employee with Good Programming skill and the Employee preferred the company with Good Career Growth"

(ii) To find the most preferable software company and employee, here we going to calculate degrees of each vertex

Table 4.4

ρ	a_1	a_2	a_3	a_4	a_5
e_1	0.7	0	0.7	0	0
e_2	0.5	0	0.4	0	0
e_3	0	1.0	0	0.9	0
e_4	0	0.8	0	0	0.6
e_5	0.5	0	0.6	0	0
$d(x_i)$	1.7	1.8	1.7	0.9	0.6

Table 4.5

ρ	b_1	b_2	b_3	b_4	b_5
e_1	0.9	0.3	0.3	0.4	0
e_2	0	0	0	0.4	0.7
e_3	0.4	0.6	0.3	0.6	0
e_4	0	0	0	0.6	0.8
e_5	0	0.7	0	0	0.4
$d(y_j)$	1.3	1.6	0.6	2.0	1.9

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Observation

As Regards Software Companies: The vertex a_2 dominate the other vertex, it is inferred that Career Growth and Onsite offer are preferable over the rest.

In the Case of Employee: The vertex b_4 dominate the other qualities, the employee most wanted are those who have Good Programming skills and Ability to work in a team.

V. CONCLUSION

In this paper, we discussed the notions of fuzzy soft bi-partite graph, Size and degree of fuzzy softbi-partite graph and investigated the application of Fuzzy soft Bi-partite graph in Employee Selection for Software companies.

Finally, we have revealed that Most of the Software Companies recruited employee with Good Programming skill and the Employee preferred the company with Good Career Growth.

And also, it inferred that Career Growth and Onsite offer are preferable over the rest and the Employee most wanted are those who have Good Programming skills and Ability to work in a team.

REFERENCES

1. M.Akram, S. Nawaz, Fuzzy soft graphs with applications , Journal of Intelligent and Fuzzy Systems 30 (6) (2016) 3619 – 3632.
2. M.Akram, S. Nawaz , Operations onsoft graphs, Fuzzy Information and Engineering 7(4) (2015) 423 – 449.
3. Dr. K. Kalaiarasi and L. Mahalakshmi, An Introduction to Fuzzy strong graphs, Fuzzy soft graphs, compliment of fuzzy strong and soft graphs,13,November 6(2017), 2235-2254.
4. J.N.Mordeson an C.S.Peneg, Operations on fuzzy graphs, Information sciences, 79, September 1994, 159 – 170.
5. S.Mohinta , T.K.Samanta, An Introduction to fuzzy soft graph , Mathematics Moravica19 – 2 (2015) 35 – 48.
6. T.K.MathewVarkey, A.M. Shyla . A Note on Bipartite and Balanced Fuzzy Graph Structures 6 ,7 (2017) : 12637 – 12640.
7. D.A.Molodtsov , Soft set theory -first results , Computers and Mathematics with Applications 37, 1999.
8. A.Rosenfeld, Fuzzy graph , in ; L.A.Zadeh, K.S.Fu, K.Tanaka, M.ShimuraedS , Fuzzy Sets and Their Applications to cognitive and decision Process, Acaemic Press, New York, 1975, pp. 75 – 95.
9. N. Sarala, K. Manju, Application of Fuzzy soft Bi-partite graph in Matrimonial process, Volume 14, Issue 4 Ver. III (Jul - Aug 2018), PP 20-24.

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