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4. Martin. J, 1977. Computer Database Organization, Prentice-Hall, New Jersey.
5. Sir Maurice Kendall., Alan Stuart and J. Keith. The Advanced theory of Statistics, v. 3, 4th Edition
6. Daniel and S. Wilks, 1995. Statistical Methods in the Atmospheric Sciences.
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9. Davis, J. C. 1973. Statistics and Data Analysis in Geology.
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GIH 452: DIGITAL IMAGE PROCESSING

Skills, employability and entrepreneurship: Students have good opportunity to learn this course for manipulating and analyzing digital images by using specialized softwares to enhance quality of images and create new applications. DIP provides a foundation for the artificial intelligence (AI) and machine learning to perform advanced image analysis. Students who qualify in this course have opportunities to work as image processors in both government and private organizations and companies.

Unit 1	**Introduction**: Digital images, Sources of errors; Image Pre-processing- Atmospheric, Geometric and Radiometric corrections, Noise removal, Resampling techniques. Image Enhancement Techniques. Contrast enhancement: Linear and Non-Linear Logarithmic contrast enhancement, Edge enhancement, Density slicing, Principal Component Analysis; IHS Transformation, Spatial filtering, Low and high frequency band ratioing and band combination.	06 hrs
Unit 2	**Image and Digital Images:** types of images and acquisition, simple image model, Sampling and reconstruction, uniform sampling and quantization.	06 hrs
Unit 3	**Digital Image Analysis:** Digital data, Image File formats, Image Rectification and Restoration.	06 hrs
Unit 4	**Image enhancement techniques:** Raw, Processed Images, Contrast Manipulation, Spatial feature Manipulation, Multi-Image Manipulation.	06 hrs
Unit 5	**Contrast Manipulation:** Grey Level Thresholding, Level Slicing, Contrast Stretching- Concept of Digital Number.	06 hrs
Unit 6	**Spatial feature Manipulation:** Convolution, Edge Enhancement, Concept and Use of Fourier Analysis in Digital Image Analysis.	06 hrs
Unit 7	**Multi-Image Manipulation:** Spectral Ratioing, Principle and Canonicle Components, Vegetation Components/Indices - Infrared Index, Simple Ratio, Perpendicular Vegetation Index (PVI), Moisture Stress Index (MSI), EVI, TVI, NDVI and NDWI.	06 hrs

Unit 8	**Digital Image Classification:** Classification scheme; Supervised classification, Training sites selection and statistical information extraction; Discriminant functions; Maximum Likelihood classifier, Euclidian distance, Mahalanobis distance; Unsupervised classification, classification accuracy assessment, Error Matrix.	06 hrs

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5. Kenneth R, Castle man, (1979). Digital Image Processing, Prentice Hall, 24-98.
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9. Remote Sensing and GIS, B Bhatta Oxford University press.

GIS 453: ADVANCED GIS

Skills, employability and entrepreneurship: This is the most important course for students to study advanced with the help of advanced software and computer programs. There is a good scope of this course for students who can work as geoinformatician, GIS engineer in government organizations like ISRO, IIRS, KSRSAC, INCOIS etc., and in private institutions such as disaster management organizations and MNCs. Students can also open their own start-up companies.

Unit 1	**GIS Data and Analysis:** Spatial Analysis:-Classification, Overlay analysis, Proximity Analysis, Polygon Neighborhoods, Data analyzing operations in GIS, Buffering and neighboring functions, integrated data, raster and vector overly method, problems of vector and raster overlay, spatial interpolation GIS for surface analysis and network analysis.	06 hrs
Unit 2	**Introduction to modeling in ArcGIS Concepts of 3D models:** Suitable Site selection – Simple overlay analysis, multi-criteria analysis, View shed analysis, Flood analysis, Sun shadow volume analysis, Using Model Builder. Grid based spatial analysis – local, focal, zonal, and global function (Neighborhood analysis).	06 hrs
Unit 3	**Topology and network analysis:** Topology – Types of Errors, Editing and Error Rectification, Types of Topology, Modeling topological Relationships, Network connectivity rules, Finding Shortest Route, Creating Geometric network, creating and building a network dataset. Applications of network analysis. Geovisualization; GIS classification methods, Image Classification.	06 hrs