

Shivaji University, Kolhapur.



Revised Syllabus For

P.G. DIPLOMA IN GEOINFORMATICS

to be implemented from the academic year 2018-19

(June 2018) onwards.

PG Diploma in Geoinformatics (1 year)

Course Type: Annual (Self-financed)

Course Duration: 1 Year (starting from June-July every year)

Eligibility: Graduate in any discipline

Desirable: Knowledge of computer applications

No. of Seats: = 35 [Merit list will be prepared based on Graduation marks (60% weightage) and Interview (40% weightage)]

Fees:Rs.25,000/- Tuition fees plus other university fee (Annual)

Commencement of Classes: First week of July every year

Class Date & Time: Monday to Friday - 2.00 to 6.00PM

Course Structure:

Paper Code	Paper Type	Title of the Paper	Total Marks
PGD-101	Theory	Surveying, Cartography and GPS	100
PGD-102	Theory	Fundamentals of Remote Sensing and Digital Image Processing	100
PGD-103	Theory	Fundamentals of Geographical Information System (GIS)	100
PGD-104	Practical	Surveying, Cartography and GPS	100
PGD-105	Practical	Photogrammetry, Remote Sensing and Digital Image Processing	100
PGD-106	Practical	Geographical Information System (GIS)	100
PGD-107	Project	Dissertation (4 months), Seminar & Viva-voce	100
PGD-108	Internship	Internship (One month)	100
Theory: 300 marks, Practical: 300 marks, and Project: 100 marks Internship: 100 Total:			800

Scheme of Examination:

There will be an **internal evaluation of 30 marks** in each theory paper (excluding practical paper and project). Internal evaluation marks include class test (10 marks), Assignment (10 marks) and seminar (10 marks) for theory papers and for practical papers, internal evaluation based on Practical assignments would be of 30 marks and final practical examination would be of 70 marks [practical Paper (60 marks) and viva voce (10 marks)].

Dissertation/Project Guide will be decided by the course co-ordinator/ HoD based on the student's area of interest and availability of teachers. Dissertation/Project report

should be submitted one week before commencement of Semester-end examination(theory/practical).Studentsmay also completetheprojectundertheguidanceof scientists/facultyworkinginreputedinstitutionorGovt.laboratories havingprior approval from the department.

Dissertation would be of 100 marks in that 50 marks would be given to project report and 50 marks will be given for presentation and viva voice.

Internship of one month in reputed company is compulsory for each student. It will be of 100 marks.

Scheme of examination:

Examination will be conducted at the end of the academic year. A candidate who fails in a paper or papers can reappear for the same in the subsequent year. A candidate failing in the dissertation shall be required to resubmit his work in the next academic year. The table gives a detailed account of the scheme of papers.

Passing minimum of marks:

A candidate has to secure not less than 40 per cent of the marks in each paper to successfully complete thiscourse.

Pattern of question paper:

Theorypaperwouldbeof100marksandeachpaperwillhave70:30pattern.30 markswillbeforinternalevaluationthroughAssignment,seminarandinternaltestand 70 marks for final examination. In final examination, the theory question paper will be having followingpattern.

Question No.	Type of Question	No of questions to be asked	Number of questions to be answered.	Marks for each question	Total marks
1	Objective Type	5	5	2 marks	10
2	Short answer type	6	5	3 marks	15
3	Short note type	6	5	5 marks	25
4	Long questions	3	2	10 marks	20
Total marks					70

Theory I: Surveying, Cartography and GPS

Unit-1: Surveying (14)

The Earth: its shape and size; Datum and co-ordinate systems; Curvature of the Earth and its effect on surveying; Trigonometrical surveying; Calculation of height & distance; Introduction to surveying instruments: Theodolite, Total Station; Introduction to Drone Surveying.

Unit-2: Map Projection (10)

Concept, Classification, types and uses; Geographical and projected co-ordinate system and grid system; Choice and classification of map projections;

Unit-3: Cartography (12)

History and Development of Cartography; Sources of cartographic data; Scale: types & importance; Cartographic methods and techniques for preparation of maps and diagrams; Types and applications of General maps and Thematic maps; Introduction to Digital Cartography.

Unit-4: Global Positioning System (12)

Introduction to GPS; Types of GPS; GPS satellite; data receiver and control points; Differential GPS; Sources of GPS errors; Application of GPS in surveying, mapping and navigation.

References:

1. Bailey, T. and Gatrell, A. C. (1995): Interactive Spatial Data Analysis. Longman, Harlow.
 2. Dorling, D. and Fairborn, D. (1997): Mapping. Ways of Representing the World. Longman, Harlow.
 3. Fraser Taylor, D.R. (1980): The Computer in Contemporary Cartography. John Wiley and Sons, New York.
 4. Fraser Taylor, D.R. (ed.) (1983): Graphic Communication and Design in Contemporary Cartography. John Wiley and Sons, New York.
 5. Griffith, D. A. and Amrhein (1997): Multivariate Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
 6. Griffith, D.A. and Amrhein (1997): Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
 7. Kanetkar, T.P. and Kulkarni, S.V. (1967): Surveying and Levelling, Part II, A.V.G. Prakashan, Poona.
 8. Keates, J.S. (1973): Cartographic Design and Production, Longman Group Ltd.
 9. Maling, D.H. (1973): Co-ordinate Systems and Map Projections. George Philip and Sons Ltd.
 10. Monkhouse, F.J. and Wilkinson, H. R (1962): Maps and Diagrams, Methuen and Company Ltd. and Company Ltd., London.
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12. Nair, N. B. (1996): Encyclopaedia of Surveying, Mapping and Remote Sensing. Rawat Publications., Jaipur and NewDelhi.
 13. Raisz, E. (1962): Principles of Cartography. McGraw Hill Books Company, Inc., New York.
 14. Misra, R.P. and Ramesh, A. (1999): Fundamentals of Cartography. Concept Publishing Company, NewDelhi.
 15. Rhind, B. and Adams, T. (ed.) (1983): Computers in Cartography. British Cartographic Society, London.
 16. Rice Oxley, M.K. and Shearer, W.V. (1929): Astronomy for Surveyors. Methuen and Company Ltd. and Company, London.
 17. Robinson, A. H. H., Sale R., Morrison J. and Muehrcke, P. C (1984): Elements of Cartography. 6th edition John Wiley and Sons, New York.
 18. Shaw, G. and Wheeler, D. (1994): Statistical Techniques in Geographical Analysis. Prentice Hall, Englewood Cliffs, New Jersey.
 19. Singh, R. L. and Singh, Rana P.B. (1993): Elements of Practical Geography. Kalyani Publishers, Ludhiana and New Delhi. (English and Hindi editions).
 20. Strahler, A.N. (1971): The Earth Sciences. Harper and Row Publishers; New York.
 21. Thrower, N. (1996): Maps and Civilisation. Cartography, Culture and Society. University of Chicago Press, Chicago.
 22. Unwin, D. (1982): Introductory Spatial Analysis. Methuen and Company Ltd., London.
 23. Walford, N. (1995): Geographical Data Analysis. John Wiley and Sons, Chichester.
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Theory II: Fundamentals of Remote Sensing and Digital Image Processing

Unit-1: Introduction & Principles of Remote Sensing (16)

Basics: Definition and scope of remote sensing; History and development of remote sensing technology; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Atmospheric window and spectral reflectance curve; Resolutions in remote sensing; Types of remote sensing; Principles and applications of optical, thermal & microwave remote sensing; Introduction to hyper-spectral remote sensing.

Unit-2: Aerial photography (10)

Aerial photographs: types, scale, & resolution; Types of aerial cameras and photographic films; Geometry of aerial photographs; Flight planning; Impact of season, time, & topography on aerial photographs; Parallax, relief displacement, and orthophotos; Elements of visual image interpretation; Aerial photos vs. satellite imagery;

Unit-3: Satellite remote sensing (12)

Satellite: types and their characteristics; Types of Sensors; Orbital and sensor characteristics of major earth resource satellites: LANDSAT, SPOT, IRS, Sentinel & Quickbird; Recent developments of Indian remote sensing satellite programme; Environmental, meteorological & communication satellites.

Unit-4: Digital Image Processing (14)

Digital image: Introduction and data formats; Introduction to image processing; Sources of Errors: Geometric and radiometric; Image rectification; Image enhancement: methods and techniques; Spatial filtering; Image classification: supervised and unsupervised; Image accuracy assessment.

References

1. Aber, J.S., Marzoff, I., and Ries, J. (2010): *Small-Format Aerial Photography: Principles, Techniques and Geoscience Applications*, Elsevier, Amsterdam, 268pp.
 2. Campbell, J.B., and Wynne, R.H. (2011): *Introduction to Remote Sensing (5th Ed.)*, Guilford Press, New York, 667pp.
 3. Jensen, J.R. (2006): *Remote Sensing of the Environment: An Earth Resource Perspective (2nd Ed.)*, Prentice Hall, New Jersey, 608pp.
 4. Konecny, G. (2003): *Geoinformation: Remote sensing, Photogrammetry and Geographic Information Systems*, Taylor & Francis, London, 266pp.
 5. Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. (2007): *Remote Sensing and Image Interpretation (6th Ed.)*, Wiley, New Jersey, 804pp.
 6. Morgan, D., and Falkner, E. (2001): *Aerial Mapping: Methods and Applications (2nd Ed.)*, CRC Press, Boca Raton, Florida, 216pp.
 7. Quattrochi, D.A., and Goodchild, M.F. (1997): *Scale in Remote Sensing and GIS*, CRC Press, Boca Raton, Florida, 432pp.
 8. Reddy, M.A. (2008): *Textbook of Remote Sensing and Geographical Information System (3rd Ed.)*, BS Publications, Hyderabad, 476pp.
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9. Sabins, F.F. (2007): *Remote Sensing: Principles and Interpretation* (3rd Ed.), Waveland Press, Long Grove, Illinois, 512 pp.
10. Schowengerdt, R.A. (2006): *Remote Sensing: Models and Methods for Image Processing* (3rd Ed.), Elsevier, Amsterdam, 560 pp.
11. Wolf, P., DeWitt, B., Wilkinson, B. (2012): *Elements of Photogrammetry with Application in GIS* (4th Ed.), McGraw-Hill, New York, 640 pp.

Journals:

1. *Remote Sensing of Environment*
2. *ASPRS Photogrammetric Engineering and Remote Sensing*
3. *IJPRS Journal of Photogrammetry and Remote Sensing*
4. *International Journal of Remote Sensing*
5. *IEEE Transactions on Geosciences and Remote Sensing*
6. *IEEE Letters on Geosciences and Remote Sensing*
7. *Journal of the Indian Society of Remote Sensing*

Websites:

1. *Indian Space Research Organisation (ISRO), India: <http://www.isro.org>*
 2. *National Remote Sensing Centre (NRSC), India: <http://www.nrsc.gov.in>*
 3. *National Aeronautics and Space Administration (NASA), USA: <http://www.nasa.gov>*
 4. *National Oceanic and Atmospheric Administration (NOAA), USA: <http://www.noaa.gov>*
 5. *United States Geological Survey (USGS), USA: <http://www.usgs.gov>*
 6. *International Society for Photogrammetry and Remote Sensing (ISPRS): <http://www.isprs.org>*
 7. *Wikimapia: <http://www.wikimapia.org>*
 8. *Bhuvan: <http://www.bhuvan.nrsc.gov.in>*
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Theory III: Fundamentals of Geographical Information System

Unit 1: Introduction to GIS (10)

Definition of GIS, History and development of GIS, Components of GIS, Hardwares and Softwares, GIS operations, Future of GIS.

Unit 2: Basic GIS (14)

Types of Geographic data; Raster and Vector data model: Advantages and Disadvantages; Fundamental of data storage: block code, run length code, chain code, quad tree; Spatial data input: Digitization and Conversion; Point, line and polygon; Concept of Arc, node and vertices; Digitization errors; Topological relationship; Topology: Error and editing.

Unit 3: GIS Analysis (12)

Vector data analysis: Buffering, Overlay analysis, Network analysis; Raster data analysis; Interpolation techniques in GIS; Terrain analysis: DEM, DTM and TIN, Viewshed Analysis; Non-spatial data: Database Management system (DBMS), Relational data model (tables and relationships), Spatial queries.

Unit 4: Applications of Geospatial Technology (12)

Geospatial Technology in Urban and Regional planning, Water resource management, Soil resource Management, Agriculture & Crop Monitoring, Forestry and Environment, Public utilities, Land use/ land cover mapping, Landform analysis and Natural hazards assessment.

References:

1. Adriaans, P., and D. Zantinge. 1996. Data Mining. New York: Addison-Wesley.
 2. Bernhardsen, Tor. 1999. Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc.
 3. Bishop, Michael P. and Shroder, John F. (Eds.) 2004. Geographic Information Science and Mountain Geomorphology. Chichester, U.K.: Praxis Publishing (Springer). 11
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10. Clarke, Keith C. 2001. Getting Started with Geographic Information Systems (3rd Ed.) (Prentice Hall Series in Geographic Information Science). Upper Saddle River, New Jersey: Prentice Hall.
 11. DeMers, Michael N. 2000. Fundamentals of Geographic Information Systems (2nd Ed.) (Wiley Student Edition). New York: John Wiley & Sons, Inc.
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 13. Gregory, D. 1978. Ideology, Science and Human Geography. New York: St. Martin's Press.
 14. Heywood, Ian; Cornelius, Sarah; and Carver, Steve. 2000. An Introduction to Geographical Information Systems (Pearson Education Asia Low Priced Edition). Longman.
 15. Kraak, Menno-Jan and Ormeling, Ferjan. 2004. Cartography – Visualization of Geospatial Data (2nd Ed.) (Pearson Education Low Price Edition). Pearson Education.
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 22. Schuurman, Nadine. 2004. GIS – A Short Introduction. Blackwell Publishing.
 23. Zeiler Michael, 2002, Modeling Our World, The ESRI Guide to Geo Data Base Design, Environmental Systems Research Institute, Inc., Redlands, California, USA-92373-8100.
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Practical I: Surveying, Cartography and GPS

Practical in Surveying

1. Introduction to Surveying
2. Dumpy level surveying
3. Theodolite surveying
4. Total station Surveying
5. Introduction to DGPS

Practical in Cartography:

6. Introduction to Map Scale
7. Vertical exaggeration of map
8. Enlargement and reduction of map
9. Map Projection
10. Introduction to SOI topographical maps
11. Interpretation of SOI maps
12. Relief representation techniques
13. Digital Cartography: Choropleth maps, Isopleth maps, Dot maps, Cadastral and thematic maps

Practical in GPS

14. GPS instrument
15. Basic functions
16. GPS surveying: Setting of GPS coordinates, Waypoints demarcation, Area Calculation through GPS, Navigation by Mobile GPS application.
17. Transfer of data in GIS software

References:

1. Bailey, T. and Gatrell, A. C. (1995): Interactive Spatial Data Analysis. Longman , Harlow.
2. Dorling, D. and Fairborn, D. (1997): Mapping. Ways of Representing the World. Longman, Harlow.
3. Fraser Taylor, D.R. (1980): The Computer in Contemporary Cartography. John Wiley and Sons, New York.
4. Fraser Taylor, D.R. (ed.) (1983): Graphic Communication and Design in Contemporary Cartography. John Wiley and Sons, New York.
5. Griffith, D. A. and Amrhein (1997): Multivariate Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
6. Griffith, D.A. and Amrhein (1997): Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
7. Kanetkar, T.P. and Kulkarni, S.V. (1967): Surveying and Levelling, Part II, A.V.G. Prakashan, Poona.
8. Keates, J.S. (1973): Cartographic Design and Production, Longman Group Ltd.

9. Mailing, D.H. (1973): Co-ordinate Systems and Map Projections. George Philip and Sons Ltd.
10. Monkhouse, F.J. and Wilkinson, H. R (1962): Maps and Diagrams, Methuen and Company Ltd. and Company Ltd., London.
11. Nag, P. (ed.) (1984): Census Mapping Survey, Concept Publishing Company, New Delhi.
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13. Raisz, E. (1962): Principles of Cartography. McGraw Hill Books Company, Inc., New York.
14. Misra, R.P. and Ramesh, A. (1999): Fundamentals of Cartography. Concept Publishing Company, New Delhi.
15. Rhind, B. and Adams, T. (ed.) (1983): Computers in Cartography. British Cartographic Society, London.
16. Rice Oxley, M.K. and Shearer, W.V. (1929): Astronomy for Surveyors. Methuen and Company Ltd. and Company, London.
17. Robinson, A. H. H., Sale R., Morrison J. and Muehrcke, P. C (1984): Elements of Cartography. 6th edition John Wiley and Sons, New York.
18. Shaw, G. and Wheeler, D. (1994): Statistical Techniques in Geographical Analysis. Prentice Hall, Englewood Cliffs, New Jersey.
19. Singh, R. L. and Singh, Rana P.B. (1993): Elements of Practical Geography. Kalyani Publishers, Ludhiana and New Delhi. (English and Hindi editions).
20. Strahler, A.N. (1971): The Earth Sciences. Harper and Row Publishers; New York.
21. Thrower, N. (1996): Maps and Civilisation. Cartography, Culture and Society. University of Chicago Press, Chicago.
22. Unwin, D. (1982): Introductory Spatial Analysis. Methuen and Company Ltd., London.
23. Walford, N. (1995): Geographical Data Analysis. John Wiley and Sons, Chichester.

Practical II: Photogrammetry, Remote Sensing and Digital Image Processing

Practical in Photogrammetry

1. Indexing of aerial photographs.
2. Introduction to vertical aerial photographs and its geometry.
3. Introduction to stereoscopes
 - i) Orientation & construction of 3-D model under Pocket stereoscope.
 - ii) Orientation & construction of 3-D model under Mirror stereoscope.
 - iii) Stereoscopic Vision test
4. Determination of scale
 - i) By establishing relationship between Photo distance and Ground distance
 - ii) By establishing relationship between Photo distance and Map distance
 - iii) By establishing relationship between Focal length and Flying height
 - iv) Determination of Average Scale of Vertical Aerial Photograph
5. Relief Displacement
 - i) Calculation of Relief Displacement
 - ii) Object height determination from relief Displacement
6. Parallax
 - i) Introduction to Parallax bar
 - ii) Object height determination from Parallax
7. Visual Interpretation and Mapping of Aerial photographs: Land use/ Land cover mapping

Practical in Satellite Remote Sensing

8. Annotations of Satellite image
9. Study of satellite image browsing system
10. Visual interpretation of FCC satellite image and Land use/ Land cover mapping

Practical in DIP:

11. Introduction to DIP software
12. Loading of image data, study of histogram and layer information
13. Image Rectification and Registration: Image to map, Image to image
14. Image Enhancement Techniques: Contrast enhancement-linear and non-linear
15. Density slicing
16. Spatial filtering- low and high frequency, edge enhancement
17. Band ratioing.
18. Resolution merge
19. Supervised Classification
20. Unsupervised classification
21. Accuracy assessment
22. Hyperspectral Image Analysis

References:

1. American Society of Photogrammetry, (1983). Manual of Remote Sensing, (2nd edition), ASP, Falls Church, Virginia.
2. Agarwal, C.S. and Garg, P.K. 2000. Textbook of Remote Sensing in Natural Resources Monitoring and Management. New Delhi: Wheeler Publishing.

3. Avery, T.E. 1985. Interpretation of aerial Photographs. Minneapolis, Minnesota: Burgess Publishing Company.
4. Bakker, Wim H., et al. 2001. Principles of Remote Sensing – An Introductory Textbook. Enschede, The Netherlands: ITC.
5. Banerjee, R.K. and Banerjee, B. 2000. Remote Sensing for Regional Development. New Delhi: Concept Publishing Company.
6. Campbell, James B. 1996. Introduction to Remote Sensing (Second Edition). London: Taylor & Francis.
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9. Jensen, John R. 2000. Remote Sensing of the Environment – An Earth Resource Perspective. Pearson Education (First Indian Edition, 2003).
10. Hord, R. Michael. 1986. Remote Sensing – Methods and Applications. (A Wiley-Interscience Publication). New York: John Wiley & Sons.
11. Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. 2004. Remote Sensing and Image Interpretation (5th Ed.). Wiley. (Wiley Student Edition).
12. Miller, V.C. 1961. Photogeology. New York: McGraw-Hill, Book Company, Inc.
13. Moffitt, H.F., and Edward, M.M., 1980. Photogrammetry, Harper and Row Publishers, New York.
14. Paine, D.P. 1981. Aerial Photography and Image Interpretation for Resource Management. John Wiley & Sons.
15. Panda, B.C. 2005. Remote Sensing – Principles and Applications. New Delhi: Viva Books Private Limited. 8
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17. Rashid, S.M. (Ed.) 1993. Remote Sensing in Geography. Delhi: Manak Publications, Pvt. Ltd.
18. Reddy, M.A. 2006. Textbook of Remote Sensing and Geographical Information Systems. Hyderabad: B.S. Publications.
19. Sabins F.F Jr. 1987, Remote Sensing: Principles and Interpretation, W.H. Freeman & Co., New York.
20. Wolf, P.R., 1974. Elements of Photogrammetry, McGraw Hill books Co., London.

Practical III: Geographical Information System

Introduction to QGIS:

1. Introduction of QGIS.
2. Projection and Reprojection.
3. Georeferencing: Toposheet & Image Registration.
4. Digitization of Toposheet.
5. Map preparation or Map Layout.
6. Data exploration & working with tables.
7. Data query: Spatial & Attribute.
8. Working with Google Earth.

Introduction to ArcGIS:

1. Overview of ArcGIS: Introduction ArcMap, ArcCatalogue and ArcToolbox.
2. Data formats in ArcGIS: shape and coverage file, import of data, feature class, geodatabase, dataframes, displaying qualitative/quantitative features, labeling features.
3. Georeferencing in ArcGIS: Coordinating system, datum conversion, map projection, storing and viewing projection information.
4. Vector data: creating new features, editing functions, digitization, errors and creation of topology.
5. Aspatial data: Understanding tables, field types, table manipulation, table relation, creation of graphs and reports.
6. Spatial analysis: Query by location/attribute, Buffer, overlay analysis, Interpolation methods, Viewshed analysis.
7. Applications: Calculation of vegetation Indices, slope & Contour, Network Analysis.
8. Map design: Layout and map composition.

Introduction to AutoCAD:

1. AutoCAD Screen Components, Working with Commands and Introduction to drawing reading.
2. Basic Drawing & Editing Commands: Drawing Lines, Erasing Objects, Drawing Rectangles, Drawing Circles, Object Snap Tracking.
3. Making Changes in Drawing: Selecting Objects for Editing, Moving, Copying, Rotating, Scaling, Mirroring Objects.
4. Advanced Object Types: Drawing Arcs, Drawing Polylines, Offsetting Objects, Editing Polylines, Drawing Ellipses, and Properties.
5. Working with Layers: Creating New Layers, Making a Layer Current, Deleting Layers
6. Basic Introduction to 3D Mapping.
7. Advanced Layouts and Printing.

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1. Adriaans, P., and D. Zantinge. 1996. Data Mining. New York: Addison-Wesley.
2. Bernhardsen, Tor. 1999. Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc.
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Information Systems – Spatial Information Systems and Geostatistics. Oxford University Press.

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18. Mitchell, A., 1999, The ESRI Guide to GIS Analysis Volume 1: Geographical Patterns and Relationships, Environmental Systems Research Institute, Inc., Redlands, California. USA 92373-8100
19. Mitchell, A., Booth Bob and Crosier Scott, 2002, Getting Started with ArcGIS. Environmental Systems Research Institute, Inc., Red Lands, California. USA - 92373-8100
20. Mitchell, A., Booth Bob and Crosier Scott, 2002, Arc GIS Spatial Analyst Environmental Systems Research Institute, Inc., Red Lands, California. USA-92373-8100.
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22. Pickles, J. 1997. "Tool or Science? GIS, Technoscience, and Theoretical Turn." Annals of the Association of American Geographers, vol. 87, pp.363-372.

23. Schuurman, Nadine. 2000. "Trouble in the Heart land: GIS and its Critics in the 1990s." Progress in Human Geography, vol. 24, no. 4, pp.569-590.
24. Schuurman, Nadine and G. Pratt. 2002. "Care of the Subject: Feminism and Critiques of GIS." Gender, Place and Culture, vol. 9, no. 3, pp.291-299.
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