GIS – 806 Spatial Statistics (3+0=3)

1. **Course Objectives:**
   a. Distinguish different types of spatial data (geostatistical, areal, point process) and understand how spatial autocorrelation plays a role in statistical modeling.
   b. Use existing methods to investigate spatial autocorrelation, in example datasets provided as exercises.
   c. Determine which spatial methods to use in their research and implement them using statistical software and GIS.
   d. Read and discuss new methods in the spatial statistics literature based on an understanding of the basic spatial statistics approaches, principles, and main assumptions

2. **Course Outcomes:**
   a. Students will learn advanced level of spatial statistics tecniques like spatial autocorrelation
   b. Students will gain hands-on experience using specialized software tools (e.g., S+Plus, ArcGIS) for spatial analysis, enabling them to execute and interpret spatial statistical analyses effectively.

3. **Course Code:**
   a. GIS – 806

4. **Credit Hours:**
   a. Theory = 03
   b. Practical = 00
   c. Total = 03

5. **Detailed Contents:**
   a. **Introduction to Spatial Data and Spatial Relationships:**
   Understand the fundamental concepts of spatial data, including types, sources, and formats. Learn about spatial relationships, patterns, and the importance of spatial context in data analysis.
   b. **Exploratory Spatial Data Analysis (ESDA):**
   Develop skills in exploratory spatial data analysis to identify patterns, clusters, and anomalies in spatial datasets. Apply techniques like spatial autocorrelation and variogram analysis to understand spatial dependencies.
   c. **Spatial Regression and Modeling:**
   Understand the concepts and applications of spatial regression models, including geographically weighted regression (GWR).
   Analyze the relationship between spatially distributed variables and assess the influence of location on regression outcomes.
   d. **Geostatistics and Kriging:**
   Gain proficiency in geostatistical techniques, particularly kriging, for spatial interpolation and prediction.
   Learn how to create spatially continuous surfaces from point data and assess the accuracy of spatial predictions.
   e. **Spatial Simulation and Stochastic Processes:**
   Explore the use of spatial simulation techniques to model complex spatial processes and uncertainties.
   Apply stochastic processes in spatial contexts to understand and predict spatial variability.

f. **Advanced Spatial Statistics Techniques:**
   Investigate advanced spatial statistical methods, such as Bayesian spatial modeling and spatial econometrics.
   Learn how to apply these techniques to complex spatial data problems in various fields.
g. **Applications of Spatial Statistics in Real-World Scenarios:**
   Develop the ability to apply spatial statistical methods to real-world scenarios, such as environmental monitoring, public health, and urban planning.
   Engage in hands-on projects and case studies to reinforce the practical application of spatial statistics.
h. **Software Tools for Spatial Analysis:**
   Gain proficiency in using specialized software tools and programming languages (e.g., R, Python, ArcGIS) for spatial statistical analysis.
   Learn how to implement spatial statistical methods using these tools and interpret the results effectively.
i. **Critical Evaluation and Communication:**
   Develop the skills to critically evaluate spatial statistical analyses and effectively communicate the results to both technical and non-technical audiences.
   Understand the ethical considerations in spatial data analysis and the implications of spatial decisions.
j. **Final project presentations**

6. **Textbooks/Reference Books:**

a. Roger S. Bivand, Edzer J. Pebesma and Virgilio Gómez-Rubio Applied Spatial Data Analysis with R (2008), Springer.