

Tribhuvan University
Institute of Science and Technology
2073
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 623)
 (Image Processing and Pattern Recognition)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.

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Group A

Attempt any two questions. (2x10=20)

1. Explain the Haar transform and derive the Haar matrix for $N = 4$ case. (3+7)

2. What do you mean by histogram and histogram equalization in image processing? Given the following gray level histogram of an image. Compute the gray levels:

| | | | | | | | | |
|------------|-----|-----|----|-----|-----|----|-----|-----|
| Gray Level | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Frequency | 300 | 300 | 40 | 400 | 500 | 60 | 600 | 800 |

After histogram equalization. (1+2+7)

3. Explain the first derivative filter with an example. Derive the filter mask for elliptical filter and write the algorithm for its implementation. (2+6+2)

Group B

Attempt all questions. (5x5=25) -

4. Discuss the various steps in the digital image processing. An image of dimension 1024×768 has 256 gray levels. Calculate number of bytes required to store the image on a computer. (6144)

5. Explain how will you use the band reject filters in image restoration.

6. What is a Neural Network? Explain Minimum Distance Classifier.

7. Explain the region growing technique for image segmentation.

8. Describe in brief that how do you implement Butterworth Low Pass Frequency domain filter for image smoothing domain?

*Mathematical model
 which functions the
 human brain.*

Tribhuvan University
Institute of Science and Technology
2074
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 623)
 (Image Processing and Pattern Recognition)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

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Group A

Attempt any two questions. (2x10=20)

1. How many images of size 1200 x 800 with 256 gray levels can be stored in a 512 MB storage space? Explain the FFT algorithm for one-dimensional case. (3+7)

2. Give the following frequency table obtained from the histogram of a 16 X 16, 8 level image.

| | | | | | | | | |
|----------------|----|----|----|----|----|----|----|----|
| M | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| N _M | 10 | 10 | 40 | 30 | 50 | 20 | 30 | 10 |

Where M = gray level and N_M = pixels having Mth gray level.

Construct Huffmann code for each gray level. Calculate the compression ratio and the relative data redundancy assuming if 3-bit code is used to code the gray level instead of Huffmann code.

(7+3)

3. Explain the laplacian filter with an example. Derive the filter mask for hyperbolic filter and write the algorithm for its implementation. (2+6+2)

Group B

Attempt all questions. (5x5=25)

4. How do you determine sequency in Hadamard transform from the natural order? Explain with example.

5. Explain how will you use the adaptive mean filters in image restoration?

6. Explain the Bit plane slicing technique for image enhancement.

7. Explain how Hough transform is useful in line detection?

8. Describe in brief that how do you implement Gaussian High Pass Frequency domain filter for image smoothing in the frequency domain.

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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 615)
 (Image Processing and Pattern Recognition)
(OLD COURSE)

Full Marks: 60
 Pass Marks: 30
 Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.*

Attempt all questions. (6x10=60)

- What is a digital image? Draw only the block diagram of a typical digital image processing system. An image of dimension 1024×768 has 256 gray levels. Calculate number of Bytes required to store the image on a computer. (1+2+3)
- Explain the intensity level slicing, the image negative and the power law transformation techniques for the purpose of image enhancement. (2+1+3)
- What is a Fourier Transform and how can you apply it in the digital image processing. Explain the different properties of the Fourier Transform. (1+1+4)
- What is zooming? A 3×3 size image has following intensity information,

| | | |
|---|---|---|
| 1 | 7 | 6 |
| 4 | 6 | 2 |
| 1 | 5 | 3 |

(6)

- Given the following frequency table obtained from the histogram of a 16×16 , 8 level image.

| | | | | | | | | |
|-------|----|---|----|----|----|----|----|----|
| M | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| N_M | 15 | 6 | 70 | 16 | 31 | 35 | 32 | 51 |

Where M=gray level and N_M =pixels having Mth gray level.

Construct Huffmann code for each gray level. (6)

- Explain how will you use the adaptive median filters in image restoration? (6)
- Explain the region growing technique for image segmentation. What are the problems associated with it. (4+2)
- Derive the equation for hyperbolic filter and write the algorithm for its implementation. (3+3)
- What are the components of a pattern recognition system? Explain with relevant diagrams. (6)
- Write short notes on:
 a) Global Thresholding Technique
 b) Butterworth High Pas Frequency domain filter (2x3)

Tribhuvan University
Institute of Science and Technology
2078



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 618)
(Principle of Programming Language)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable
The figures in the margin indicate full marks.

Group A

Attempt any two questions. (2x10=20)

1. Differentiate between scalar and composite data type. Describe briefly the approaches to specification and implementation of Character String data type.
2. Explain the concept of heap storage management with reference to variable size elements.
3. What is exception and exception handler? Also explain about system exceptions and programmer-defined exceptions.

Group B

Attempt all questions. (5x5=25)

4. Explain in brief about the attributes of a language are considered important.
5. Explain the concept of virtual machine and software simulation.
6. What do you understand by ambiguity in a grammar? Explain with an example.
7. What are the two aspects of type equivalence? Explain each in brief.
8. What are the levels of sequence control? Explain statement level sequence control.

Tribhuvan University
Institute of Science and Technology
2078



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 619)
(Advanced Cryptography)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

*Candidates are required to give their answers in their own words as far as practicable.
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Group A

Attempt any two questions. (2x10=20)

1. How stream ciphers differ from block ciphers? Discuss how RC4 works? (4+6)
2. Define session key. Write protocols for sharing of session key using Denning-Sacco and Otway-Rees approaches (2+8)
3. What is message authentication code? Describe the working mechanism of HMAC algorithm? (3+7)

Group B

Attempt all questions. (5x5=25)

4. How shift, affine ciphers with examples.
5. How encryption and decryption is done in Elliptic Curve Cryptography?
6. Discuss the role of ticket granting server in Kerberos.
7. How ELGamal Digital Signature Scheme generates signature?
8. Write short notes on (2x2.5)
a. Merkle Damgard Construction
b. Schnorr's Identification Protocol

Tribhuvan University
Institute of Science and Technology
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Master Level /II Year/ IIIrd Semester/ Science

Full Marks: 45

Computer Science and Information Technology (CSc. 621)
(Fuzzy Systems)

Pass Marks: 22.5

Time: 2 hours

Candidates are required to give their answers in their own words as far as practicable
 The figures in the margin indicate full marks.

Group A**Attempt any Two questions.** **$(2 \times 10 = 20)$**

1. Consider fuzzy sets

(10)

$$\begin{aligned} A &= \{0.6/5, 0.9/10, 0.5/15, 0.5/20, 0.6/25\} \\ B &= \{0.4/5, 0.3/10, 0.8/20, 0.8/30, 1/35\}. \end{aligned}$$

Now compute

- a. $A \cup B$
- b. $B_{0.8}^+$
- c. Compute support and boundary of A and B
- d. Determine whether A and B are convex or not
- e. Compute relation R using A and B

2. What do you mean by fuzzy equivalence relation? How can you relate fuzzy tolerance and equivalence relations? Justify with an example, when a fuzzy relation can be tolerance.

 $(2+2=6)$

3. How Mamdani inference model is different from the TSK inference? Construct fuzzy rule base system for First Order Sugeno (TSK) model. Show how inference works in the model?

 $(3+7)$ **Group B****Attempt all questions.** **$(5 \times 5 = 25)$**

4. What is uncertain knowledge? How probabilistic reasoning is done in uncertain knowledge?

 $(1+4)$

5. Define chromosome, crossover and mutation in genetic algorithms with example.

(5)

6. How adaptive fuzzy controllers differ from the standard fuzzy controllers? Discuss about the model based fuzzy controllers.

(5)

7. What is approximate reasoning? Exemplify approximate reasoning with multiple rules.

 $(2+3)$

8. Consider a fuzzy set $A, = \{0.1/5 + 0.4/7 + 0.7/8 + 0.78/9 + 0.78/10 + 0.78/12 + 1/11\}$. Now if you are asked to defuzzify the fuzzy set A using either Mean Max Membership or Max Membership Function to obtain a value which is near about, which one you will choose and why? Justify your answer with detail computation and membership graph.

(5)

Tribhuvan University
Institute of Science and Technology
2078
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 624)
(Remote Sensing and GIS)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

*Candidates are required to give their answers in their own words as far as practicable.
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Group A

Attempt any two questions. (2x10=20)

1. Define the satellite orbit. Write about their types with example.
2. MODIS has 36 bands of two (band 1-2) 250m, five (bands 3-7) 500m and rest (8-36) 1000m spatial resolution with 16-bit pixel size. Calculate the image size.
3. What is Support Vector Machine? What are hard margin and soft margin in SVM? Discuss about a linear classifier.

Group B

Attempt all questions. (5x5=25)

4. Explain about the bagging. What are out-of-bag samples?
5. What is the swath width? Write swatch width of Landsat, MODIS and Sentinel 2A and B.
6. Write about ISODATA clustering. How is it different from k-mean clustering?
7. TheIFOV for AVHRR is 1.4 mrad, its altitude is 533km. Calculate the ground resolution of AVHRR
8. Explain following terminologies (2x2.5=5)
 - Top of atmosphere reflectance
 - Surface reflectance

Tribhuvan University
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2071



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 616)
(Remote Sensing and GIS)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Attempt all questions.

1. Critically discuss the importance of Projection system in Geographic Information System (GIS).
2. Explain the integrated function of Geographic Information System (GIS).
3. What is Remote Sensing? Explain the basic process/stages of Remote Sensing.
4. Explain Remote Sensing (RS) sensors and its importance.
5. Describe advantages and disadvantage of vertical and oblique aerial photographs.
6. What are the detectors of film's exposure? Describe it briefly.

Tribhuvan University
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2073
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 621)
(Fuzzy Systems)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

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Group A

Attempt any two questions. (2x10=20)

- ✓ 1. Define a fuzzy set. Discuss the basic fuzzy set operations. Construct any two fuzzy sets over the domain $Z = \{10, 20, 30, 40, 50, 60\}$ and check whether or not the DeMorgan's Law holds true for the sets.
- ✓ 2. Define T-norm and T-conorm over fuzzy sets. Show how T-norm and T-conorm operators satisfy the commutativity, associativity and monotonicity.
3. How Mamdani and Sugeno models can be used to infer conclusion in fuzzy rule base systems?
Support your answer with proper example for any one model.

Group B

Attempt all questions. (5x5=25)

- ✓ 4. Discuss about the Model Reference Adaptive Controllers. How they handle tracking error?
- ✓ 5. How genetic algorithm can be used to solve problems? How crossover is done in genetic algorithm?
- ✓ 6. How fuzzy associative memory is constructed? How aggregation of fuzzy rules is done in fuzzy rule base system?
- ✓ 7. Define defuzzification. How defuzzification can be done using weighted average and Mean Max membership approaches?
- ✓ 8. What are fuzzy variables? Using your own intuition and your own definition of the universe of discourse plot fuzzy membership functions to the variable Height of liquid in a tank as;
 - Very full
 - Full

Mean Max

$$A = \left\{ \begin{array}{c} a \\ \max \end{array} \right\}$$

$$B = \left\{ \begin{array}{c} b \\ \max \end{array} \right\}$$

Tribhuvan University
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 621)
 (Fuzzy Systems)
(NEW COURSE)

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Group A

Attempt any two questions. (2x10=20)

1. Define a fuzzy set. Discuss the basic fuzzy set operations. Construct any two fuzzy sets over the domain $Z = \{10, 20, 30, 40, 50, 60\}$ and check whether or not the DeMorgan's Law holds true for the sets.
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 Support your answer with proper example for any one model.

Group B

Attempt all questions. (5x5=25)

4. Discuss about the Model Reference Adaptive Controllers. How they handle tracking error?
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7. Define defuzzification. How defuzzification can be done using weighted average and Mean Max membership approaches?
8. What are fuzzy variables? Using your own intuition and your own definition of the universe of discourse plot fuzzy membership functions to the variable Height of liquid in a tank as;
 - a. Very full
 - b. Full

Tribhuvan University
Institute of Science and Technology
 2075
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 621)
 (Fuzzy Systems)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

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Group A

Attempt any two questions. (2x10=20)

1. Consider fuzzy sets $A=\{0.4/10, 0.2/15, 0.3/20, 0.5/25, 1/30\}$ and $B=\{1/5, 0.9/10, 0.4/15, 0.6/20, 0.9/25\}$. Now compute Union and Intersection of A and B. Also compute complement of A and alpha cut of A with $\alpha=0.5$. Illustrate whether Excluded Middle Law holds true for B or not.
2. What do you mean by fuzzy relation? Construct a fuzzy relation using any two fuzzy sets. Also compute the X-projection, Y-projection and respective cylindrical extensions for the relation.
3. How TSK model can be used in fuzzy inference? Configure a fuzzy rule base system and show the TSK inference procedure with appropriate computations.

Group B

Attempt all questions. (5x5=25)

4. What is defuzzification? How weighted average method works? Illustrate with example.
5. What are fuzzy neural networks? What operators are used in fuzzy neural networks?
6. Discuss about PID controllers.
7. What is approximate reasoning? How composition operator can be used in approximate reasoning?
8. What is uncertain knowledge? How probabilistic reasoning is used in uncertain knowledge?

Tribhuvan University
Institute of Science and Technology
 2075
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 621)
 (Fuzzy Systems)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

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Group A

Attempt any two questions. **(2x10=20)**

1. How fuzzy set differs from traditional set? Define boundary, core, support, prototype and alpha cut of a fuzzy set. Support your answer with suitable examples for each.
2. Define one to many and many to one fuzzy mapping with examples. When a fuzzy relation is said to be equivalence. Construct a fuzzy relation which is equivalence.
3. How Mamdani inference model is used in fuzzy inferencing systems? Construct a fuzzy rule based system and illustrate the Mamdani inference procedure.

Group B

Attempt all questions. **(5x5=25)**

1. What is fuzzification? How fuzzy sets can be constructed using triangular membership function?
2. Define the fuzzy neuro system. How fuzzy neural networks are designed?
3. What is fuzzy controller? Describe how model based controllers work.
4. Discuss about T-norm and T-conorm operators.
5. What is uncertain knowledge? How probabilistic reasoning is used in uncertain knowledge?

Tribhuvan University
Institute of Science and Technology

2076



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 621)
(Fuzzy Systems)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.

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Group A

Attempt any two questions. (2x10=20)

1. How fuzzy set is different from traditional set? Illustrate with an example that the Excluded Middle Axiom holds true for traditional set but not for fuzzy set.

2. Given the fuzzy sets defining the soil as;

$$\text{Dry} = \{0/10, 0.5/20, 0.65/40, 0.85/60, 1/80, 1/100\}$$

$$\text{Wet} = \{0.5/10, 0.15/20, 0.55/40, 0.6/50, 0.95/90, 1/100\}$$

Now construct a fuzzy relation from the above sets. Compute the X and Y projection of the relation. Also compute the alpha-cut of the relation for $\alpha=0.6$.

3. What is fuzzy inference? How fuzzy inference is done in TSK model? Support your answer with an example.

Group B

Attempt all questions. (5x5=25)

4. Discuss about the Model Reference Adaptive Controllers. How they handle tracking error?

5. Describe the fuzzy rule base system with its components.

6. How genetic algorithm can be used to solve problems? Explain with algorithm.

7. How can you generate fuzzy sets using trapezoidal function? Illustrate with example.

8. How composition operator can be used in approximate reasoning. Illustrate with example.

Tribhuvan University
Institute of Science and Technology
2071


Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 611)
(Principle of Programming Language)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.

Attempt all questions.

1. Explain any six attributes of a good programming language that you consider to be most important.
2. What is binding? What type of binding occurs at language definition and language implementation?
3. Clarify the significance of grammar in programming language development? Explain EBNF and syntax chart with examples.
4. Which are the three components needed to specify a data type? Explain them briefly with examples.
5. Explain briefly the specification and implementation of integer data type.
6. What is heap storage management? How can we do storage recovery using garbage collection in a heap with fixed sized elements?
7. What is the basic mechanism of sequence control in expression? Explain.
8. Define referencing environment and differentiate local and non local referencing environment.
9. Describe briefly about deadlock and starvation.
10. What is scheduled subprogram? Explain about different technique of subprogram scheduling.

Tribhuvan University
Institute of Science and Technology
2072


Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 611)
(Principle of Programming Language)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Attempt all questions.

1. Discuss the importance of language standardization. Explain briefly about different issues needed to be addressed to use the standards effectively.
2. What is the idea behind software simulation? Discuss its advantages and disadvantages.
3. What is attribute grammar? Explain synthesized and inherited attributes.
4. What is type checking? Explain the concept of coercion and explicit type conversion.
5. Explain briefly the specification and implementation of Boolean data type.
6. Explain three different phases in storage management.
7. What is sequence control? Explain the methods of explicit sequence control.
8. Describe simple subprogram call return with diagram.
9. Describe briefly mutual exclusion problem.
10. Describe exception and exception handler with an example.

Tribhuvan University
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 2073


Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 618)
 (Principle of Programming Language)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

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 The questions are of equal value.

Group A

Attempt any two questions. **(10x2=20)**

1. Explain in detail and compare the concepts “subprogram definition” and “subprogram activation record”.
2. Define data object and data type? Explain specification and implementation of integer data object.
3. What is heap storage management? Explain in detail about garbage collection method of storage recovery.

Group B

Attempt all questions. **(5x5=25)**

4. List and explain the important attributes of good programming language.
5. What is binding? Discuss about different binding times? Explain the importance of binding time?
6. Differentiate formal and actual parameters. Describe each method of parameter transmission.
7. What do you understand by synthesized and inherited attributes? Explain with example.
8. Explain exception handler and scheduled subprograms.

Tribhuvan University
Institute of Science and Technology
2073
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 611)
(Principle of Programming Language)
(OLD COURSE)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Attempt all questions.

1. Why is it necessary to study principle of programming language? Explain any six points in brief.
2. Differentiate between hardware computer and firmware computer. What are the advantages of firmware computers?
3. List and explain briefly the key criteria in syntax design.
4. What are “assignment and initialization”? Explain their purpose.
5. Explain briefly the specification and implementation of character data type
6. Explain the concept of encapsulation and how can it be achieved using subprograms.
7. List and explain three types of sequential control statements.
8. Describe any three parameter transmission methods.
9. What is task? Discuss different task synchronization methods with example.
10. What are co routines? How can they be implemented? Explain.

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2074



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(NEW COURSE)

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Group A

Attempt any two questions. (10x2=20)

1. What do you understand by structured data object? What are the major attributes of specifying data structure? Specify "List" data structure with its major attributes.
2. Differentiate between hardware and firmware computer. Explain in detail about translators.
3. What do you understand by storage management? What are the different elements that require storage during program execution?

Group B

Attempt all questions. (5x5=25)

4. To study "principle of programming language" is necessary, give reasons.
5. What is syntax? Explain the different syntactic criteria for making programming language efficient.
6. What is type checking? Discuss the advantages and disadvantages of static and dynamic type checking.
7. What do you understand by lambda calculus? Explain the operations that can be applied on lambda expression.
8. Describe the implementation of simple call return subprogram.

Tribhuvan University
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2075
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 618)
(Principle of Programming Language)
(NEW COURSE)

Full Marks: 45
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The questions are of equal value.

Group A

Attempt any two questions. **(10x2=20)**

1. Define Structured Data Type? Describe briefly the approaches to specification and implementation of Record data type.
2. Discuss about the pros and cons of programmer-controlled storage management. Explain the three phases of storage management.
3. Describe all the statement-level control structures with example of each.

Group B

Attempt all questions. **(5x5=25)**

4. Discuss any five attributes of a good language that you consider to be most important.
5. Explain the concept of virtual machine.
6. List out the advantages and disadvantages of static and dynamic type checking.
7. What is local and non-local referencing environment? List and define types of non-local referencing environments.
8. Explain in brief about co-routine and scheduled subprograms.

Tribhuvan University
Institute of Science and Technology

2076



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 618)
(Principle of Programming Language)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

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Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.

Group A

Attempt any two questions. **(10x2=20)**

1. Define syntax. What are the different syntactic elements for any programming language? Explain them in brief.
2. Define the terms "association" and "referencing environment". What is local and non-local referencing environment? List and define types of non-local referencing environments.
3. What is a data structure? What types of operations are considered when specifying a structured data type?

Group B

Attempt all questions. **(5x5=25)**

4. What is standardization of a programming language? Explain the terms obsolescence and conformance.
5. Explain the term binding time? Discuss about different types of binding time.
6. Explain briefly about the heap storage management technique for fixed sized elements.
7. What are formal and actual parameters? Describe different methods of parameter transmission.
8. Explain about exception and exception handlers.

Tribhuvan University
Institute of Science and Technology
2071
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 612)
(Advanced Cryptography)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Attempt all questions.

1. Explain the difference between mono-alphabetic and poly-alphabetic cryptosystems with suitable instances.
2. Define cryptanalysis. Create the suitable example for the cryptanalysis of the Affine Cipher.
3. What is the difference between a block cipher and a stream cipher? Explain the purpose of S-boxes in DES.
4. Design the general structure of Advanced Encryption Standard (AES) and provide the algorithm for AES key expansion.
5. What is the concept of discrete logarithm? Explain discrete logarithm problem.
6. What is an elliptic curve? Explain the zero point of an elliptic curve with suitable example.
7. Define cryptographic hash function. What should be the securities associated with hash function? Explain.
8. Explain the difference between un-keyed and keyed hash function. Describe Secure Hash Algorithm (SHA) that produce 160 bit message digest.
9. Write short notes on key predistribution, session key distribution, and key agreement. Explain Diffie-Hellman key predistribution.
10. Short answers (any two):
 - i. Kerchoffs' principle
 - ii. Threshold scheme
 - iii. Preimage, Second preimage, and Collision resistant.

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2072



Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 612)
(Advanced Cryptography)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Attempt all questions.

1. Define Cryptosystem. Justify that the Affine Cipher is a special case of the Substitution Cipher.
2. Explain the importance of the probabilities of occurrences of the letters, diagrams and trigrams with suitable example.
3. Define perfect secrecy. Show that Shift Cipher has perfect secrecy.
4. Explain the process of constructing S-box for Advanced Encryption Standard.
5. Design the general depiction of Data Encryption Standard (DES) algorithm. Explain the Avalanche effect.
6. Briefly explain the working principle of RSA with suitable example.
7. What is an elliptic curve? Explain the zero point of an elliptic curve with suitable example.
8. Define message authentication code. Explain nested MAC using two keyed hash families.
9. Write short notes on key predistribution, session key distribution, and key agreement. Explain Kerberos.
10. Short answers (any two):
 - i. Index of coincidence
 - ii. Secret sharing scheme
 - iii. SHA-512 bits padding and appending length

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2073
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Master Level /II Year/ IInd Semester/ Science
Computer Science and Information Technology (CSc. 619)
(Advanced Cryptography)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.
The questions are of equal value.*

Group A

Attempt any two questions. (10x2=20)

1. Design the single round of the Data Encryption Algorithm (DES). Explain the process of key generation for DES in more detail.
2. What is the difference between weak and strong collision resistance? Explain message digest generation using SHA-512.
3. Explain session key distribution scheme. Write the algorithm for the Needham-Schroeder (NS) scheme. Describe Denning-Sacco attack on NS Scheme.

Group B

Attempt all questions. (5x5=25)

4. What is the concept of product cryptosystem invented by Shannon? Explain four different stages used in a single round of the Advanced Encryption Standard.
5. What is the concept of discrete logarithm? Explain discrete logarithm problem.
6. Explain the detailed structure of Elgamal cryptographic system with suitable example.
7. What is iterated hash functions? Explain Merkle-Demgard construction.
8. Write short notes on:
 - i. Random oracle model
 - ii. Visual secret sharing scheme



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 2074


Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 619)
 (Advanced Cryptography)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.
 The questions are of equal value.

Group A

Attempt any two questions. **(10x2=20)**

1. What characteristics are required in a secure hash function? Explain the SHA-512 processing of a single 1024-bit block.
2. Explain IDEA (International Data Encryption Algorithm) with suitable diagram.
3. Write the algorithm for Blom key distribution scheme. Explain the Blom key distribution scheme with suitable example.

Group B

Attempt all questions. **(5x5=25)**

4. Explain the importance of the probabilities of occurrences of the letters, diagrams and trigrams with suitable example.
5. What is an elliptic curve? Explain the zero point of an elliptic curve with suitable example.
6. Explain the process of constructing S-box for Advanced Encryption Standard.
7. Define secret sharing scheme. Write the algorithm for Shamir (t, w) threshold scheme.
8. Write short notes on:
 - i. Digital signature
 - ii. Kerberos system

Tribhuvan University
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 2075
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 619)
 (Advanced Cryptography)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.
 The questions are of equal value.

Group A

Attempt any two questions. (10x2=20)

1. Explain the benefits of International data encryption algorithm (IDEA) over data encryption standard (DES). Draw the diagram for IDEA and describe its key generation process.
2. What is random oracle model? Illustrate compression function and iterated hash function with suitable processing steps.
3. What is the basic idea of digital signature? Explain digital signature standard (DSS) approach.

Group B

Attempt all questions. (5x5=25)

4. Differentiate the terms cryptography, cryptanalysis, and cryptology. Explain cryptanalysis of the affine cipher with suitable example.
5. Discuss how stream ciphers are different from block ciphers. Explain synchronous stream ciphers with diagrams.
6. What is the application of secret sharing scheme? Write algorithm for Shamir (t, w)-threshold scheme.
7. Explain Kerberos protocol for session key distribution.
8. Write short notes on:
 - i. Message authentication code (MAC)
 - ii. Digital Certificate

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2076
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 619)
(Advanced Cryptography)
(NEW COURSE)

Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.

Group A

Attempt any two questions.

(2x10=20)

1. Describe about Synchronous Stream Ciphers. Illustrate the working mechanism of LFSR and NLFSR. (2+8)
2. How session key is different from interchange key? Write the protocols for key exchange using Needham-Schroeder and Denning-Sacco. (10)
3. How hash functions are used for message authentication? Discuss how SHA-3 algorithm works. (3+7)

Group B

Attempt all questions.

(5x5=25)

4. Discuss about the threshold schemes with Liars.
5. What is shift cipher? How cryptanalysis of shift cipher is done.
6. How encryption and decryption is performed in Blowfish algorithm?
7. How addition of points is done in Elliptic Curve? Illustrate with example.
8. Write short notes on
a) Random Oracle Model
b) Visual Secret Sharing Scheme

(2.5+2.5=5)

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 2075
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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 623)
 (Image Processing and Pattern Recognition)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.
 The figures in the margin indicate full marks.

Group A

Attempt any two questions. (2x10=20)

1. Sketch the following periodic waveform in the time domain and calculate its Fourier transformation. [10]

2.

$$f(t) = \begin{cases} 3 & ; -2 \leq t \leq 2 \\ 0 & ; \text{otherwise} \end{cases}$$

3. Define image degradation and restoration. Explain the noise models with its effecting nature in degrading the image. [4 + 6]

4. Equalize the histogram of the 8×8 image given below. The image has gray levels 0, 1, 2, ..., 7. [10]

4, 4, 4, 4, 4, 4, 4, 0
 4, 5, 5, 5, 5, 5, 4, 0
 4, 5, 6, 6, 6, 5, 4, 0
 4, 5, 6, 7, 6, 5, 4, 0
 4, 5, 6, 6, 6, 5, 4, 0
 4, 5, 5, 5, 5, 5, 4, 0
 4, 4, 4, 4, 4, 4, 4, 0
 4, 4, 4, 4, 4, 4, 4, 0

Group B

Attempt all questions. (5x5=25)

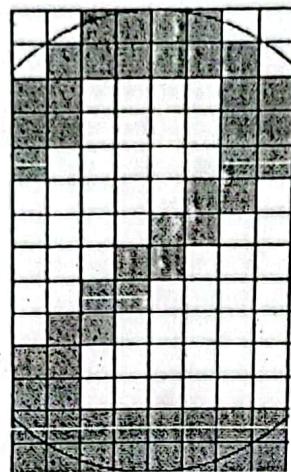
5. Define image segmentation. Explain the significance of image subtraction and image averaging. [1 + 4]

6. Describe the relationship between the pixels with one - another. [5]

7. Distinguish between pattern and pattern class. Explain the strategy for pattern recognition. [2 + 3]

8. Define chain code. Find the 8 – directional chain code for following image in clockwise direction. Assume the starting position is third pixel from the top starting position.

[1 + 4]



9. Write short notes on (Any TWO)

[2.5+2.5]

- a. Hough Transform
- b. Bandpass Filter
- c. Smoothing vs Sharpening

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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 623)
 (Image Processing and Pattern Recognition)
(NEW COURSE)

Full Marks: 45
 Pass Marks: 22.5
 Time: 2 hours.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks..

Group A

Attempt any two questions. (2x10=20)

1. a) What do you understand by image processing? Draw the block diagram of image processing system and explain.
 b) Write expression for discrete Fourier Transform for 1D and 2D signal.
 c) Explain importance of image enhancement in the Fourier Domain.
2. What is noise in the context of image? Classify different types of noise models with examples. Explain four kinds of filtering mechanism to overcome the noise.
3. Calculate the entropy and the Huffman code for the given image data in the table.

| | | | | | | | |
|----|----|----|---|---|---|---|---|
| 9 | 8 | 7 | 7 | 7 | 5 | 5 | 5 |
| 7 | 7 | 7 | 7 | 4 | 4 | 5 | 5 |
| 6 | 6 | 6 | 9 | 9 | 9 | 6 | 6 |
| 6 | 6 | 7 | 7 | 7 | 9 | 9 | 9 |
| 3 | 7 | 7 | 8 | 8 | 8 | 3 | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 10 | 10 | 11 | 7 | 7 | 7 | 6 | 6 |
| 4 | 4 | 5 | 5 | 5 | 2 | 2 | 6 |

Group B

Attempt all questions. (5x5=25)

4. What do you understand by image restoration? Explain how it is different from image enhancement.
5. Considering an image, explain neighborhood, adjacency and path between pixels with examples.

6. Explain how a point and edges can be detected in an image?
7. Explain the following operations:
 - i) Contrast stretching
 - ii) Bit plane slicing
8. Explain sensitivity and specificity that is derived from confusion matrix and describe its use for pattern classification.

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**Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 613)
(Fuzzy Systems)**

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all questions.

1. How probabilistic reasoning differ from fuzzy reasoning? Is fuzzy reasoning a substitute of probabilistic reasoning? Justify your answer with example. (6)
2. What is the use of fuzzy composition operation. Prove or disprove $R \circ S = S \circ R$ for Max-Min composition. (8)
3. We want to compare two sensors based upon their detection levels and gain settings. For a universe of discourse of gain settings, $X = \{0, 20, 40, 60, 80, 100\}$, the sensor detection levels for the monitoring of a standard item provides typical membership functions to represent the detection levels for each of the sensors; these are given below in standard discrete form

$$S_1 = \{0/0, 0.5/20, 0.65/40, 0.85/60, 1/80, 1/100\}$$

$$S_2 = \{0/0, 0.45/20, 0.6/40, 0.8/60, 0.95/80, 1/100\}$$

Find the following membership functions using standard fuzzy operations: (8)

- a. Generate fuzzy set of $S_1 \cap S_2$
 - b. Create Relation R from S_1 and S_2 and compute $R_{0.4}$
 - c. Support of S_1 and S_2
 - d. Determine whether S_1 and S_2 are convex or not
4. Using your own intuition and your own definition of the universe of discourse plot fuzzy membership using Trapezoidal function for the following fuzzy variables on Level of liquid in a tank using;
 - a. Very full
 - b. Full
 - c. Medium
 5. Consider a fuzzy rule base system for the study of animation, where quality of the animation is determined by presence of contrast, brightness and morphing. Consider the fuzzy sets defining these parameters are defined by the continuous fuzzy sets;

$$\text{Highly Contrast} = \{0/2, 0.3/5, 0.5/8, 1/11, 0.6/14, 0.3/17, 0/20\}$$

$$\text{Low Contrast} = \{0/1, 0.2/2, 0.4/6, 0.8/8, 0.5/10, 0.1/10, 0/11\}$$

$$\text{Highly Bright} = \{0/5, 0.3/10, 0.7/15, 1/20, 0.8/25, 0.3/40, 0/45\}$$

$$\text{Mild Bright} = \{0/3, 0.2/5, 0.4/10, 0.7/20, 0.5/25, 0.1/30, 0/35\}$$

$$\text{Heavy Morphing} = \{0/34, 0.3/40, 0.5/45, 1/50, 0.6/55, 0.3/60, 0/65\}$$

$$\text{Moderate Morphing} = \{0/6, 0.4/10, 0.6/15, 0.8/20, 0.5/25, 0.3/30, 0/39\}$$

The fuzzy rule base system for predicting level of morphing consists of following rules;

Rule 1: If x is in Highly Contrast or Highly Bright then y is in Heavy Morphing

Rule 2: If x is in Low Contrast and Mild Bright then y is in Moderate Morphing

Now, represent all of the given fuzzy sets with their membership graphs. Using Mamdani Model with Weighted Average Method of defuzzification, determine the result of Morphing using Contrast level 8 and Brightness 20. (8)

6. Consider a Tagaki Sugeno Fuzzy Controller defined by the rules

Rule 1: If error is Positive and change_in_error is Positive then output is

$$\frac{0.1 \times \text{error} + \text{change_in_error}}{\text{error}}$$

Rule 2: If error is Negative or change_in_error is Positive then output is

$$\frac{\text{error} - \text{change_in_error}}{0.6}$$

Find the output if error is 0.06 and change in error is 0.3. Use any of the membership functions to define the fuzzy linguistic variables Positive from [0.1, 1], Negative from [-0.6, 0.6] and Zero from [-1, 1] intervals. (6)

7. State extension principle. Consider a single input single output (SISO) system where a fuzzy number x defined by the set $A_9x = \{0/-2, 0.5/-1, 1/0, 0.6/1, 0.3/2, 0/3\}$. Suppose we have a fuzzy arithmetic operation $y = x^2$. Now construct the fuzzy set for y i.e. $B(y)$ with its elements and membership values using extension principle. (6)

8. How adaptive fuzzy controllers differ from the standard fuzzy controllers? Discuss about the model based fuzzy controllers. (6)

9. Define chromosome, crossover and mutation in genetic algorithms with example. (6)

6. Write about latitude and longitude systems. Convert the $45^{\circ}52'30''$ N (degree, minutes and second) to decimal degree.
7. What is spatial resolution? Explain about the possible application of images having different spatial resolution images.
8. Explain following terminologies. (2.5+2.5=5)
 - (a) Digital number (DN)
 - (b) Surface reflectance

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**Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 624)
(Remote Sensing and GIS)
{NEW COURSE}**

**Full Marks: 45
Pass Marks: 22.5
Time: 2 hours.**

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.*

Group A

Attempt any two questions. (2x10=20)

1. Landsat 8 OLI has 10 multi-spectral bands of 30m spatial resolutions having 6000 lines and 6600 samples and one panchromatic band of 15 m spatial resolution with 16-bit pixel size. Calculate the size of image.
2. Explain image encoding and its types with example.
3. Write about k-means algorithm. Implement the K-means clustering for the following dataset with $k = 2$.

| Sl. | Variable 1 | Variable 2 |
|-----|------------|------------|
| 1 | 1.0 | 1.0 |
| 2 | 1.5 | 2.0 |
| 3 | 3.0 | 4.0 |
| 4 | 5.0 | 7.0 |
| 5 | 3.5 | 5.0 |
| 6 | 4.5 | 5.0 |
| 7 | 3.5 | 4.5 |

Group B

Attempt all questions. (5x5=25)

4. Explain about low pass kernel with example.
5. Differentiate between supervised and unsupervised classification.

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Master Level /II Year/ IIIrd Semester/ Science
Computer Science and Information Technology (CSc. 613)
(Fuzzy Systems)

Full Marks: 60
Pass Marks: 30
Time: 3 hours.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all questions.

1. Why fuzzy logic is often known as multivalued logic? How it differs from other logic? How reasoning in fuzzy logic differs from reasoning in uncertain probabilistic reasoning? (6)

2. Explain, about the composition methods adopted in fuzzy relation with suitable examples. Create fuzzy relations R and S. Illustrate, using any of the fuzzy composition method, whether $R \circ S = S \circ R$ holds true or not. (8)

3. For a universe of discourse, $X = \{0, 120, 140, 160, 180, 200\}$, the fuzzy sets are defined as;

$$A = \{0/0, 0.3/120, 0.65/140, 0.85/160, 1/180, 1/200\}$$

$$B = \{0/0, 0.5/120, 0.16/140, 0.33/160, 0.5/180, 1/200\}$$

Find the following membership functions using standard fuzzy operations: (8)

- a. Generate fuzzy set of $A \cap B$
- b. Core A and B
- c. Create relation R from A and B and compute $R_{0.5}$
- d. Test whether A and B are sub-normal or not

4. Using your own intuition and your own definition of the universe of discourse plot fuzzy membership using R-function for the following fuzzy variables on Height of person in class; (6)

- a. Very Tall
- b. Tall
- c. Medium

5. Consider a fuzzy rule base system for the study of hydrology where rainfall (in millimeter), humidity (in percentage), and temperature (in centigrade) are defined by continuous fuzzy sets as:

$$\text{Heavy Rainfall} = \{0/2, 0.3/5, 0.5/8, 1/11, 0.6/14, 0.3/17, 0/20\}$$

$$\text{Light Rainfall} = \{0/1, 0.2/2, 0.4/6, 0.8/8, 0.5/10, 0.1/10, 0/11\}$$

$$\text{High Humidity} = \{0/5, 0.3/10, 0.7/15, 1/20, 0.8/25, 0.3/40, 0/45\}$$

$$\text{Low humidity} = \{0/3, 0.2/5, 0.4/10, 0.7/20, 0.5/25, 0.1/30, 0/35\}$$

$$\text{High Temperature} = \{0/34, 0.3/40, 0.5/45, 1/50, 0.6/55, 0.3/60, 0/65\}$$

$$\text{Mild Temperature} = \{0/6, 0.4/10, 0.6/15, 0.8/20, 0.5/25, 0.3/30, 0/39\}$$

The fuzzy rule base system for predicting temperature consists of following rules;

Rule 1: If x is in Heavy Rainfall or High Humidity then y is in High Temperature

Rule 2: If x is in Light Rainfall and Low Humidity then y is in Mild Temperature

Now, represent all of the given fuzzy sets with their membership graphs. Using Mamdani Model with Weighted Average Method of defuzzification, determine the temperature using Rainfall is 8 millimeter and humidity is 20 percent. (8)

6. Consider a fuzzy spectrometer which generates different kinds of waves. Since the fuzzy spectrometer may not generate the accurate output as the SetPoint (SP), we may require a fuzzy controller. Consider the controller is Tagaki Sugeno Fuzzy controller defined by the rules.

Rule 1: If error is Negative or change_in_error is Positive then output is

$$\text{error} - \frac{\text{change_in_error}}{\text{error}}$$

Rule 2: If error is Positive and change_in_error Zero then output is

$$\text{error} + 0.3 \times \text{change_in_error}$$

Now define the linguistic variables Positive, Negative and Zero in the interval [0.1, 1], [-0.6, 0.6] and [-1, 1] respectively using triangular membership function and find the output of the controller if error is 0.06 and change in error is 0.3. (6)

7. State extension principle. Consider a multiple input single output (MISO) system where a fuzzy number x and y are defined by the set $A(x) = \{0/2, 0.3/3, 0.6/4, 1/5, 0.5/6\}$ and $B(y) = \{0/5, 0.5/6, 1/7, 0.6/8, 0.3/9\}$. Suppose we have a fuzzy arithmetic operation $z = x + y$. Now construct the fuzzy set for z i.e. $B(z)$ with its elements and membership values using extension principle (Max (Min)). (6)

8. Describe about the superposition and homogeneous property of linear controllers. How nonlinear fuzzy adaptive controllers work? (6)

9. Define chromosome, crossover and mutation in genetic algorithms with example. (6)