VIVEKANAND COLLEGE, KOLHAPUR

(AN EMPOWERED AUTONOMOUS INSTITUTE)

Structure and Syllabus

for the degree of

M. Sc. Geoinformatics

Syllabus

As per NEP - 2020 Guidelines
(Introduced from Academic Year 2025-26)

Department of Geography

Vivekanand College, Kolhapur
(An Empowered Autonomous Institute)
Department of Geography
Departmental Teaching and Evaluation scheme
One/Two- Years PG Programme
Department/Subject Specific Core or Major (DSC) (as per NEP-2020 Guidelines)

M. Sc. Geoinformatics, Part I, Sem I
NEP-2.0
(Introduced from Academic Year 2025-26)

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
			Semester-I							
1	DSC-I	DSC39GEO11	Fundamentals of Remote Sensing & Photogrammetry	4	-	80	20	-	100	4
2	DSC-II	DSC39GEO12	Fundamentals of Geographical Information System & GPS	4	-	80	20	-	100	4
3	DSE-I	DSE39GEO11	Geodesy and Digital Cartography	4	-	80	20	-	100	4
		DSE39GEO12	Business communication and Soft skill							
4	RMD	RMD39GEO11	Research Methodology	4	-	80	20	-	100	4
5	DSC-PR-I	DSC39GEO19	Advance GIS & Computer Programming	-	12	-	-	150	150	6
Semester – I Total				**16**	**12**	**320**	**80**	**150**	**550**	**22**
			Semester-II							
1	DSC-III	DSC39GEO21	Digital image processing & Geo-spatial Analysis	4	-	80	20	-	100	4
2	DSC-IV	DSC39GEO22	Database Management System & Geo -statistical methods	4	-	80	20	-	100	4
3	DSE-II	DSE39GEO21	Advance internet & web technology in Geoinformatics	4	-	80	20	-	100	4
		DSE39GEO22	Advance Surveying & Project Management							
4	DSC-PR-II	DSC39GEO29	DIP, Computer programming & Geo - statistics	-	12	-	-	150	150	6
5	FPR/OJT	FPR39GEO21	OJT/Field Project	-	4			100	100	4
Semester – II Total				**12**	**16**	**240**	**60**	**250**	**550**	**22**
Total Sem I & II				**28**	**28**	**560**	**140**	**400**	**1100**	**44**

Title of Course: Fundamentals of Remote Sensing and Photogrammetry
Course Code: DSC39GEO11
Total Credits: 04
Course Outcomes:
On completion of this course, the student shall be able to
1. Understand the basic principles of remote Sensing and Photogrammetry.
2. Obtain knowledge of the sensor characteristics of various RS Systems
3. Acquire knowledge of different missions & their utility
4. Understand functioning, data acquisition and orbit operations of missions.

Module No.	Modules	Credit (04)
1	**Introduction to Remote Sensing** Introduction, Definition, Development, Overview of Remote Sensing System, Electromagnetic radiation (EMR), Theories of EMR, Laws of Radiation, EM Spectrum, Sources of EMR, Interaction of EMR with earth & atmosphere	01
2	**Platform, Sensors and Data Products** Platform and Sensors, Orbits, Types of Sensors, Fundamentals of Radiometry, Data Products and RS data errors	01
3	**Basics of Photogrammetry** Photogrammetry: Basic aerial Photography, Basic geometry of aerial photograph, central and orthographic projections, difference between map and aerial photograph, Types of aerial photographs. Aerial Photo and Image Interpretation: Elements of visual interpretation for aerial photos and satellite imageries	01
4	**Stereo and Digital Photogrammetry** Stereo Photogrammetry: Introduction, orientation of aerial photographs – inner, relative, absolute orientation, Collinearity and Coplanarity conditions, Concept of Rotation Matrix. Digital Photogrammetry: Concept and Techniques of Digital Photogrammetry, Data Generation and Research Application of Cartosat- 1 Data, Lidar-altimeter.	01

Reference books:

1. Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London
2. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
3. Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India
4. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
5. Sabins, F. F. (1996): Remote Sensing: Principles and interpretation, W.H. Freeman and Company, San Francisco

Title of Course: Fundamentals of GIS & GPS

Course Code: DSC39GEO12
Total Credits: 04
Course Outcomes:

1. Understand the core concepts of Geographic Information Systems (GIS) and the role of spatial data in decision-making.
2. Collect, manage, and analyse geospatial data using GIS software to address real-world problems.
3. Apply cartographic principles to create accurate and visually effective maps for various applications.
4. Utilize spatial analysis techniques, such as buffering and overlay, to solve geographical and environmental issues.

Module No.	Module Title	Credit (04)
1	**Introduction to GIS** Definition, evolution and Development of GIS, Components of GIS, Functionality of GIS, Spatial and Attribute Data, Data Structures -Raster and Vector data structures, Data file and database, Advantage and Limitation of GIS,	01
	Creating GIS Database	
2	Spatial Data: Concepts of Space and Time, Layers Coverage, Spatial Data Models Spatial Data Input: Digitization, Error Identification, Errors: Types, Sources, Correction; Editing and Topology Building Non-Spatial Data: Advantages of Data Base Management System. Conceptual Implementation Models, Hierarchical, Network, and Relational Models	01
3	**Introduction to Geoprocessing** Geoprocessing Tools, Vector & Raster Geoprocessing, Overlay Operations, Proximity Analysis, Attribute-Based Operations, GIS Data Models	01
4	**Fundamentals of Global Positioning System** Fundamentals of GPS, History and Types of GPS, space segments, user segments and control segments, Accuracy of GPS measurements, point positioning and relative positioning, methods of surveying with GPS, Introduction to IRNSS, GPS Error and Limitation	01

Reference Books:

1. Bolstad, P. (2005) GIS Fundamentals: A first text on Geographic Information Systems, Second Edition. White Bear Lake, MN: Eider Press, 543 pp.
2. Burrough, P.A. and McDonnell, R.A. (1998) Principles of geographical information systems. Oxford University Press, Oxford, 327 pp.
3. Campbell, J.B. (2002). Introduction to remote sensing, 3rd ed., The Guilford Press. ISBN 1- 57230-640-8.
4. Chang, K. (2007) Introduction to Geographic Information System, 4th Edition. McGraw Hill.
5. Curran Paul J Principles of Remote Sensing UK: ELBS,
6. Elangovan, K (2006) GIS: Fundamentals, Applications and Implementations. New India Publishing Agency, New Delhi"208 pp.

7. Heywood, I., Cornelius, S., and Carver, S. (2006) An Introduction to Geographical Information Systems. Prentice Hall. 3rd edition.
8. Jensen, J.R. (2000). Remote sensing of the environment: an Earth resource perspective. Prentice Hall. ISBN 0-13-489733-1
9. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
10. Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore
11. Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi

Title of Course: Geodesy and Digital Cartography
Course Code: DSE39GEO11

Total Credits: 04

Course Outcomes:

On completion of this course, the student shall be able to

1. Students will understand the fundamental concepts and theories behind map design and cartographic representation.
2. Learners will gain skills in interpreting spatial data and transforming it into effective, visually appealing maps.
3. Students will be able to apply cartographic techniques to create maps that communicate geographic information clearly and accurately.
4. Participants will critically analyze different types of maps and evaluate their accuracy, aesthetics, and functionality.

Module No.	Module Title	Credit (04)
1	**Concept of Geodesy** Definition and fundamentals of geodesy; Spherical, ellipsoid and geoid shape of the earth; Grid and Graticule, Datums: Horizontal vs. Vertical.	01
2	**Map Projections** General principles of map projections, Classification, Choice of projections; Cartesian vs. Geodetic coordinate systems; WGS 84 and UTM projection system.	01
3	**Fundamentals of Cartography** History and Development of Cartography; Sources of cartographic data; Indexing of SOI toposheet; Scale: types and importance; Definition and classification of map; Elements of map; Map Design and its principles, Cartographic methods and techniques for preparation of maps and diagrams.	01
4	**Digital Cartography** Concept of Digital Cartography, Digital Cartography: its comparisons with conventional cartography and GIS; Spatial and attribute database, Concept of base map, Symbolization, Generalization and Visualization; Colour system, Modern techniques of map production: animation, simulation, web maps and AI. VR in cartography.	01

Reference books:

1. Dorling, D. and Fairborn, D. (1997): Mapping. Ways of Representing the World. Longman, Harlow.
2. Griffith, D. A. and Amehein (1997): Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
3. Strahler, A.N. (1971): The Earth Sciences. Harper and Row Publishers; New York.
4. Kraak M.J. (2010) Cartography: Visualization of Geospatial Data (3rd ed.), Pearson Edu. Ltd.
5. Tom Herring, “Geodesy Elsevier,2009,
6. Schwarze, V.S. Geodesy: The challenge of the 3rd millennium, Springer verlag, 2002.
7. James R.Smith, “Introduction to Geodesy”, John wiley & Sons Inc. 1997
9. Dent, B.D.(1999): Cartography- Thematic Map Design, 5th Edition, WCB Mc Grew Hill, Boston.

Web References:

1. www.natmo.gov.in

2. www.surveyofindia.gov.in
3. www.gsi.gov.in
4. www.nbsslup.icar.gov.in
5. https://oceanservice.noaa.gov/podcast/jan18/nop12-geodesy.html

Title of Course: Business communication and Soft skill

Course Code: DSE39GEO12
Total Credits: 04
Course Outcomes:
On completion of this course, the student shall be able to
1. Understand all aspects of handling geographical information, also it provides a simple platform to understand most of the geographical phenomena and the occurrence of these phenomena.
2. Perform map making and understand how to apply patterns and colors when representing features on a map.

Module No.	Module Title	Credit (04)
1	**Introduction to Business Communication** Communication Process, 7Cs of Effective Communications and Writing Skills, Etiquette and Interview: Body Language Introduction, Body Language, Advantages of Knowing Body Language, Importance of Body Language in General, Body Language Examples and What They Show, Sending the Right Messages with Your Body Language	01
2	**Personality development** Characteristics, Factors, Roles of Personality - An overview, Approaches to Studying Personality, Characteristics of Personality, Factors of Personality, Roles of Personality in Organizational Behavior	01
3	**Professionalism** Introduction, Professionalism (Dressing and Grooming) : An explanation, The Importance of Professionalism in Business, Corporate Dressing and Personal Grooming, Corporate Dressing for Success at Workplace, Personal Grooming	01
4	**Interview Preparaion** Induction, Curriculum Vitae / Resume Writing: Types of Interview, the purpose of the interview, Dos and Don't s in CV/Resume Writing, Group Discussion and Time Management	01

Reference books:

1. Jethwaney, J. (2010). Corporate Communications: Principles and Practices. *OUP Catalogue*.
2. Kaul & Asha, Effective Business Communication, PHI 2nd Edition, 2006.
3. Lesikar R.V & Flately M V, Basic Communication Skills for empowering the internet generation, Tata-McGraw Hill, 2009.
4. Kuczerawy, A. (2017). The Power of Positive Thinking. J. Intell. Prop. Info. Tech. & Elec. Com. L., 8, 226.
5. Parker, Y., & Brown, B. (2012). The damn good resume guide: A crash course in resume writing. Ten Speed Press.

Title of Course: Research Methodology

Course Code: RMD39GEO11
Total Credits: 04
Course Outcomes:
On completion of this course, the student shall be able to

1. Understand the key concepts and principles of research design and methodology.
2. Develop skills to formulate research questions, hypotheses, and objectives.
3. Gain proficiency in data collection, analysis techniques, and interpretation.
4. Apply ethical standards and critical thinking in conducting and presenting research.

Module No.	Module Title	Credit (04)
1	**Introduction to Research Methodology** Methods of Geospatial Studies, Research: Definition, Types, Classification, Case Studies, Methods of Explanation: Inductive, Deductive, Empiricism, Positivism, Hempel, Hypothesis, Theories, Laws, and Models	01
2	**Methods of data collection** Research Question, Objectives, Significance of Research, Research Design , Data Collection: Types, Methods, Tools and Techniques, Recent Trends in RS and GIS Research	01
3	**Ethics in Scientific Research** Ethics in Scientific Research and Plagiarism, Scientific Journals: Elsevier & springer, Impact Factor, Citation, Introduction to useful online platforms: Mendeley, Google Scholar, Research Gate, Shodhganga	01
	Report writing	
4	Research Proposal,Presentation of Research findings: Report Writing; abstract, Literature Review, writing styles & manuals, Presentation and Formatting; Citation, H, G, I10 index, footnotes, Glossary, appendices, References, Bibliography and various referencing styles	01

Reference books:

1. Basil Gomez, John Paul Jones., (2010). Research Methods in Geography: A Critical Introduction, John Wiley & Sons, New York.
2. Daniel Montello, Paul Sutton, (2006). An Introduction to Scientific Research Methods in Geography, SAGE.
3. Ron Iphofen (2018). The SAGE Handbook of Qualitative Research Ethics, SAGE.
4. Gomez, B. and Jones, J. P. III (2010): Research Methods in Geography: A Critical Introduction, John Wiley and Sons
5. Goudie, A. (Ed) (2004): Encyclopedia of Geomorphology, Routledge, London
6. Gregory, D., Johnston, R., Pratt, G., Watts, M. and Whatmore, S. (2009): The Dictionary of Human Geography, Wiley-Blackwell, Singapore
7. Montello, D. and Sutton, P. (2013): An Introduction to Scientific Research Methods in Geography and Environmental Studies, SAGE Publications
8. Warf, B. (Ed) (2006): Encyclopedia of Human Geography, SAGE Publications, London

Title of Course: Advance GIS and Computer Programming
Course Code: DSC39GEO19

Total Credits: 06

Course Outcomes:

1. Students will develop proficiency in using QGIS and ArcGIS for spatial data analysis and geoprocessing tasks.
2. Learners will gain hands-on experience in creating, managing, and analyzing spatial databases.
3. Students will understand the fundamental concepts of programming, including data types, control structures, and algorithms.
4. Learners will develop the ability to write and debug programs using high-level programming languages.

Module No.	Module Title	Credit (06)
1	**Practical of QGIS Software** 1. Interface of QGIS. 2. Working with Projections. 3. Georeferensing: Toposheet and Image Registration. 4. Digitization of Map Data. 5. Satellite Image Browsing Systems 6. Working with WMS Data 7. Making a Map Layout.	**01**
2	**Advance QGIS** 8. Data query: Spatial and Attribute. 9. Animating Time Series Data 10. Interpolating Point Data 11. Travel Time Analysis with Uber Movement 12. Service Area Analysis using Open route service 13. Working with Google Earth.	**01**
3	**Practicals of ArcPro Software - Part 1** 14. Overview of ArcGIS: Introduction Arc Map, Arc Catalogue and Arc Toolbox. 15. Data Formats in ArcGIS: Importance of Data, Shapefile, Feature Class, Geodatabase, Data Frames, Labeling Features. 16. Georeferencing in ArcGIS: Coordinating System, Datum Conversion, Map Projection, Storing and Viewing Projection Information. 17. Vector Data: Creating New Features, Editing Functions, Digitization, Errors and Creation of Topology. 18. Aspatial Data: Understanding Tables, Field Types, Table Manipulation, Table Relation, Creation of Graphs and Reports.	**01**
4	**Practicals of ArcPro Software - Part 2** 19. Map Design: Layout and Map Composition. 20. Spatial Analysis-I: Query By Location/Attribute, Identifying Spatial and Non-Spatial Data, Geoprocessing Wizard,Overlay Analysis, Spatial Analysis Functions, Multi Criteria Analysis using Boolean Logic 21. Spatial Analysis-II: Interpolation Methods, Viewshed and Watershed Analysis, Surface and Grid Analysis: DEM, DSM and DTM, Creating 3D data, Animation	**01**

	22. Applications: Calculation of Vegetation and Water Indices, Slope and Contour, Network Analysis. 23. Import and Create 3D Model in ArcGIS Pro	
5	**Python Programming - Part 1** 24. Working with python editors and using IDEs, Variables and operators Data types: number, string, list, tuple, dictionary and set, Conditional statements , Looping statements	**01**
6	**Python Programming - Part 2** 25. Functions, OOP: Class, Object, Abstraction, Inheritance, Constructor, Polymorphism, Incapsulation , File Handling (I/O), Debugging and error handling in python	**01**

Reference books:

1. Adriaans, P., and D. Zantinge. (1996). Data Mining. New York: Addison-Wesley.
2. Benjamin C. Pierce (2002). Types and Programming Languages, The MIT Press.
3. Bernhardensen, Tor. (1999). Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc.
4. Bishop, Michael P. and Shroder, John F. (Eds.) (2004). Geographic Information Science and Mountain Geomorphology. Chichester, U.K.: Praxis Publishing (Springer).11
5. Bracken, Ian and Webster, Christopher. (1990). Information Technology in Geography and Planning (Including Principles of GIS). London & New York: Routledge. 13
6. Bruce J. MacLennan (1999). Principles of Programming Languages: Design, Evaluation, and Implementation, Oxford University Press.
7. Burrough, Peter A. and McDonnell, Rachael A. (1998). Principles of Geographical Information Systems – Spatial Information Systems and Geostatistics. Oxford University Press.
8. Buttenfie ld, B.P. and R.P. McMaster (1991). Map Generalization: Making Rules for Knowledge Presentation. New York: Wiley.
9. Chang, Kang-tsung. (2002). Introduction to Geographic Information Systems. New Delhi: Tata McGraw-Hill Publishing Company Limited.
10. Chrisman, N. (1998). "Academic Origins of GIS," In T. Foresman (Ed): The History of Geographic Information Systems. Upper Saddle River, NJ: Prent ice Hall, pp. 33-43.
11. Clarke, Keith C. (2001). Getting Started with Geographic Information Systems (3r d Ed.) (Prent ice Hall Series in Geographic Information Science). Upper Saddle River, New Jersey: Prentice Hall.
12. David Gelernter and Suresh Jagannathan (1990). Programming Linguistics, The MIT Press.
13. Goldschlager, L. (1998). A Lister Computer Science - a modern Introduction Prentice Hall,
14. John C. Mitchell (2002). Concepts in Programming Languages, Cambridge University Press.
15. John Jelle (2016) Python Programming: An Introduction to Computer Science, Franklen Beedle.
16. Michael L. Scott (2005). Programming Language Pragmatics, Morgan Kaufmann Publishers.
17. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.Programming Languages, the MIT Press.
18. Ravi Sethi (1996). Programming Languages: Concepts and Constructs, 2nd ed., Addison-Wesley

M.Sc. Part I, Geoinformatics, Sem II

NEP-2020
(Introduced from Academic Year 2025-26)

Title of Course: Digital Image Processing & Geo-spatial Analysis
Course Code: DSC39GEO21
Total Credits: 04
Course Outcomes:

On completion of this course, the student shall be able to

1. Extract additional information from geographical data that might not be obvious simply by looking at a map.
2. Understand how efficiently they can encode, save, retrieve, overlay, correlate, alter, analyse, query, and display geographical data. Digital image processing and visual inspection are crucial components, and the results of these methods also help to gather data from the images.
3. Apply a range of geo-spatial analysis techniques using remote sensing and GIS tools toward solving quantitative problems in one or more core disciplinary areas such as geography, ecology, environmental sciences, bio-geosciences, urban planning, natural resources management etc.
4. Quantitatively analyze data to evaluate scientific hypotheses and arguments in remote sensing and geographic information science.

Module No.	Module Title	Credit (04)
1	**Introduction to DIP** Introduction to Digital Image Processing: Digital Images: Types Sources of Errors: Atmospheric, Radiometric and Geometric.	01
2	**Digital Image Enhancement and Classification Techniques** Contrast Enhancement: Linear, Non-Linear, Logarithmic and Exponential, Gaussian Stretch, Density Slicing. Spatial Filtering: Low Frequency, High Frequency, Edge Enhancement, Band Rationing and Band Combination Image Classification Scheme: Supervised Classification: Training Sites Selection and Statistical Information Extraction, Discriminate Functions. Classifier:Maximum Likelihood, Euclidian Distance, Mahalanobis Distance, Parallelepiped. Unsupervised Classification.Classification Accuracy Assessment and Error Matrix GCP and ground validation of data/image	01
3	**Geospatial Analysis- Vector & Raster** Spatial Analysis – Vector Based: Overlay Operations: Point-in-Polygon, Line-in-Polygon, Polygon-in-Polygon. Spatial Analysis – Raster Based: Map Algebra, Grid Based Operations, Local, Focal, Zonal and Global Functions, Cost Surface Analysis, Optimal Path and Proximity Search Single Layer Operations: Feature Identification, Extraction, Classification Manipulation. Multilayer Operation: Union, Intersection, Symmetrical Difference, Update, Merge, Append and Dissolve	01
4	**Network, Point, Surface and Spatial Analysis**	01

	Network Analysis: Concepts, Evaluation of Network Complexity Using Alpha-Gamma Indices, C-Matrices for Evaluating Connectivity of the Network, Network Data Model, Path Analysis, Types of Network Analysis: Optimum Cyclic Path, Vehicle Routing, Path Determination and Cost-Path Analysis. Point Pattern Analysis: Methods for Evaluating Point Patterns: Clustered and Random Distribution Surface Analysis: Interpolation Methods: Trend Surface Analysis, IDW, Kriging, Measures of Arrangement and Dispersion, Autocorrelation, Semi-Variogram Spatial Modeling: Role of Spatial Model, Explanative, Predictive and Normative Models, Correlation-Regression Analysis in Model Building. Handling Complex Spatial Queryandcase Studies	

Reference books:

1. Burrough, P.A. and McDonnell, R. (1998): Principles of Geographic Information Systems. Oxford University Press, Oxford.
2. Campbell, J. B. (2002): Introduction to Remote Sensing. 5th ed. Taylor & Francis, London.
3. Cha, B., Dattaa, D., Majumdar (2001): Digital Image Processing Analysis, Prentice - Hall of India, New Delhi
4. Curran, P.J. (1985): Principles of Remote Sensing, Longman, London.
5. Floyd, F., Sabins, Jr. (1986): Remote Sensing : Principles and Interpretation, W.H. Freeman, New York
6. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
7. George, J. (2003): Fundamentals of Remote Sensing. Universities Press (Pvt.) Ltd, Hyderabad.
8. Gibson, Paul.J. and Clare H. Power (2000), Introductory Remote Sensing: Digital Image Processing and Applications, Routledge, London.
9. Girard, M. C. and Girard, C. M. (2003): Processing of Remote Sensing Data. Oxford & IBH, New Delhi.
10. Harry, C.A. (ed.) (1978): Digital Image Processing, IEEE Computer Society.
11. Hord, R.M. (1982): Digital Image Processing of Remotely Sensed Data, Academic Press, New York.
12. Jensen R. John (2006), Remote Sensing of the Environment An Earth Resource Perspective, Pearson Education Pvt. Ltd., Delhi.
13. John A. Richards, Springer-Verlag (1999), Remote Sensing and Digital Image Analysis.
14. Leuder, D.R. (1959): Aerial Photographic Interpretation: Principles and Application. McGraw Hill, New York.
15. Lillesand, T. M., Kiefer, R. W. Chipman, J. W.(2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
16. Milman S. Andrew (1999), Mathematical Principles of Remote Sensing making Inferences from Noisy Data, Ann Arbor Press, Noida.
17. Nag, P. Kudrat, M. (1998): Digital Remote Sensing, Concept Publishing Company,New Delhi
18. Paul J. Curran. (1985), Principles of Remote Sensing, English Language Book Society, Longman.

19. Reeves, R.G. (ed.) (1983): Manual of Remote Sensing, Vols. 1 & 2, American Society of Photogrammetry & Remote Sensing, Falls Church, Virginia.
20. Richard E.Woods Prentice Hall, (2007), Digital Image Processing (3rd Edition)
21. Richards, J. A, Jia, X. (1999): Remote Sensing and Digital Image Processing, Springer, Verlag Berlin
22. Sabins, F. F. (1996): Remote Sensing: Principles an Interpretation, W. H. Freeman Company, New York

Title of Course: Database Management System and Geo-Statistical Methods
Course Code: DSC39GEO22
Total Credits: 04
Course Outcomes:
On completion of this course, the student shall be able to

1. Describe the fundamental elements of relational database management systems.
2. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
3. Design ER models to represent simple database application scenarios.
4. Extract data from the database using SQL.
5. Understand the basic concept of spatial databases.

Module No.	Module Title	Credit (04)
1	**Introduction to DBMS** File system vs DBMS – Database Management Systems – Database Architectures, Introduction to data, database, spatial database; Data Storage types , Database Structure Models; Types of Database management system, Data management using SQL.	01
2	**Introduction to RDBMS** Data constraint-primary key, foreign key, unique key, null, not null, Normalization, default key etc. SQL: Introduction to SQL, Features of SQL, Basic data types, SQL statements/commands, DDL,DML, DCL, Set operations in SQL, SQL functions: MAX, MIN SORT, COUNT, AVERAGE, Numeric, String, Date Functions, Type conversion functions.	01
3	**Geo-Statistical Methods and Probability** Statistical Methods for Geography; Scientific method and mathematical notation; Descriptive Statistics; Measures of central tendency: Mean, Median, and Mode; Measures of Dispersion: Range, Variance, Standard Deviation, z-score, Skewness, Kurtosis and Histograms. Probability Concepts; Discrete Probability Distributions: Uniform, Binomial and Poisson Distributions; Continuous Probability Distributions; Probability Models; Central Limit Theorem and Confidence Intervals.	01
4	**Hypothesis Testing & Correlation Regression** Sources of Data; Sampling; Hypothesis Testing: z-test and t-test; Analysis of Variance (ANOVA). Covariance; Pearson's Correlation Coefficient; Spearman's Rank Correlation Coefficient; Correlation and Geographic Problems; Regression Analysis.	01

Reference Book:

1. Swain, P.H. and Davis, S.M. (ed.), (1978): Remote Sensing: The Quantitative Approach. McGraw Hill, New York
2. Connolly, T. M., & Begg, C. E. (2005). Database systems: a practical approach to design, implementation, and management. Pearson Education.
3. Deshpande, P. S. (2008): SQL & PL/SQL for Oracle 10g, Blackbook, Dreamtech Press, New Delhi

4. Ramakrishnan, R., Gehrke, J., & Gehrke, J. (2003). Database management systems (Vol. 3). New York: McGraw-Hill.
5. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). Database system concepts.
6. Ullman, J. D. (1983). Principles of database systems. Galgotia publications.

Title of Course: Advance internet and web technology in GIS
Course Code: DSE39GEO21
Total Credits: 04
Course Outcomes:

On completion of this course, the student shall be able to

1. Develop interactive web mapping applications using modern web technologies and APIs.
2. Implement and consume geospatial web services.
3. Perform spatial analysis within a web environment using server-side or client-side processing.
4. Manage and optimize geospatial data for web applications, including database integration and performance tuning.

Module No.	Module Title	Credit (04)
1	**Introduction To Open Web Mapping** Web Page Basics, Web Mapping, Geospatial Web Services, OGC-framework of open web mapping, importance of open web mapping, international open web standards as published by the Open Geospatial Consortium	01
2	**Internet GIS Concepts & Web GIS** Overview of Internet GIS concepts & features: Internet protocol, Domain Name , System, Internet services, www. Web servers, Web clients. CGI,The web and GIS, Web GIS origin and Evolution, concept, Applications, Impact, web content	01
3	**Geoportals** Concept- uses- functions- architectures- geoportal applications-challenges and prospects. Web page design principles, HTML, XML, data formats, helper applications, Java, databases and the Web Application of Internet services to GIS, Internet GIS software, interoperability issues & Open GIS-GSDI and NSDI, Applications-e-business, e-government	01
4	**Indian Geo-Portals** Bhuvan, Mosdaik, Vedas	01

Reference Books:

1. Burrogh P.A., (1980) Principles of Geographical Information System for Land Resources Assessment, Oxford Publications.
2. Kang-tsung Chang , (2008), Introduction to Geographical Information System, , Fourth Edition, Tata McGraw Hill,
3. Kropla B., (2005). Beginning MapServer Open-Source GIS Development, Apress, New York.
4. Pinde Fu and Jiulin Sun, (2010). Web GIS: Principles and applications, ESRI Inc.,U.S.
5. Pinde Fu (2020). Getting to Know Web GIS, ESRI Inc.,U.S.
6. Tyler Mitchell (2015). Web Mapping Illustrated: Using Open Source GIS Toolkits, O′Reilly; 1ed.

Web References:

1. http://mapserver.gis.umn.edu
2. http://postgis.org/home
3. https://earthengine.google.com/
4. www.vedas.sat.gov.in

Title of Course: Advance Surveying and Project Management
Course Code: DSE39GEO22
Total Credits: 04
Course Outcomes:
On completion of this course, the student shall be able to
1. Handle advanced survey instruments such as total station, DGPS, and UAVS.
2. Conduct surveys and collect the required data.
3. Integrate remote sensing data, such as aerial and satellite imagery, LIDAR and other remote sensing technology into surveying projects for enhanced spatial information.
4. Gain knowledge of expectations, delivering value, and ensuring client satisfaction.
5. Understand a comprehensive project plan that includes tasks, timelines, resource allocation, dependencies, and milestones.
6. Gain the project management knowledge and skills, necessary to manage an entire project

Module No.	Module Title	Credit (04)
1	**Introduction to DGPS**	01
	Introduction to GPS: GPS Survey, Data Import, Processing and Mapping, Introduction to Differential GPS (DGPS): Principle and Function, Data Collection and Data Processing, Single and Dual Frequency DGPS, RTK, and Static Surveys in DGPS, Use of DGPS in Topographical Survey	
2	**Introduction to Total Station & UAV**	01
	Introduction to Total Station: Principle and Function, REM, RDM, Use of Total Station for data processing and analysis Comparison of Total Station with DGPS in Topographical Surveying Introduction to Unmanned Aerial Vehicle (UAV): Principles and Functions, Types of UAV, DGCA directions and rules	
3	**Project Management 1**	01
	Project scope and limitations, Availability of resources, and collecting requirements, Project phases, timelines, and schedules, Project monitoring and control, Budget, Resource optimization and schedule analysis, Techniques for prioritizing requirements, Milestones and understanding dependencies.	
4	**Project Mangement 2**	01
	Product/ work quality checks, Risk analysis, and management, Cost estimation budget, and release planning. Presentation of Research Findings: Progress Report, Report Writing, Formatting and Presentation	

Reference books:

1. Jeff, H. (1995): Differential GPS Explained, Trimble Navigation
2. Lawrence, L. and Alex, L. (2008): GPS Made Easy: Using Global Positioning Systems in the Outdoors, Rocky Mountain Books, Calgary
3. Mohinder, S. G., Lawrence, R. W. and Angus, P. A. (2001): Global Positioning Systems, Inertial Navigation and Integration, John Wiley and Sons Inc., New York
4. Newell, M., & Grashina, M. (2003). The project management question and answer book. Amacom.
5. Nokes, S. (2007). The definitive guide to project management. Pearson Education India.

6. Project Management Institute (2021). A Guide to the Project Management Body of Knowledge: PMBOK® Guide. Seventh Edition. Pennsylvania: Project Management Institute, Inc. ISBN: 978-162825664
7. Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
8. Schwalbe, K. (2009). Introduction to project management. Boston: Course Technology Cengage Learning
9. Stanley E. Portny (2013). Project Management for Dummies. 4th ed. New Jersey: John Wiley & Sons, Inc. 408. ISBN-13: 978-1118497234
10. Stinespring, B. M. (2000): The Experimental Evaluation of a DGPS Based Navigational System for the ARIES AUV, Monterey, California: Naval Postgraduate School; Springfield.

Title of Course: DIP, Computer programming & Geo-statistics
Course Code: DSC39GEO29
Total Credits: 06
Course Outcomes:
On completion of this course, the student shall be able to

1. Extract additional information from geographical data that might not be obvious simply by looking at a map.
2. Understand how efficiently they can encode, save, retrieve, overlay, correlate, alter, analyze, query, and display geographical data. Digital image processing,
3. Write Python programs proficiently using different editors and IDEs.
4. Utilize variables, operators, and data types effectively for data manipulation.
5. Apply Object-Oriented Programming principles to design and create classes and objects.
6. Produce basic Python code that is functional and extendable.
7. Package code into usable Python Toolboxes that will be available to users via ArcToolbox.
8. Perform map designing using Python scripting.

Module No.	Module Title	Credit (06)
1	**Image Pre-Processing** 1. Introduction to ERDAS 2. Familiarization with Image Processing System:Loading of Image Data, Identification of Objects on Visual Display, Study of Histograms and Layer stacking 3. Image Rectification: Image to Map, Image to Image, Extracting area of Interest and mosaicking 4. Image Enhancement Techniques: Linear and Non- Linear Contrast Enhancement, Band Rationing & combination, Edge Enhancement, Spatial filtering- High and Low Pass, Density Slicing	01
2	**Image Classification** 5. Image Classification: Classification : Supervised, Unsupervised, use of Different Algorithms, Change Detection 6. Accuracy Analysis: Producer, User Accuracy, Overall and Mapping Accuracy, Kappa Coefficient	01
3	**Advanced Python Programming - 1** 7. NumPy and SciPy: Introduction to NumPy, Creation of vectors and matrices, Matrix manipulation 8. Pandas: Introduction, Pandas data structures – Series and DataFrame, Data wrangling, loading a dataset into a DataFrame, Selecting Columns, Selecting Rows, Adding/ Deleting new data in a DataFrame, manipulation of tabular data 9. Data Visualization: Matplotlib and Seaborn, 10. GeoPandas: Introduction, Installation, Vector data processing, reading/writing shapefile, plotting, clip, overlay, spatial join, choropleth maps, classification	01
4	**Advanced Python Programming - 2** 11. Rasterio: Introduction, Installation, opening data, reading, saving, georeferenced and visualizing raster files, spatial indexing, creating data, 12. Web Scraping: Beautiful Soap, python web browser Module, Downloading Files from the Web with the requests Module, Saving downloaded Files to the Hard Drive, HTML 13. Introduction to Django, framework: Component structure	01

5	**Arcpy for ArcGIS Pro** 14. Geoprocessing using python scripting (Clip, Split by Attributes, Buffer). Exploring spatial data using python (Checking, Describing, and Listing data), Manipulating spatial and tabular data using Python, Working with geometries using python	**01**
6	**Introduction to R software and Geo-statistics Techniques** 15. Introduction to R software: Exploratory data analysis, Probability, and statistical operations, Regression, and least squares using R 16. Geostatistics: Point data interpolation techniques including kriging methods - Simple kriging, Ordinary kriging, Universal kriging	**01**

Reference book:

1. Booth, B., Shaner, J., MacDonald, A., Sanchez, P. Pfaff, R. (2004): ArcGIS,Geodatabase Workbook, Redlands
2. Cha, B., Dattaa, D., Majumdar (2001): Digital Image Processing Analysis, Prentice-Hall of India, NewDelhi
3. Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The Arc/Info Method, ESRI Press, Redland.
4. Eric Pimpler (2015). Programming ArcGIS with Python Cookbook, Packt Publishing Limited; 2nd edition.
5. ESRI (2003): Introduction to ArcGIS- I, Course Lectures,GIS Education Solutions
6. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall,NewJersey
7. John Jelle (2016) Python Programming: An Introduction to Computer Science, Franklen Beedle.
8. Laura Tateosian (2018). Python For ArcGIS. Springer.
9. Lillesand, T. M., Kiefer, R. W.Chipman, J. W.(2008): Remote Sensing and Image Interpretation, JohnWiley & Sons, New Delhi
10. Melania, H. M., Rhonda, P., Minami, M., Hatakeyama, A. M. (2004): ArcGIS, Using ArcMap, ESRI Press, Redlands
11. Mitchell, A. (1999): The ESRI guide to GIS analysis, Redlands
12. Nag, P. Kudrat, M. (1998): Digital Remote Sensing, Concept Publishing Company, New Delhi
13. Paul A. Zandbergen (2020) Advanced Python Scripting for ArcGIS Pro, ESRI Press.
14. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.
15. Richards, J. A, Jia,X.(1999): Remote Sensing and Digital Image Processing, Springer, Verlag Berlin
16. Silas Toms, and Dara O'Beirne (2017). ArcPy and ArcGIS -: Automating ArcGIS for Desktop and ArcGIS Online with Python, Packt Publishing Limited; 2nd edition.
17. Zeiler, M. (1999): The ESRI guide to Geodatabase design, Redlands

Web References:

1. https://www.python.org/about/gettingstarted/
2. https://www.w3schools.com/python/
3. https://nptel.ac.in/courses/106106212
4. https://pro.arcgis.com/en/pro-app/latest/arcpy/get-started/installing-python-for-arcgis-pro.htm
5. https://www.esri.com/training/catalog/60db423e8b20f13a5ac9cc09/working-with-raster-data-using-python/
6. www.hexagongeospatial.com
7. www.nrsc.gov.in

8. https://bhuvan.nrsc.gov.in/
9. https://www.e-education.psu.edu/geog862/node/1407

Title of Course:On Job Training/Field Project

Course Code: FPR39GEO21
Total Credits: 04
Course Outcomes:

On completion of this course, the student shall be able to
1. Improve their professional skills related to their employability.
2. Carry out field project on their own.
3. Effectively manage the assigned workload and complete given tusk.
4. Learn new concept and improve their knowledgebase.
5. Do team work and manage on job practical difficulties.

Duration:
One month during vacation

Joining Report of On Job Training:
Students are expected to join for their on job training with prior intimation to the department. They are expected to carry out work under the guidance of job supervisor.

On Job Training Placement:
Students can join any institution/ corporation/ industry as per their choice but within the scope of the subject area.

Total Contact Hours: 120 Hrs.
Note (s):
1. Students need to submit report of their work in prescribed format.
2. Internal assessment while on job training will be done by the job supervisor and need to be forwarded to the Department.