S.No.	Topic	No. of Lectures
11.	Introduction to Fuzzy logic modelling and control of a system. Fuzzification, inference and defuzzification.	2
12.	Fuzzy knowledge and rule bases.	2
13.	Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control.	2
14.	Implementation of fuzzy logic controller. Stability analysis of fuzzy control systems.	2
15.	Intelligent control for SISO/MIMO nonlinear systems. Model based multivariable fuzzy controller.	2
	Total	**36**

IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	To work on data transformations, brief review on statistical criteria for termination of epochs, deciding the input output and hidden layers and neutrons for ANN problems,	3
2.	Working on different algorithms of ANN to different problems in agricultural engineering, working with different fuzzy relations,	2
3.	propositions, implications and inferences, working with defuzzification techniques and fuzzy logic controllers, concept of coding,	3
4.	selection, crossover, mutation and application of genetic programming for global optimization, use of available software for application of soft computing techniques.	4
	Total	**12**

X. Suggested Reading

- David EG. *Genetic Algorithms*.
- Rajasekaran S and Vijayalakshmi Pai GA. 2017.*Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications*. PHI Learning Pvt. Ltd.
- Ross TJ. 1997. *Fuzzy Logic with Fuzzy Applications*. McGraw Hill Inc.
- Simon H. 2003. *Neural Networks: A Comprehensive Foundation*. Pearson Edition.
- Sivanandam SN and Deepa SN. 2011. *Principles of Soft Computing*. Wiley India Pvt. Ltd., 2nd Edition.
- Sivanandam SN and Deepa SN. 2013. *Principles of Soft Computing*. Wiley India.

  I. Course Title   : **Digital Image Processing**
  II. Course Code   : **CSE 506**
III. Credit Hours   : **2+1**

IV. Aim of the course

To give an overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation and morphological image processing.

V. Theory

Unit I

Digital image fundamentals, elements of visual perception, light and the

electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, linear and nonlinear operations.

Unit II

Image enhancement in the spatial domain, basic gray level transformations, histogram processing, basics of spatial filtering, smoothing spatial filters, sharpening spatial filters.

Unit III

Color image processing, color fundamentals, color models, pseudo color image processing, basics of full-color image processing, color transformations, smoothing and sharpening, color segmentation.

Unit IV

Image segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, segmentation by morphological watersheds.

Unit V

Morphological image processing, dilation and erosion, opening and closing, extensions to gray-scale images.

VI. Practical

To write program to read and display digital image, image processing program using point processing method, program for image arithmetic operations, program for image logical operations, program for histogram calculation and equalization, program for geometric transformation of image, understand various image noise models and to write programs for image restoration and to remove noise using spatial filters. Brief outline of image processing tools.

VII. Learning outcome

This course introduces digital image processing. It focuses on the theory and algorithms underlying a range of tasks including acquisition, formation, enhancement, segmentation and representation.

VIII. Lecture Schedule

S.No.	Topic	No. of Lectures
1.	Introduction and Fundamentals, Motivation and Perspective, Applications, Components of Image Processing System,	3
2.	Element of Visual Perception, A Simple Image Model	1
3.	Sampling and Quantization.	2
4.	Light and the electromagnetic spectrum, image sensing and acquisition	2
5.	Basic relationships between pixels, linear and nonlinear operations	2
6.	Image Enhancement in Spatial Domain	2
7.	Introduction; Basic Gray Level Functions	2
8.	Histogram Specification	2
9.	Basics of spatial filtering, smoothing spatial filters, sharpening spatial filters	2
10.	Color image processing, color fundamentals	1
11.	Color models, pseudo color image processing	1
12.	Color transformations, smoothing and sharpening, color segmentation.	2
13.	Image segmentation, detection of discontinuities	1

S.No.	Topic	No. of Lectures
14.	Edge linking and boundary detection, thresholding, region-based segmentation	2
15.	Segmentation by morphological watersheds	1
16.	Morphological image processing, dilation and erosion	2
17.	Opening and closing, extensions to gray-scale images	2
	Total	**30**

IX. List of Practical

S.No.	Topic	No. of Practicals
1.	Display digital image, image processing program using point processing method, program for image arithmetic operations	3
2.	Program for image arithmetic operations, image logical operations, histogram calculation and equalization	4
3.	Program for geometric transformation of image, understand various image noise models	4
4.	Programs for image restoration and to remove noise using spatial filters	4
5.	Brief outline of image processing tools	1
	Total	**16**

X. Suggested Reading

- Jayaraman S, Esakkirajan S and Veerakumar T. *Digital Image Processing*. Tata McGraw Hill Publication.
- Rafael CG and Richard EW. *Digital Image Processing*. Third Edition, Pearson Education.
- Sridhar S. *Digital Image Processing*. Oxford University Press.