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APPLICATION OF ($\in$, $\in \vee$ Q) - FUZZY IDEALS TO MEDICAL DIAGNOSIS SYSTEM

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Abstract

A developing theory of ($\in$, $\in \vee$ q) - fuzzy ideals is applied to medical diagnosis system. This theory will help doctors to select the effective symptoms and could make diagnosis of diseases concern. Two cases have been studied in detail and 15 cases have been summarized to strengthen the application.
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§1 Background of ($\in$, $\in \vee$ q) - fuzzy ideals of lattice

Fuzzy set was initiated by Zadeh [29] and so many researchers were conducted the generalizations of the notion of fuzzy sets. Rosenfeld [18] wrote paper on fuzzy groups. Seselija, Tepavcevska and others [22], [23], [24] have presented a far reaching framework of L - fuzzy and P - fuzzy algebras.

Lattice theory [16] is employed for describing acquisition of mental models. Lattice theory [19] employed for rules' learning, while in [3], [10], [11] it is employed for decision making under ambiguity in the context of fuzzy logic. Yuan and Wu introduced the concept of fuzzy lattices [28] and Ajmal studied it in a greater detail [1]. Swami and Raju [25] and Tepavcevska and Trajkovski [26] studied L-fuzzy lattices. Vassilis G. Kaburlasos, Vassilios Petridis [12] have introduced a novel framework for learning in lattices that the framework of fuzzy lattices.

Liu [27] applied the concept of fuzzy sets to the theory of rings and introduced the notions of a fuzzy subring and a fuzzy ideal of a ring. Moreover, this concept is discussed by many researchers [6, 13, and 17]. In [14], Ming and Ming introduced the concept of quasi-coincidence of a fuzzy point with a fuzzy subset. Bhakat and Das [2] introduced a new type of a fuzzy subring (ideal, prime) of ring called an ($\in$, $\in \vee$ q) - fuzzy subring (ideal, prime) based on quasi-coincidence. In [7], Davvaz defines ($\in$, $\in \vee$ q) - fuzzy subnearring and ideals of a near ring. In [9], Dhanani and Pawar introduced the concept of ($\in$, $\in \vee$ q) - fuzzy ideals of lattice.

§2 Usefulness of Fuzzy theory to Medical Diagnosis

It seems that the medical community has recognized fuzzy sets most for their "ability to introduce notions of continuity into deductive thinking". Because it is continuous, the behavior of fuzzy systems is likely to be closer to medical reality than that of their categorical counterparts. At the same time, fuzzy sets allow one to fully enjoy the ease of expression offered by symbolic models and their formalisms, avoiding the unwieldiness of the analytical alternatives. Fuzzy sets can bridge the gap between the discrete world of reasoning and the continuity of reality; today, this appears to be the main reason why they are considered useful.
In [21], Sanchez applied the theory of fuzzy relation to Medical Diagnosis System. Later many researchers applied the theory of fuzzy sets to Medical diagnosis system. De et. al. [8] have studied Sanchez's [21] method of medical diagnosis using intuitionistic fuzzy set. And Saikia et. al. [20] extended the method of [8] using intuitionistic fuzzy soft set theory. Recently, in [15] Moein, Monadjemi and Moallem described the Medical diagnosis system using Fuzzy logic. In [5] Das and Borgohain applied theory of fuzzy soft set in medical diagnosis using fuzzy arithmetic operations on fuzzy number. In [4] Chetia proposed a method to study Sanchez's approach of medical diagnosis through Interval Valued Fuzzy Soft Sets obtaining an improvement of same presented in De et. al. [8].

In this paper we apply the theory of ($\in$, $\in \vee$ q) - fuzzy ideals in lattices to Medical Diagnosis System which henceforth we call it as $\in$ - method. This $\in$ - method helps doctors to select effective symptoms and could make diagnosis of the diseases concern. In all existing fuzzy theory methods [4, 5, 8, 15, 20 and 21], fuzzy sets are constructed on symptoms determined from expert medical documentation. In current $\in$ - method, fuzzy sets are constructed on expert medical documentation and also experts experience / opinion. Thus only documentation may lead to insufficient diagnosis. Even only experts opinion (i.e., no documentation, no check – ups, etc.) may be dangerous to select effective symptoms. Thus we have fuzzified expert medical documentation

and also experts experience / opinion for selecting the effective symptoms. We have applied $\in$ - method to 17 different cases and conclusions drawn by $\in$ - method matches with doctor's opinion. Thus $\in$ - method will help doctors to select the effective symptoms and could make diagnosis of the diseases concern more effectively and in short span of time. This $\in$ - method can be applied in general by following algorithm given further in §6.

§3 Medical Diagnostic System

The major task of medical sciences is to prevent and diagnosis of diseases. Following difficulties encountered during medical diagnosis that have to be taken into account:

• For valid diagnosis, a doctor will reach only after a long experience of sufficient number of cases studied. For rare or new diseases experienced doctors are in the same situation as newcomers.

• Humans can recognize patterns or objects very easily but fail when probabilities have to be assigned to observations.

• The quality of diagnosis is totally dependent on the doctor's talent as well as his/her experiences.

• Emotional problems and fatigue degrades the doctor's performance.

• Medical science is one of the most rapidly growing and changing fields of science. New theories, inventions, drugs and line of management are replacing or modifying the older day by day. Even unknown diseases turn up every now and then. Hence, a doctor should always try hard to keep him/her up to date.

A doctor makes differential diagnosis after hearing patients complaints, measuring parameter (like Pulse rate, Blood pressure and Body temperature), Systemic examination and carrying out various diagnostic tests like Blood-Urine examination, ECG, CT Scan, MRI, Interventional procedures and draws a final diagnosis.

A single symptom could have many differential diagnoses. For example, a patient comes with a complaint of chest pain, it is necessary to evaluate the cause, which can be multifactorial like condition of Heart, Lungs or Musculo-Skeletal.

At times, a doctor may need other doctors or consultants experts' opinion regarding two or more diseases.

In this paper we use fuzzy algorithm to solve such problems. Fuzzy algorithms execute in three major stages: fuzzification, formulation, and defuzzification. In the fuzzification stage, real world sensory inputs in a given universe of discourse are characterized on the closed interval [0, 1] according to their levels of membership in fuzzy sets. These sets are given names which express qualities of the input variable using easily understood linguistic terms. A membership function maps the value of the input variable to a degree of membership in each of the fuzzy sets. The fuzzified value then, represents the level of truth of each of these linguistic terms for a given input. In formulation stage we applied $(\in , \in \vee q)$ – fuzzy sub lattice to the fuzzified input value to determine a [still fuzzy] command output. The defuzzification stage extracts a crisp command output from formulation.

§4 Preliminaries

Let X denotes a non-empty set. A partially ordered set [13] is a set in which a binary relation $x \leq y$ is defined, which satisfies the following conditions for all x, y, z in X as,

i) For all x in X, $x \leq x$. (Reflexive)

ii) If $x \leq y$ and $y \leq x$, then $x = y$. (Antisymmetry)

iii) If $x \leq y$ and $y \leq z$, then $x \leq z$. (Transitivity)

A conventional lattice, or alternatively crisp lattice [13], is a partly ordered set any two of whose elements have a greatest lower bound or meet denoted by $x \wedge y$ and a least upper bound or join denoted by $x \vee y$.

A mapping $\mu : X \rightarrow [0,1]$ is called a *fuzzy subset [9]* of X.

Let f and g be any two fuzzy subsets of X. Then $f \cap g$ *and* $f \cup g$ are fuzzy subsets of X defined by, $(f \cap g)(x) = \min \{ f(x), g(x) \}$, $(f \cup g)(x) = \max \{ f(x), g(x) \}$.

For a fuzzy subset μ of a lattice X, μ is an $(\in , \in \vee q)$ – fuzzy sublattice [9] of X if and only if the conditions

I) $\mu(x \wedge y) \geq \mu(x) \wedge \mu(y) \wedge 0.5$

II) $\mu(x \vee y) \geq \mu(x) \wedge \mu(y) \wedge 0.5$ holds for all $x, y \in X$ and

μ is an $(\in , \in \vee q)$ – fuzzy ideal of X if and only if the condition (I), (II) holds and

III) $x \wedge a = x$ implies $\mu(x) \geq \mu(a) \wedge 0.5$ holds for all $a, x \in X$

If μ and λ are $(\in , \in \vee q)$ - fuzzy ideals of X then $\mu \cap \lambda$ is also $(\in , \in \vee q)$ - fuzzy ideals of X [9].

§5 Procedure

Define fuzzy sets A_i, i = 1 to n, on various tests taken by patient during diagnosis of diseases with these linguistic variables such as almost high or very high. Let P_j, j = 1 to m, be statements that "The various symptoms shows a disease" (e.g., P_1: "It shows sinustis", P_2: "It shows tumor", etc). Let τ_j, j = 1 to m, be fuzzy sets defined on P_j by expert which tell about how much the test useful to identify diseases based on their knowledge. Let X = [0, 1]. Let μ be an $(\in , \in \vee q)$ fuzzy ideal defined on A_i, i = 1 to n. Let λ_j be an $(\in , \in \vee q)$ fuzzy ideal defined on τ_j, j = 1 to m. Then the patient have a symptom of a disease is given by

$\gamma_j(P_j) = \bigvee_{i=1}^{n} (\mu(A_i) \wedge \lambda_j(\tau_j(P_j)_i))$ for all j where γ_j, j = 1 to m, be fuzzy sets defined on P_j. Here $\vee$ denotes max and $\wedge$ denotes min. Thus $\gamma = \mu \cap \lambda$. Hence γ is $(\in, \in \vee q)$ - fuzzy ideals of X. Thus maximum value of γ tells us about more sign of a disease.

§6 Algorithm

$\in$ - method can be applied in general by following algorithm as,

i) Record values of Test taken by patient during diagnosis.

ii) Fuzzify the recorded values to get A_i.

iii) Input the values τ_i given by expert which tell us about how much the test useful to identify diseases based on their knowledge / experience.

iv) Compute μ and λ as, $\mu(A_i(x)) = A_i(x) \vee 0.5$ for all x and $\lambda(\tau_j(P_j)_i) = \tau_j(P_j)_i \vee 0.5$.

v) Compute γ as $\gamma_j(P_j) = \bigvee_{i=1}^{n} (\mu(A_i) \wedge \lambda_j(\tau_j(P_j)_i))$.

vi) Maximum value of $\gamma_j(P_j)$ concludes that patient suffers from diseases P_j .

§7 Case Studies

For this, Information of some patients were taken and studied carefully,

Case I: Sixty year male patient came with complaint of Burning micturation. The Doctor initially assumed some possible diseases such as, Urinary tract infection (UTI) (P_1), Renal Stone(P_2) and Diabetes(P_3). For confirmation, he advised patient for Blood check up, Urine Check up and USG abdomen. Based on following reports we fuzzified as,

i	Test	Values	Normal Values	A_i	τ_1 (P_1)	τ_2 (P_2)	τ_3 (P_3)	$\mu(A_i)$	λ_1 (τ_1 (P_1))	λ_2 (τ_2 (P_2))	λ_3 (τ_3 (P_3))
1	Haemoglobin (gm%)	6.50	13-15	0.81	0.2	0	0.1	0.81	0.5	0.5	0.5
2	ESR mm	34	0-14	0.77	0.2	0.1	0.2	0.77	0.5	0.5	0.5
3	Urea (mg/dl)	27.50	20-40	0	0	0	0	0.5	0.5	0.5	0.5
4	RBSL(mg/dl)	92.50	90-110	0	0	0	0	0.5	0.5	0.5	0.5
5	Calcium (mg%)	7.69	9-10.4	0.33	0.1	0	0.1	0.5	0.5	0.5	0.5
6	Urine(R) Protiens	Trace	Trace / Absent	0	0	0	0	0.5	0.5	0.5	0.5
7	Urine culture	Abnormal*	Normal / Abnormal	1	1	0	0	1	1	0.5	0.5
8	USG abdomen	Abnormal**	Normal / Abnormal	1	0.8	0	0	1	0.8	0.5	0.5

* Abnormal due to Organism seen E.coli.

** Abnormal due to internal echoes seen in urinary bladder.

The fuzzy set defined for various test are given below for all x in respective universal set as,

$$= \frac{13-x}{8} \quad if\ 5 \le x \le 13 \qquad = \frac{x-14}{26} \quad if\ 14 \le x \le 40 \qquad = \frac{x-40}{60} \quad if\ 40 \le x \le 100$$

$$A_1(x) = 1 \quad if\ x < 5 \quad , \quad A_2(x) = 1 \quad if\ x > 40 \quad , \quad A_3(x) = 1 \quad if\ x > 100 \quad ,$$
$$= 0 \quad else \qquad = 0 \quad else \qquad = 0 \quad else$$

$$= \frac{x-110}{90} \quad if\ 110 \le x \le 200 \qquad = \frac{9-x}{4} \quad if\ 5 \le x \le 9$$

$$A_4(x) = 1 \quad if\ x > 200 \quad , \quad A_5(x) = 1 \quad if\ x < 5 \quad ,$$
$$= 0 \quad else \qquad = 0 \quad else$$

$$A_6(x) = 1 \quad if\ absent\ ,$$
$$= 0 \quad if\ traced$$

$A_7(x)=1$ *if abnormal*, $A_8(x)=1$ *if abnormal*.
$=0$ *if normal* $=0$ *if normal*

$(\tau_j(P_j))_i$ for i = 1 to 8 and j = 1 to 3 is grade membership given by expert which tell us about how much the test useful to identify diseases based on their knowledge / experience. Define fuzzy sets $\mu(A_i(x))=A_i(x)\vee 0.5$ for all x and i = 1 to 8 and $\lambda(\tau_j(P_j)_i)=\tau_j(P_j)_i\vee 0.5$ for i = 1 to 8 and j = 1 to 3. Clearly μ and λ are $(\in, \in\vee q)$ - fuzzy ideals of X. Hence μ ∩ λ is $(\in, \in\vee q)$ - fuzzy ideals of X. Define $\gamma_j(P_j)=\bigvee_{i=1}^{n}(\mu(A_i)\wedge\lambda_j(\tau_j(P_j)_i))$ for all j = 1 to 3. Thus, $\gamma_1(P_1)=1, \gamma_2(P_2)=0.1$ *and* $\gamma_3(P_3)=0.2$. Thus UTI gets maximum grade membership. Thus, we conclude that patient suffers from Urinary tract infection. It matches with doctor's opinion.

Case II: Sixty five year male patient came with complaint of Burning micturation and dribbling of urine. The Doctor initially assumed some possible diseases as, Renal Stone (P_1) and Prostatic Hypertrophy (P_2). For confirmation, He advised the patient for Blood check up, Urine Check up, USG abdomen for Prostate. Based on following reports we fuzzified as,

i	Test	Values	Normal Values	A_i	$\tau_1(P_1)$	$\tau_2(P_2)$	$\mu(A_i)$	$\lambda_1(\tau_1(P_1))$	$\lambda_2(\tau_2(P_2))$
1	Haemoglobin	13.20 gm%	13-15 gm%	0	0	0	0.5	0.5	0.5
2	ESR	14 mm	0-14 mm	0	0	0	0.5	0.5	0.5
3	RBSL	141.3 mg/dl	90-110 mg/dl	0.35	0	0	0.5	0.5	0.5
4	Calcium	7.98 mg %	9-10.4 mg %	0.26	0.3	0	0.5	0.5	0.5
5	Urine(R)	Normal	Normal / Abnormal	0	0.3	0.1	0.5	0.5	0.5
6	USG abdomen	Abnormal*	Normal / Abnormal	1	0	1	1	0.5	1

* Abnormal due to Mild Prostatomegaly with grade2 intravesical Prostatic projection with consequent changes of urinary retention

The fuzzy set defined for various test are given below for all x in respective universal set as,

$=\frac{13-x}{8}$ *if* $5\le x\le 13$ $=\frac{x-14}{26}$ *if* $14\le x\le 40$

$A_1(x)=1$ *if* $x<5$, $A_2(x)=1$ *if* $x>40$,
$=0$ *else* $=0$ *else*

$=\frac{x-110}{90}$ *if* $110\le x\le 200$

$A_3(x)=1$ *if* $x>200$,
$=0$ *else*

$=\frac{9-x}{4}$ *if* $5\le x\le 9$

$A_4(x)=1$ *if* $x<5$, $A_5(x)=1$ *if abnormal*,
$=0$ *else* $=0$ *if normal*

$A_6(x)=1$ *if abnormal*.
$=0$ *if normal*

$(\tau_j(P_j))_i$ for i = 1 to 6 and j = 1 to 2 is grade membership given by expert which tell us about how much the test is useful to identify diseases based on their knowledge / experience.

Define fuzzy sets $\mu(A_i(x))=A_i(x)\vee 0.5$ for all x and i = 1 to 6 and $\lambda(\tau_j(P_j)_i)=\tau_j(P_j)_i\vee 0.5$ for i = 1 to 6 and j = 1 to 2. Clearly μ and λ are $(\in, \in\vee q)$ - fuzzy ideals of X. Hence μ ∩

λ is $(\in, \in \vee q)$ - fuzzy ideals of X. Define $\gamma_j(P_j) = \bigvee_{i=1}^{n} (\mu(A_i) \wedge \lambda_j(\tau_j(P_j)_i))$ for all j = 1 to 2. Thus, $\gamma_1(P_1) = 0.5$ *and* $\gamma_2(P_2) = 1$. Thus Prostatic Hypertrophy gets maximum grade membership. Thus we conclude that patient suffers from Prostatic Hypertrophy. It matches with the doctor's opinion.

Similarly we can use $\in$ - method to different case studies. The following table gives the summary of 15 cases studied and analyzed according to the previous two cases. As per the patient's complaints and their examination, Doctor advised patient for various tests for confirmation of possible diseases. Fuzzified values $\gamma_j(P_j)$, where j = 1, 2 were obtained and accordingly conclusions were drawn.

No.	Male/ Female	Age years	Complaints	Possible Diseases P_1 or P_2		Advise	$\gamma_1(P_1)$	$\gamma_2(P_2)$	Conclusion
1	Female	54	Cough and Fever	Chronic Bronchitis	Pneumonia	Blood Check up and X – Ray	0.5	1	Pneumonia
2	Male	26	Fever	Viral fever	typhoid	Blood Check up and Urine	0.8	0.5	Viral fever
3	Male	52	Pain in abdomen	Renal Stone	Appendicitis	Blood Check up and USG abdomen	1	0.8	Renal Stone
4	Male	60	Vomiting and loose motion	Dysentery	Necrotizing enterocolits	Blood Check up, Stool examination and USG abdomen	0.6	1	Necrotizing enterocolits
5	Female	46	Fever with chills	Viral fever	Malaria	Blood Check up and Urine	0.7	0.5	Viral fever
6	Male	65	Burning Micturation and Urination in drops	Diabetes Mellitus	Prostratomegaly	Blood Check up, Urine and USG abdomen	0.5	1	Prostratomegaly
7	Female	54	Increased Frequency of Urination	UTI	Diabetes Mellitus	Blood Check up and Urine	0.5	0.9	Diabetes Mellitus
8	Female	56	Joint Pains	GOUT	Rheumatoid Arthritis	Blood Check up	0.8	1	Rheumatoid Arthritis
9	Male	50	Difficulty in passing Urine	Renal Stone	Prostatic Hypertrophy	Blood Check up, Urine and USG abdomen	0.5	1	Prostatic Hypertrophy
10	Female	40	Burning Micturation	UTI	Renal Stone	Blood Check up, Urine and USG abdomen	0.5	1	Renal Stone
11	Male	50	Pain in Abdomen	Appendicitis	Renal Stone	Blood Check up, Urine and USG abdomen	0.5	1	Renal Stone
12	Female	36	Cough	URTI	Chronic Bronchitis	Blood Check up and Chest X – Ray	1	0.5	URTI
13	Male	50	Difficulty in passing Urine	Renal Stone	Prostatic Hypertrophy	Blood Check up, Urine and USG abdomen	0.5	1	Prostatic Hypertrophy
14	Female	56	Swelling in neck	Thyroid nodule	Graves disease	Blood Check up, USG thyroid gland and iodine scan	0.7	1	Graves disease
15	Female	56	Pain in abdomen with Burning Micturation	UTI	Renal stone	Urine and USG abdomen	0.5	1	Renal Stone

Patients of both gender and various age groups between 26 to 65 years were studied. All came with almost different complaints such as Pain in Abdomen, Burning Micturation, and Difficulty in Passing Urine, Fever, and Cough etc. Hearing their complaints and after examining them, Doctors came out with differential diagnosis such as Renal Stone, Prostatic Hypertrophy, Viral fever, etc. For

confirmation doctors advised for Blood check up, Urine check up, USG abdomen, etc. Fuzzification was done and conclusions were drawn on maximum value of γ_j for j = 1 and 2.

§8 Conclusion

The above theory correlates with the clinical diagnosis made by Doctors. Thus using this theory of $(\in, \in \vee q)$ – fuzzy ideals of lattices, will help doctors to select the effective symptoms and could make diagnosis of the diseases concern.

REFERENCES

[1] N. Ajmal and K. V. Thomas, Fuzzy lattices, Info. Sciences, **79** (1994), 271-291.

[2] S. K. Bhakat and P. K. Das, Fuzzy subrings and ideals redefined, Fuzzy Sets and Systems, **81 (3)** (1996), 383–393.

[3] S. L. Chen, Urysohn - Closedness on Fuzzy Lattices, International Journal of Uncertainty, Fuzziness and Knowledge - Based Systems, **4(1)** (1996), 87-93.

[4] B. Chetia, An Application of Interval - Valued Fuzzy Soft Sets in Medical Diagnosis, Int. J. Contemp. Math. Sciences, **5(38)** (2010), 1887–1894.

[5] P. K. Das, R. Borgohain, An application of fuzzy soft set in medical diagnosis using fuzzy arithmetic operations on fuzzy number, SIBCOLTEJO, **5** (2010), 107-116.

[6] B. Davvaz, Roughness in rings, Inform. Sci., **164** (2004), 147-163.

[7] B. Davvaz, $(\in, \in \vee q)$ - fuzzy subnearrings and ideals, Soft. Computing, **10** (2006), 206–211.

[8] S. K. De, R. Biswas, A. R. Roy, An application of intuitionistic fuzzy sets in medical diagnosis, Fuzzy Sets and Systems, **117**(2001), 209-213.

[9] S. H. Dhanani and Y. S. Pawar, $(\in, \in \vee q)$ - fuzzy ideals of lattice , International Journal of Algebra, **4(26)** (2010), 1277–1288.

[10] B. R. Gaines, Fuzzy and Probability Uncertainty Logics, Infor. and Control,**38**(1978),154-169.

[11] J. A. Goguen, L-Fuzzy Sets, Jour. of Mathematical Analy. and Application, **18**(1967), 145-174.

[12] V. G. Kaburlasos and V. Petridis, Fuzzy Lattice Neurocomputing (FLN) models, Neural Networks, **13(10)** (2000), 1145-1170.

[13] H. V. Kumbhojkar and M. S. Bapat, On prime and primary fuzzy ideals and their radicals, Fuzzy Sets and Systems, **53** (1993) 203-216.

[14] P. P. Ming and L. Y. Ming, Fuzzy topology I. Neighbourhood structures of a fuzzy point and Moore – Smith convergence, J. Math. Anal. Appl., **76** (1980), 571 - 579.

[15] S. Moein, S. A. Monadjemi and P. Moallem, A Novel Fuzzy-Neural Based Medical Diagnosis System, World Academy of Science, Engineering and Technology, **37** (2008).

[16] N. Moray, Intelligent aids, mental models, and the theory of machines, International Journal of Man - Machine Studies, **27**(1987), 619-629.

[17] T. K. Mukherjee and M. K. Sen, On fuzzy ideals of ring, Fuzzy Sets and System, **21**(1987), 99-104.

[18] A. Rosenfeld, Fuzzy Groups, J. Math. Anal. And Appl., **35** (1971), 512-517.

[19] M. Sahami, Learning Classification Rules Using Lattices. In Proceedings of the Eighth European Conference on Machine Learning (ECML – 95) Heraklion, Crete, Greece (1995).

[20] B. K. Saikia, P. K. Das and A. K. Borkakati, An application of Intuitionistic fuzzy soft sets in medical diagnosis, Bio Science Research Bulletin, **19(2)** (2003), 121-127.

[21] E. Sanchez, Inverse of fuzzy relations - Application to possibility distributions and medical diagnosis, Fuzzy Sets and Systems, **2(1)** (1979), 75-86.

[22] B. Seselija and A. Tepavcevic, Representation of lattices by fuzzy sets, Inform. Sci., **79**(1994), 171-180.

[23] B. Seselija and A. Tepavcevic, On a generalization of fuzzy algebras and congruences, Fuzzy Sets and Systems, **65** (1994), 85-94.

[24] B. Seselija, Lattice of partially ordered fuzzy subalgebras, Fuzzy Sets and Systems, **81**(1996), 265-269.

[25] U. M. Swamy and D. V. Raju, Fuzzy ideals and congruences of lattices, Fuzzy Sets and Systems, **95** (1998), 249-253.

[26] A. Tepavcevic and G. Trajkovski, L-fuzzy lattices: An introduction, Fuzzy Sets and Systems, **123**(2001), 209-216.

[27] W. Liu, Fuzzy invariant subgroups and fuzzy ideals, Fuzzy Sets and Systems, **8**(1982), 133 –139.

[28] B. Yuan and W. Wu, Fuzzy ideals on a distributive lattice, Fuzzy Sets and Systems, **35**(1990), 231–240.

[29] L. A. Zadeh, Fuzzy sets, Inform. and Control, **8** (1965), 338-353.