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## **FACULTY OF ENGINEERING AND TECHNOLOGY**

Soft Computing

LECTURE -39

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# OUTLINE

- **Fuzzy Control**
- **Architecture of Fuzzy Control**
- **Mat lab**
- **Components of an Information Retrieval System**
- **Clustering of Document and Terms**
- **Steps of TSP using GA**
- **Multiple Choice Question**
- **References**

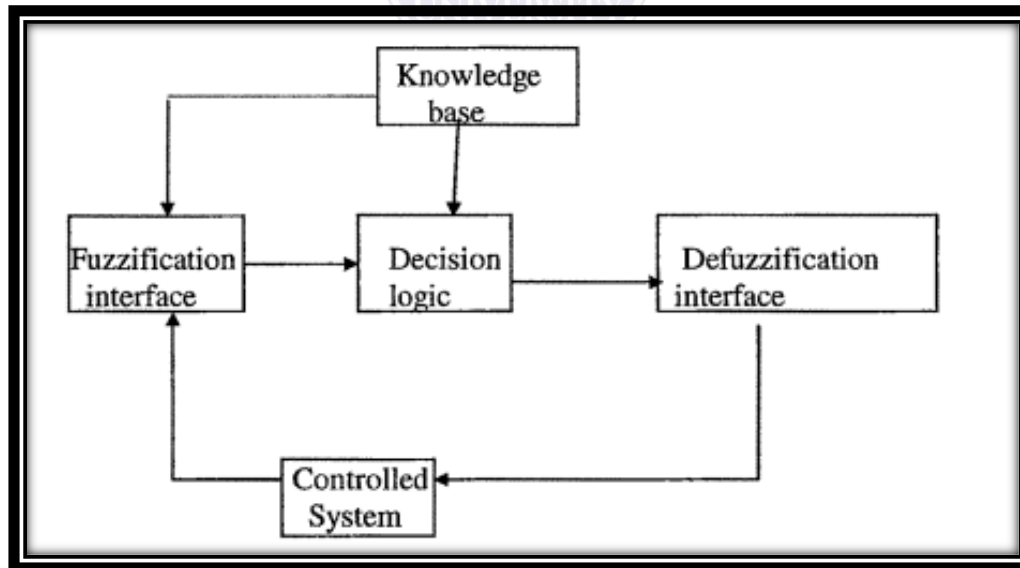


# FUZZY CONTROL

## Fuzzy Control

A control system is an arrangement of physical components designed to alter another physical system so that this system exhibits certain desired characteristics. Following are some reasons of using Fuzzy Logic in Control Systems –

- ❑ While applying traditional control, one needs to know about the model and the objective function formulated in precise terms. This makes it very difficult to apply in many cases.
- ❑ By applying fuzzy logic for control we can utilize the human expertise and experience for designing a controller.
- ❑ The fuzzy control rules, basically the IF-THEN rules, can be best utilized in designing a controller.



# GENETIC ALGORITHM BASED INTERNET SEARCH TECHNIQUES

## Important process in web information retrieval framework

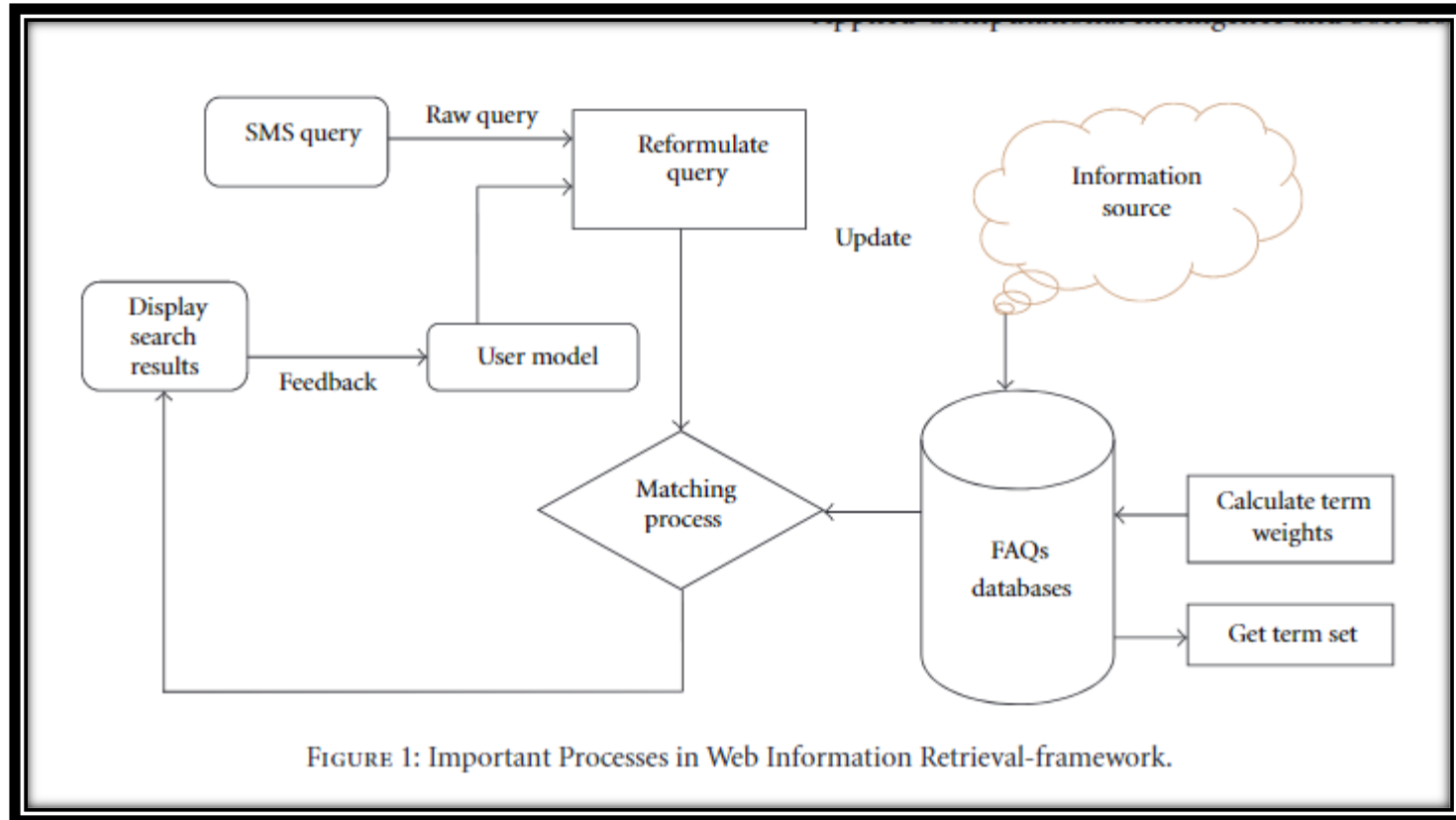
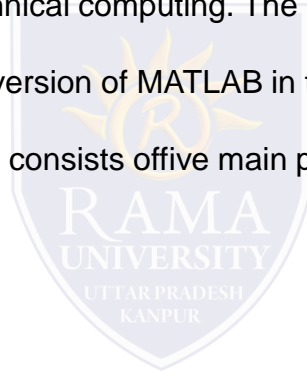


FIGURE 1: Important Processes in Web Information Retrieval-framework.

## Introduction to MATLAB Environment for Soft computing Techniques

The developments tools such as MATLAB, SIMULINK, and tools boxes are described in the section. Their use is illustrated by applications.

MATLAB [5] is a high-performance language for technical computing. The name MATLAB stands for matrix laboratory. A numerical analyst called Cleve Moler wrote the first version of MATLAB in the 1970s. It has since evolved into a successful commercial software package. The MATLAB system consists offive main parts:



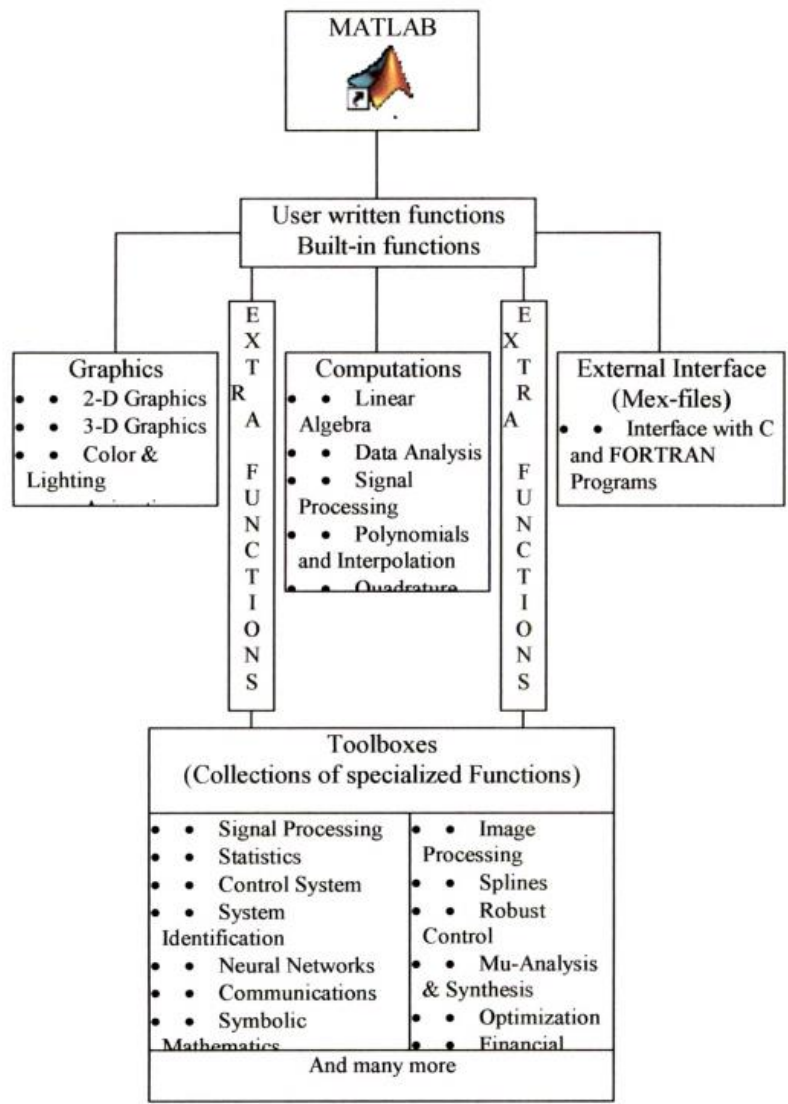
# INTRODUCTION TO MATLAB ENVIRONMENT FOR SOFT COMPUTING TECHNIQUES

## MATLAB

### The MATLAB Mathematical Function Library: -

This is a vast collection of computational algorithms ranging from elementary functions, like sum, sine, cosine, and complex arithmetic.

**The MATLAB Language:** - This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features.



## MATLAB

### The MATLAB Application Program Interface (API): -

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It includes facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

Toolboxes available in MATLAB 7.0 and used in the thesis are listed in table



Control System Toolbox	Model Predictive Control Toolbox
Optimization Toolbox	Robust Control
Neural Network	Fuzzy Logic

**TABLE 3.2: TOOL BOXES used from MATLAB 7**

## MATLAB Function

There are various function some of them are listed in table.

<b>Functions</b>	<b>description</b>
Addmf	Add a membership function to an FIS
Addrule	Add a rule to an FIS
Addvar	Add a variable to an FIS
Evalfis	Perform fuzzy inference calculations
Newfis	Create new FIS
Trimf	Triangular membership function



## Neural Network Toolbox

There are various neural network toolbox listed below in table.

<b>Functions</b>	<b>description</b>
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Newfis	Create new FIS
Trimf	Triangular membership function

## Neural Network Toolbox

There are various neural network toolbox listed below in table.

The MATLAB neural network toolbox provides a complete set of functions and a graphical user interface for the design, implementation, visualization, and simulation of neural networks. It supports the most commonly used supervised and unsupervised network architectures and a comprehensive set of training and learning functions. The neural network toolbox extends the MATLAB computing environment to provide tools for the design, implementation, visualization, and simulation of neural network. Table 3.5 lists MATLAB functions used for training and learning of the ANN controller.

Functions	description
newff :	Create a Feed forward back propagation network.
purelin	Linear transfer function
tansig	hyperbolic tangent sigmoid transfer function.
Traingd	Gradient descent back propagation.
sim	Simulation of simulink model
gensim	Gnerate simulink block simulate a neural network.
Train	trains a network NET according to NET.trainFcn and NET.trainParam.

## Fuzzy Logic Algorithm

### Initialization:

- Define Linguistic variables and terms
- Construct Membership Functions
- Construct Rule Base

### Fuzzification:

Convert crisp input data to fuzzy values using the membership functions

### Inference:

Evaluate the rules in the rule base and combine the results in rule base

### Defuzzification:

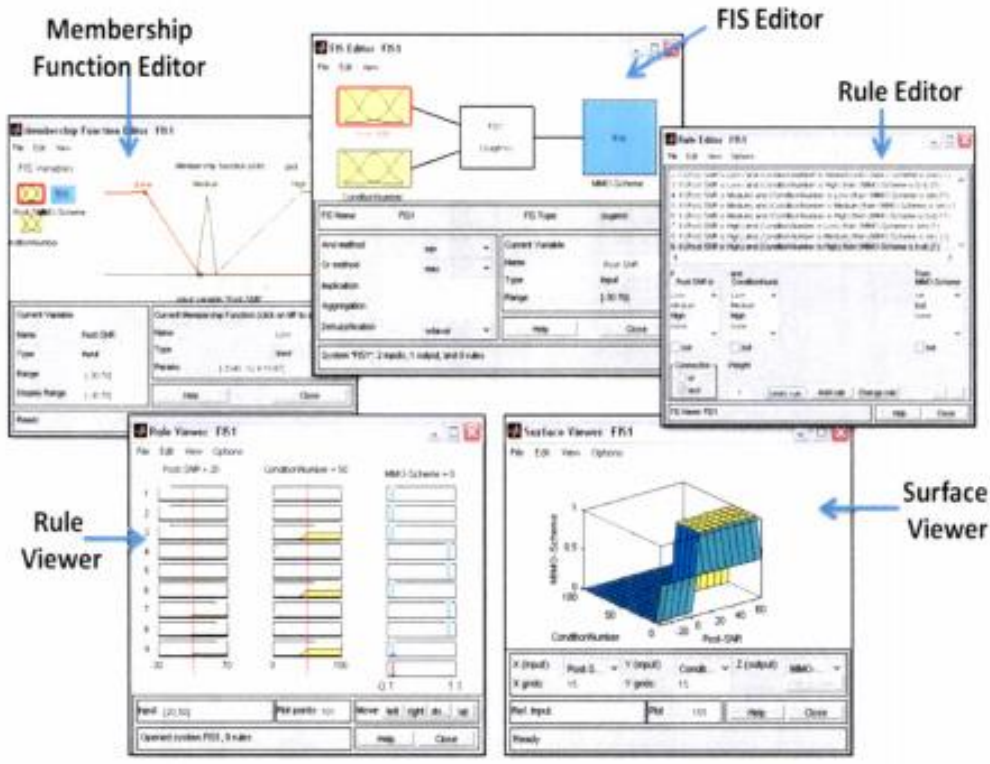
Convert output data to non-fuzzy values



# INTRODUCTION TO MATLAB ENVIRONMENT FOR SOFT COMPUTING TECHNIQUES

## MATLAB Simulation-Fuzzy Logic Toolbox

MATLAB Simulation-Fuzzy Logic Toolbox The Fuzzy Logic Systems can be designed and simulated using MATLAB Fuzzy Logic Toolbox. The Fuzzy Logic Toolbox, provides functions and GUI based editors for building Fuzzy Inference System (FIS).



Fuzzy Inference System Editors and Viewers

## List of FIS Editor Blocks and description

<b>FIS Editor Blocks</b>	<b>Description</b>
FIS Editor	Display general Information about FIS
Membership Function Editor	Display and edit the MFs associated with the input and output variables of FIS
Rule Base Editor	View and edit fuzzy rules
Rule Viewer	View detailed behavior of a FIS to help es diagnose the behavior of specific rul
Surface Viewer	Generates a 3-D surface from two input variables and the output of FIS

## List of MATLAB Functions for Designing FIS

<b>MATLAB Function</b>	<b>Description</b>
newfis	Create new Fuzzy Inference System
readfis	Load FIS from File
evalfis	Perform Fuzzy Inference Calculations
addvar	Add variable to FIS
addmf	Add MF's to FIS
addrule	Add rule to FIS
defuzz	Defuzzify Membership Functions

## Designing Neural Network

1. Collection of data
2. Designing the network
3. Training the network
4. Testing the network



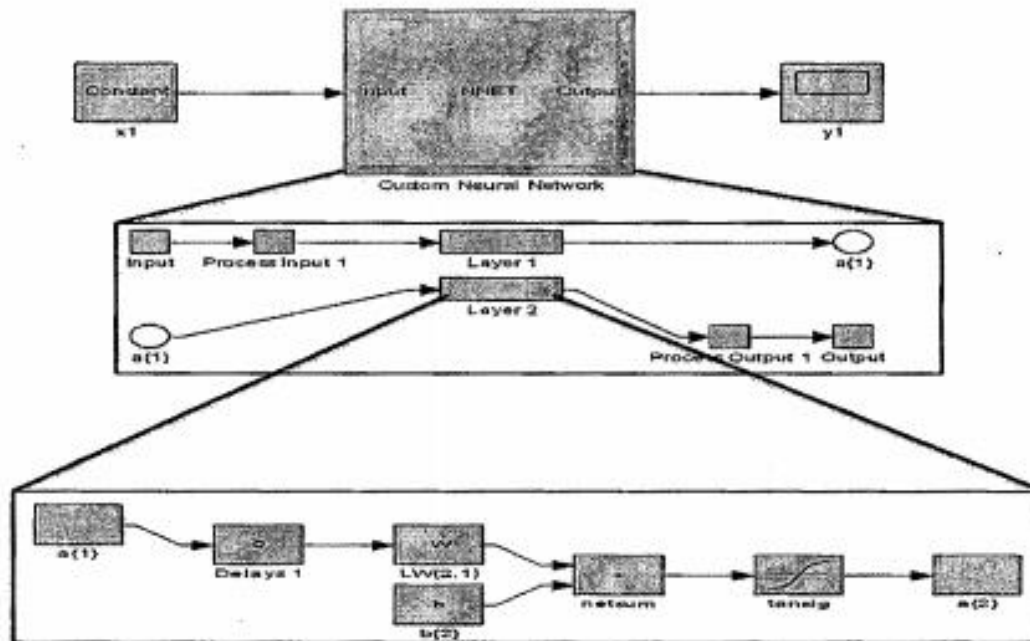
# INTRODUCTION TO MATLAB ENVIRONMENT FOR SOFT COMPUTING TECHNIQUES

## MATLAB Simulation: Neural Network Toolbox

The image displays four overlapping windows from the MATLAB Neural Network Toolbox, illustrating the workflow from starting to training a neural network. Annotations with blue arrows point to specific windows:

- nnstart**: Points to the "Welcome to Neural Network Start" window, which provides introductory information and links to various toolboxes.
- nntool**: Points to the "Neural Network Data Manager" window, which is used for loading and managing data sets.
- View ANN**: Points to the "Network: network7" window, which shows a visual representation of a neural network with an Input layer (1 node), a Hidden Layer (3 nodes), and an Output Layer (1 node).
- Create ANN**: Points to the "Create Network in Tools" window, which allows for configuring the network's architecture and training parameters.
- Training ANN**: Points to the "Neural Network Training" window, which displays the training progress, including error metrics and a plot of the network's performance over time.

## Neural Network Simulink model





## MATLAB Simulation: Global Optimization Toolbox

The screenshot displays the MATLAB Optimization Tool interface for the Genetic Algorithm Solver. The interface is divided into several sections:

- Problem Setup and Results:** Shows the solver selected as 'ga - Genetic Algorithm'. The problem is defined with a fitness function of 'Quasimodot', 2 variables, and various constraints (linear inequalities, linear equalities, bounds, nonlinear constraint functions, and integer variable indices).
- Options:** A list of configuration options for the solver, including Population, Fitness scaling, Selection, Reproduction, Mutation, Crossover, Migration, Constraint parameters, Hybrid function, Stopping criteria, Plot functions, Output function, Display to command window, and User function evaluation.
- Run Solver:** A button to execute the optimization process.
- View Results:** A section showing the current iteration (51) and a 'Clear Results' button.
- See the Final Point:** A section displaying the final point of the optimization, with values 0.025 and 0.018.
- Help:** A button to access the help documentation.

Blue arrows point from text labels to specific elements in the interface:

- 'Choose Solver' points to the 'ga - Genetic Algorithm' dropdown.
- 'Enter Problem and Constraints' points to the 'Problem' and 'Constraints' sections.
- 'Set Options' points to the 'Options' section.
- 'Run Solver' points to the 'Run solver and view results' section.
- 'View Results' points to the 'Current iteration' and 'Optimization running' sections.
- 'See the Final Point' points to the 'Final point' section.

The 'Optimization running' section shows the following text:

```
Optimization running.  
Objective function value: 0.1894526294233811  
Optimization terminated: average change in the fitness value less than
```

The 'Final point' section shows the following values:

```
Final point  
1: 0.025 0.018
```

# MULTIPLE CHOICE QUESTION

1. What is the output of the following code?

```
A=[0 0 0; 0 9 0; 1 2 3]; nnz[A]
```

- a) 4
- b) 5
- c) 3
- d) Error

2. What is the output of the following code?

```
A=[1 2 3; 32 23 26; 0 0 0]; spones(A)
```

- a) Returns a sparse matrix with the non-zeros replaced by normally distributed random numbers
- b) Returns a sparse matrix with the zeros replaced by ones
- c) Returns a sparse matrix with the non-zeros replaced by fractions
- d) Returns a sparse matrix with the non-zeros replaced by random numbers

3. The space located for the matrix generated from the spones command is \_\_\_\_\_

- a) Same as a sparse matrix
- b) Same as the original matrix
- c) Same as an identity matrix
- d) Double that of the sparse matrix

4. What is the output of the following code?

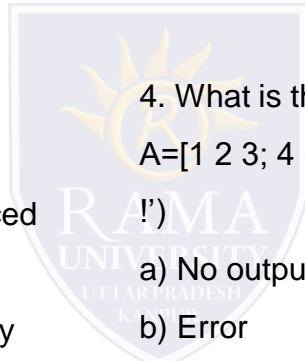
```
A=[1 2 3; 4 5 6; 7 8 9];if( nzmax(A)==nzmax(spones(A) ) disp('Yeah !')
```

- a) No output
- b) Error
- c) Yeah !
- d) Output suppressed

5. What is the output of the following code?

```
nnz(spconvert([1 2 3; 4 5 6; 7 8 9]))
```

- a) 3
- b) 2
- c) 1
- d) 6



# MULTIPLE CHOICE QUESTION

6. What is the output of the following code?

```
nzmax(spconvert([1 2 3; 4 5 6; 7 8 9]))
```

- a) 2
- b) 3
- c) 1
- d) Error

[View Answer](#)

7. A memory for sparse matrix is dedicated by the \_\_\_\_\_ command.

- a) spalloc
- b) sparsealloc
- c) allocspar
- d) no such command

8. What is the output of the following command?

```
spalloc(2,3, 7)
```

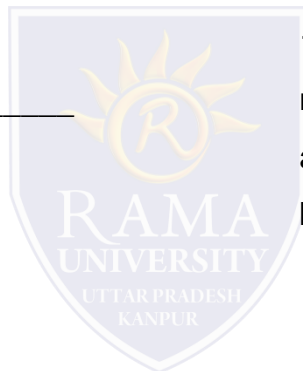
- a) A 2\*3 sparse matrix
- b) Memory is allocated for a 2\*3 sparse matrix
- c) A 3\*2 sparse matrix
- d) Error

9. The default number of non-zero elements which can be put into the memory allocated by the spalloc command is  $> 1$ .

- a) True
- b) False

10. The pattern generated by the spy command is a measure of the number of zeros in the input matrix.

- a) True
- b) False



# MULTIPLE CHOICE QUESTION

1. How can we smoothen the following graph of  $\sin(t)$  and  $\cos(t)$  into a circle?

- a) reduce the gap between linearly spaced elements of the dependent variable  $t$
- b) reduce the gap between elements of the dependent variable  $t$
- c) increase the gap between linearly spaced elements of the dependent variable  $t$
- d) increase the gap between elements of the dependent variable  $t$

2. Which command gives a title to the graph plotted by MATLAB?

- a) `plot()` generates the title itself
- b) `title()`
- c) `hlabel()`
- d) `heading()`

3. Which command enables a title for the x-axis?

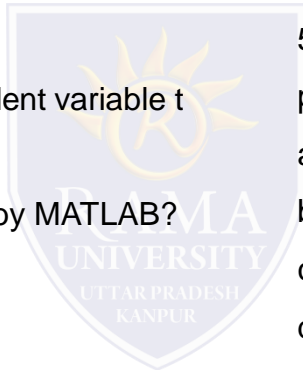
- a) `xlabel()`
- b) `horilabel()`
- c) `xlabel[]`
- d) no command

4. Which command enables a title for the y-axis?

- a) `vertlabel()`
- b) `ylabel()`
- c) `ylabel[]`
- d) no command

5. How can several graphs for the same function be plotted on the same window?

- a) Contour plots
- b) Bode plots
- c) 3-D plots
- d) n-D plots



# MULTIPLE CHOICE QUESTION

6. What is the output of the following command?

```
meshgrid [x,y]
```

- a) two  $x*y$  matrices
- b) one  $x*y$  matrix
- c) one  $y*x$  matrix
- d) error

7. What is the output of the following code?

```
t=0:0.001*pi:pi/2; plot(t,sin(t),*);
```

- a) An inverted sine curve
- b) A sine curve
- c) A point
- d) Error

8. What is the slope of the sawtooth waveform generated by the sawtooth command?

- a)  $1/\pi$
- b)  $\pi$
- c)  $1/(2*\pi)$
- d)  $2*\pi$

9. What is the period of the sawtooth() waveform which is generated by the sawtooth() command?

- a)  $2*\pi$
- b)  $\pi^2$
- c)  $\pi$
- d)  $3*\pi/2$

10. The command used to generate an array of arrows is \_\_\_\_\_

- a) `quiver[]`
- b) `arrows()`
- c) `quiver()`
- d) `arrows[]`



# MULTIPLE CHOICE QUESTION

11. What is the output of the following code?

```
t=0:.001*pi:2*pi; plot(cos(t),sin(t))
```

- a) A circle
- b) A straight line
- c) A unit circle
- d) A sinusoid

12. The period of sinusoidal curves can be changed in MATLAB.

- a) True
- b) False

13. The command to draw the nature of a function over a default fundamental period is \_\_\_\_\_

- a) ezplot()
- b) plot()
- c) stem()
- d) plot3()

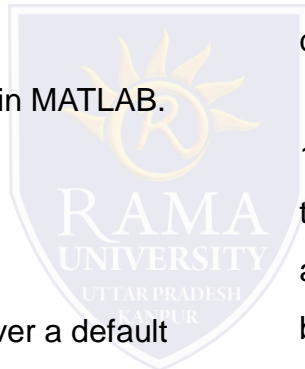
14. In the following code, what is the fundamental frequency of the sawtooth command?

```
f=1/50; sawtooth(2*pi*1/f*t)
```

- a) 50
- b) .02
- c) 100
- d) Error

15. The limits of the axes drawn are only specified in the command used to plot the graph itself.

- a) True
- b) False



# MULTIPLE CHOICE QUESTION

1. Which command is suitable to change the axes of the graph plotted?

- a) axes
- b) axis
- c) yxaxes
- d) no command

2. What is the output of the following code?

```
ezplot(x^2)
```

- a) No such command
- b) A parabola
- c) A part of a parabola
- d) Error

3. Which command can be used to generate multiple graphs in the same window?

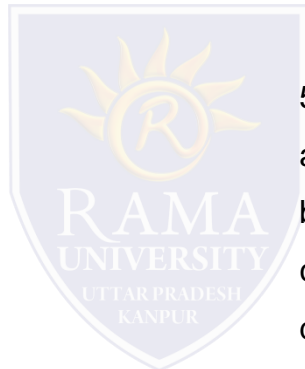
- a) hold on
- b) wait
- c) not possible without contour command
- d) not possible

4. Inline functions can be plotted by the \_\_\_\_\_ command.

- a) ezplot()
- b) plot3()
- c) plot()
- d) cannot be done

5. Which toolbox provides the plot command?

- a) Symbolic Maths Toolbox
- b) Signal Processing Toolbox
- c) Engineering Toolbox
- d) Functions



# REFERENCES

- ❑ <https://www.javatpoint.com/artificial-neural-network-hopfield-network>
- ❑ <https://www.geeksforgeeks.org/traveling-salesman-problem-using-genetic-algorithm/>

