

**SYLLABUS  
FOR  
ONE YEAR POSTGRADUATE DIPLOMA  
IN  
GEOMATICS (GIS/RS)**



**DEPARTMENT OF GEOGRAPHY  
UNIVERSITY OF PESHAWAR**

**M DEPARTMENT OF GEOGRAPHY,  
UNIVERSITY OF PESHAWAR, PAKISTAN**

**SCHEME OF STUDY FOR POST-GRADUATE DIPLOMA IN GEOMATICS**

**Theme of the Diploma Programme**

The task of managing land and the earth's resources is becoming increasingly important as a result of the increasing world population and economic growth. To keep pace with demand, planners and resource managers now make considerable use of complex and powerful computerized Geographical Information Systems (GIS). GIS users such as land and urban planners, resource managers and application scientists depend on the availability of up-to-date, well-structured data. Aerial photographs, satellite images, Global Positioning System and other attribute data are often used as a source, along with modern techniques. Technical means are necessary to extract data from these sources and to georeference the data accurately. Furthermore, systems are required to manipulate the spatial data and present it in quality maps and other output. To achieve this, it is essential to initiate a programme of Advanced Geomatics at post-graduate level.

**Objectives of the diploma programme**

The objective of the diploma programme is:

- To provide the students theoretical knowledge and practical training for the production, interpretation, analysis and display of spatial data and maps
- To train the students to interact judiciously with actual or possible phenomena of the world.
- To make students aware of in-depth knowledge of one specific (individually chosen) aspect of the Geomatic process.

**Outcome of the diploma programme:**

The programme is intended to train students to function at the supervisory level in rapidly changing map and geo-information production environments. It focuses on state-of-the-art technology.

**Eligibility criteria:**

BA/BSc. Furthermore, the Admission Committee will decide about the eligibility of the candidate's for the Diploma Course in which he/she is seeking admission.

**Length of study one year Post-graduate Diploma Programme consist of**

<i>Semester</i>	<i>Time Frame</i>	<i>Courses</i>	<i>Credit hours</i>
Semester- I	Five months First week of September to end of January	Compulsory courses Course no. Geog 601,602,603,604	12 credit hours
Semester- II	Five month First week of February to end of June	Optional courses	9 credit hour
Research project	2 month July & August	Application of GIS in related field	3 credit hour
Total	12 months		24 credit hour

**Admission Fee**

The Post-graduate Diploma Programme will be on self-support basis. The faculty of the department of Geography, Urban and Regional Planning, in close coordination with the faculty from related departments, University of Peshawar as well as from related national and international organizations will provide inputs in conducting courses.

## **Project & Seminar**

*Objectives and outcome:* The main thread running through the diploma course is "the integration of proficiency". After the two-semester period, students will interact and cooperate in a joint interdisciplinary project on a realistic data set. Such activities are designed to stimulate a broader appreciation of the entire production process. This final part of the course is devoted to two months individual, production-oriented project in the selected field. In this project, participants apply the knowledge and skills acquired during the course, and are encouraged to use data from various organizations.

The Diploma Course will include additional 3 Credit Hours projects of about 2 months that will address a specific topic for specialization.

- I. Project Report on selected fields: Related to Physical, Human, Environmental Geography and different sector of Economy.
2. Every student will prepare a Seminar under the guidance of a staff advisor and present the Seminar before the staff and students of the department.

## **SEMESTER I**

**Geog: 601**

**Credit hour: 3**

### **Fundamental of Geographic Information System (GIS)**

*Learning Objective:* To make students understand with the theoretical basis and practical training needed to build, manage database and perform spatial analysis using GIS tools.

**CONTENTS:** Introduction to GIS, Principles and Concepts of GIS, GIS Database Management and Development, GIS data sources, Digitisation of data/output, management, manipulation, analysis, modeling output and organization, new way of looking GIS data and GIS technology, Need for trained individuals, introduction of ILWIS or Arc GIS or MapInfo or Arc view or ERDAS GIS Software. Digitisation of Point, line and polygon, GIS for analysis, Application of GIS as a tool in Development Projects e.g. Agriculture, Land Use Planning, Forestry and Wildlife Management, Archaeology, Geology, Socio-Economic and Municipal, Environmental Management and Monitoring, Change Detection, Global Scale Application.

#### **References**

1. Abrams, J. and Hall, P. (2006) "*Mapping— New Cartographies of Networks and Territories*". University of Minnesota Design Institute, Minnesota.
2. Aronoff, S. (1989) "*Geographic Information System: A management perspective*" W.D.L. publishers, Ottawa.
3. Aronoff, S. (2005) "*Remote Sensing for GIS Managers*". ESRI Press, New York.
4. Bernhardsen, T. (1992) "*Geographic Information System*". Viak IT, Myrene, Norway.
5. Burrough, P.A. (latest edition) "*Principles of Geographical Information Systems for land Resources Assessment*". Clarendon Press, Oxford.
6. Clark, K.C. (1997) "*Getting started with GIS*". Prentice Hall, New York.
7. Lillesand, H., Kiefer, M., and Ralph. W. (1994) "*Remote Sensing and Image Interpretation*". John Wiley Sons, Inc. New York.
8. Maginr, D. J. (1991) "*Geographic Information System*". Longman, London.
9. Masser, I. and Blakemore, M. (1991): "Handling Geographical Information: Methodology and Potential Applications". Longman. New York.

**Geog: 602**

**Credit hour: 3**

### **Digital Cartography**

*Learning Objective:* To train students in basic concepts of mapping, map reading, geodesy and coordinate systems used in GIS/RS practical exercises.

**CONTENTS:** Introduction to computer mapping and display, Cartography today, Need of maps, Basic characteristic of map, Types of maps, Map projection, Geographic coordinate system, Metric coordinate system, Direction of map, Scale references, Map scale and representation, Data models

for digital cartographic information, introduction to topographic sheets, internal and external information, spatial data, attribute data, data transformation, Map production.

### References

1. Abrams, J. and Hall, P. (2006) "*Else/Where: Mapping — New Cartographies of Networks and Territories*". University of Minnesota Design Institute, Minnesota.
2. Brewe, A. C. (2005) "*Designing Better Maps: A Guide for GIS Users*". ESRI Press. P. 220.
3. Carey, H. H. (1983) "*How to use maps and globe*". Franklin Watts, London.
4. Dink, P. (latest edition): "*Map Work*". Atma Ram and sons, New Delhi.
5. Ehrenberg, R. E. (2005) "*Mapping the world: An illustrated history of cartography*". National Geographic.
6. Maginr, D. J. (1991) "*Geographic Information System*". Longman, London.
7. Philip, L. (1961) "*Physical Geography*". London-University Press, London.
8. Shaheen, F. (1998): "*A New Geography Book on Map Work and Field Work*". A.H. Publishers, Lahore.
9. Singh, R.L. (Latest edition) "*Elements of Practical Geography*". Kalyani Publisher, New Delhi.
10. Strahler, A. and Strahler, A. (1994) "*Introduction to Physical Geography*". John Wiley & Sons, Inc. New York.

**Geog: 603**

**Credit hour: 3**

### **Introduction to Remote Sensing**

**Objectives:** This course is designed to make students aware about the basic concepts regarding remote sensing data capturing, classification, analysing, monitoring and mapping for geo-information production.

#### **CONTENTS:**

- i. Introduction:** Remote Sensing, Electromagnetic Radiation, Electromagnetic Spectrum, Interactions with the Atmosphere, Radiation, Passive versus. Active Remote Sensing, Characteristics of Images
- ii. Sensors:** Sensors (on the Ground, In the Air, In Space), History of remote sensing, Satellite Characteristics, Pixel Size and Scale, Spectral Resolution, Radiometric Resolution, Temporal Resolution, Cameras and Aerial Photography, Multi-spectral Scanning, Thermal Imaging, Geometric Distortion, Weather Satellites, Land Observation Satellites, Marine Observation Satellites, Other Sensors, Data Reception
- iii. Microwaves:** Introduction, Radar Basic, Viewing Geometry & Spatial Resolution, Image distortion, Target interaction, Image Properties
- iv. Image Analysis:** Introduction, Visual interpretation, Digital processing, Pre-processing, Enhancement, Transformations, and Classifications

#### **References**

1. Aronoff, S. (2005) "*Remote Sensing for GIS Managers*". ESRI Press, New York.
2. Canada Centre for Remote Sensing (2005) "*Fundamentals of remote sensing*". Remote Sensing Tutorial, Natural Resources, Canada.
3. Carleton .A. (1990) "*Satellite Remote sensing in climatology*". CBS publishers and distributor, New Delhi
4. Carter D.J. (1986) "*The remote sensing*". Mc Carta LTD, London
5. Davis .S. (1978) "*Remote sensing the Quantitative approach*". McGraw-Hill New York
6. European Space Agency (1988) "*Remote sensing moving towards the 21<sup>st</sup> century*". Proceeding of international geosciences and Remote sensing Symposium.12-16 September 1988 volume I, Edinburgh U.K.
7. Lillesand, T. M. (2006) "*Remote sensing and image interpretation*". John Wiley & Sons, Inc. New York
8. Michael H.R. (1986) "*Remote Sensing method and application*". John Wiley and sons Inc. New York.

**Geog: 604**

**Credit hour: 3**

### **Fundamentals of Integrated Land and Water Information System**

**Learning objective:** To train students in Ilwis GIS, and practical exercises in preparation, integration and analysis of geo-spatial data.

**CONTENTS:** Introduction to ILWIS, Displaying geographic data, Structure of spatial data in ILWIS, Displaying maps and Layer management, about domains, coordinates, representation and table, Attribute data, pixel information, spatial data input, spatial data management, Attribute data handling, Image processing, spatial and non-spatial data imports, Spatial data analysis, retrieval, classification and measurement operations, Spatial data analysis, overlay operations, spatial data analysis, neighbourhood and connectivity operations, Using digital Elevation Models, geostatistical tools, Presentation of results.

#### **References**

1. ITC (2001) “*ILWIS Academic User’s Guide*”. International Institute for Aerospace Survey and Sciences, Netherland.
2. Aronoff, S. (2005) “*Remote Sensing for GIS Managers*”. ESRI Press, New York.
3. ITC (2002) “*ILWIS Application Guide*”. International Institute for Aerospace Survey and Sciences, Netherland.
4. Maginr, D. J. (1991) “*Geographic Information System*”. Longman, London.

## **SEMESTER II**

**Geog: 605**

**Credit hour: 3**

### **Digital Image Processing**

**Learning objective:** To train students in ERDAS imagine as GIS software, its uses, integrating the spatial data as well as analysis and application in practical exercises.

**CONTENTS:** The concept of Electromagnetic Spectrum, Sensor Systems (Orbits, Satellites, Sensors and Platforms), Digital Image Processing Cycle Overview, Introduction to ERDAS Imagine, Display preferences, Raster data, vector data, Data imports and export, map projection systems, image rectification, image to image rectification, Map digitization, vector data editing, colour composites, Band ratio, map subsets, map Composing, image classification, supervised and unsupervised classification, Vector data Querying, Image interpretation, Mosaic formation, Viewshed Analysis, Data display, layout formation, Spatial Models.

#### **References**

1. ERDAS imagine tour guide (2004) “*IMAGINE ESSENTIALS*”.
2. Aronoff, S. (2005) “*Remote Sensing for GIS Managers*”. ESRI Press, New York.
3. Maginr, D. J. (1991) “*Geographic Information System*”. Longman, London.

**Geog: 606**

**Credit hour: 3**

### **Arc-view GIS and its function**

**Learning Objective:** To train students in Arc-view GIS software, its uses, analysis and application in practical exercises.

**CONTENTS:** Introduction to Arc-View GIS; Creating map, Adding tabular data to map, Adding addresses and other location to map, Symbolizing your data, Labelling maps with text and graphics, creating new data, choosing map Projection, Layout and printing maps; Getting the attributes of features, Finding feature with particular attributes, Finding features near other feature, Finding feature that fall inside polygons, Finding features that intersect other feature, Working with the feature, Aggregating your data; Creating and editing spatial data, using a digitising tablet, using other types of data, working with images, working with other drawings; Analysis of existing spatial data, checking pixel information, display of spatial data.

#### **References**

1. Aronoff, S. (2005) “*Remote Sensing for GIS Managers*”. ESRI Press, New York.
2. Dent, D. B. (2002) “*Cartography with Arc View GIS Software*”. McGraw-Hill, New York.

3. Environmental Systems Research Institute (ESRI) (1999) “*Arc-view (version 3.1) user’s guide book*”. Environmental Systems Research Institute, Inc. New York.
4. ESRI (1996) “*Arc view spatial analyst: advanced spatial analysis using raster and vector data*”. Environmental Systems Research Institute, Inc. New York
5. ESRI (1999) “*Arc view (version 3.1) Application user guide book*”. Environmental Systems Research Institute, Inc. New York.
6. ESRI (1999) “*Arc-view 3D Analyst application user’s guide-book*”. Environmental Systems Research Institute, Inc. New York.
7. ESRI (1999) “*Arc-view Network Analyst Application user guide book*”. Environmental Systems Research Institute, Inc. New York.
8. ESRI (1999) “*Arc-view spatial data analyst application user guide book*”. Environmental Systems Research Institute, Inc. New York.
9. Maginr, D. J. (1991) “*Geographic Information System*”. Longman, London.

**Geog: 607**

**Credit hour: 3**

### **Global Positioning System (GPS) and Basic Geodesy**

**Learning objective:** *To train students in collecting geo-spatial data through GPS for determining position, altitude, track, velocity and time in a common reference system on the Earth and export to GIS system.*

**CONTENTS:** Introduction GPS, Reference system, GPS Satellite Orbits, Propagation of the GPS Signals, GPS Receivers and the observable, GPS Observation and positioning concept, GPS data processing methodology, Quality control and GPS, GPS carrier phase, Ambiguity Fixing concept, Fixing concepts, Active GPS measurements, GPS as a tool in Global Geodynamics, Atmospheric Models from GPS, Spherical earth, ellipsoidal earth, geoidal earth, Cartographical use of the sphere, Geographical coordinates, Latitude longitude, Properties of the graticule, Determination, Horizontal control Network, Vertical control, data export from GPS

**References**

1. Aronoff, S. (2005) “*Remote Sensing for GIS Managers*”. ESRI Press, New York.
2. Kleusberg, A. and Teunissen (1996) “*GPS for Geodesy*”. Lecture Notes in earth sciences, Springer –Verlag, vol.60.
3. Krakiwsky, E. J. Vanicek (1986) “*Geodesy: The concept*”. Elsevier Science publishing Co.
4. Maginr, D. J. (1991) “*Geographic Information System*”. Longman, London.
5. Smith. J.R. (1997) “*Introduction to geodesy: The history and concept of Modern geodesy*”. John Wiley and Ltd. London.
6. El-Rabbany, A. (2006) “*Introduction to GPS: The Global Positioning System*”. Artech House Publishers, Boston.

**Geog: 608**

**Credit Hour: 3**

### **Aerial Photo Interpretation**

**Learning Objectives:** *To make students understand in interpretation of aerial photographs to obtain quantitative and qualitative information about the earth surface, its cultural and physical landscape.*

**CONTENTS:** Introduction to aerial photography, History of aerial photography, Field of photogrammetry, Essentials for the study of aerial photograph, Drawing of maps from aerial photos. Purpose of aerial photographs, Photo readings, Mosaics, Creation of stereo model, Necessity for ground control points, quality of aerial photo, Principles of photo interpretation, Types of photographs, Grey tones: definition, factors affecting grey tones, actual terrain colour, Aerial Photographic scales in Pakistan, Application of aerial photographic techniques to the various fields.

**Reference**

1. Ghosh, S. K. (1988) “*Analytical photogrammetry*”. Pergamon Press, New York.
2. Leuder, D. R. (latest edition) “*Aerial photographic interpretation*”. McGraw-Hill, London.

- Lillesand, T. M. (2006) *“Remote sensing and image interpretation”*. John Wiley & Sons, Inc. New York.
- Robinson, et al. (1995) *“Elements of Cartography”*. John Wiley and son, New York.
- Tewinkel, G. C. (Latest edition) *“Manual of Photographic interpretation”*. American society of photogrametry, Washington.

**Geog: 609**

**Credit Hour: 3**

### **Advanced Remote Sensing Applications**

**Learning Objectives:** To make students understand in using high-resolution multispectral data, sophisticated image processing softwares, theory and application of image processing techniques.

**CONTENTS:** Introduction to advanced remote sensing, Remote sensing and earth energy budget, Electromagnetic spectrum and radiation, Physical foundation of Visible, Infrared and microwaves remote sensing, high and low resolution remote sensing, Theoretical explanation of reflection, absorption and transmission, High resolution multi-spectral data, advanced image processing softwares, Theory and application of image processing techniques, Accuracy testing, Height measurement techniques, Area measurement techniques, image enhancements: Geometric data correction, atmospheric data correction, radio-metric data correction, transformations and classification.

#### **Reference:**

- Aronoff, S. (2005) *“Remote Sensing for GIS Managers”*. ESRI Press, New York.
- Canada Centre for Remote Sensing (2005) *“Fundamentals of remote sensing”*. Remote Sensing Tutorial, Natural Resources, Canada.
- Carleton .A. (1990) *“Satellite Remote sensing in climatology”*. CBS publishers and distributor, New Delhi
- Carter D.J. (1986) *“The remote sensing”*. Mc Carta LTD, London
- Davis .S. (1978) *“Remote sensing the Quantitative approach”*. McGraw-Hill New York
- European Space Agency (1988) *“Remote sensing moving towards the 21<sup>st</sup> century”*. Proceeding of international geosciences and Remote sensing Symposium.12-16 September 1988 volume I, Edinburgh U.K.
- Lillesand, T. M. (2006) *“Remote sensing and image interpretation”*. John Wiley & Sons, Inc. New York
- Michael H.R. (1986) *“Remote Sensing method and application”*. John Wiley and sons Inc. New York.

**Geog: 610**

**Credit hour: 3**

### **MapInfo, its uses and application**

**Learning objective:** To train students in MapInfo GIS software, its uses, integrating the spatial data as well as analysis and application.

**CONTENTS:** Introduction to MapInfo, main concept of MapInfo, data input, manipulation of data, spatial data input, data output, projection and coordinate system, conversion tool and its uses, spatial objects, Data base development and management, attribute data handling, spatial data analysis, layout of spatial data, data base query, saving of layout in raster format, display of spatial and attribute data, and presentation of result in the form of maps, diagrams and tables.

#### **References**

- Maginr, D. J. (1991) *“Geographic Information System”*. Longman, London.
- MapInfo (1998) (version 5.2) user’s guide book
- MapInfo (1999) (version 5.12) application user’s guide book
- MapInfo (2005) (version 8) application user guide book

**Geog: 611**

**Credit hour: 3**

### **Introduction to Spatial Analysis**

**Learning objective:** This course provides a detailed examination of the common spatial analytical tools used in a Geographical Information Systems environment. The students will understand the both vector and raster data analysis in a spatial context. Spatial analyses will be carried out using mainly ESRI's ArcGIS.

**Contents:** Understanding the concept (vector, raster and statistical analysis), Thematic Mapping, data input sources, vector and raster data, Spatial data input, Spatial data management, handling attribute data, spatial data analysis, Import and export of data, handling satellite images, data base development, data base management, Data query, development of TIN models, Digital Elevation Model, Data display, presentation of result in the form of maps, diagrams and tables

#### **References**

1. Burke, R., Napoleon, E. and Ormsby, T. (2004) "Getting to Know ArcGIS Desktop: The Basics of ArcView, ArcEditor, and ArcInfo Updated for ArcGIS 9". ESRI Press, New York.
2. Dent, D. B. (2002) "Cartography with Arc View GIS Software". McGraw-Hill, New York.
3. Environmental Systems Research Institute (ESRI) (1999) "Arc-view (version 3.1) user's guide book". Environmental Systems Research Institute, Inc. New York.
4. Environmental Systems Research Institute (ESRI) (2001-2002) "Arc-GIS (version 8.2) user's guide book". Environmental Systems Research Institute, Inc. New York.
5. ESRI (1999) "Arc-view 3D Analyst application user's guide-book". Environmental Systems Research Institute, Inc. New York.
6. ESRI (1999) "PC Arc-info user's guide 1999". Environmental Systems Research Institute, Inc. New York.
7. ESRI (2001-2002) "Arc map (version 8.2) user's guide book 2001-2002". Environmental Systems Research Institute, Inc. New York.
8. ESRI (2001-2002) "Arc-Catalogue (version 8.2) user guide book 2001-2002". Environmental Systems Research Institute, Inc. New York.
9. ESRI (2001-2002) "Arc-GIS (version 8.2) application user's guide book". Environmental Systems Research Institute, Inc. New York.
10. Maginr, D. J. (1991) "Geographic Information System". Longman, London.

**Geog: 612**

**Credit hour: 2**

### **Quantitative techniques**

**Learning objectives:** To train students in collection, analysis, interpretation, presentation of quantitative data.

**CONTENTS:** Introduction to quantitative techniques, Data and information, Measurement of central tendency, Measurement of Dispersion, Universe and population, Sampling and type sampling, Probability Theory, Statistical diagrams, the Normal Distribution Curve, Tests of Significance, Non-Parametric Tests, Correlation and Regression, The Analysis of Variance.

#### **References**

1. Bhatti, I. A. (latest edition) "Statistics made easy". Bhatti Publishers, Jhelum.
2. Chapman, J. and McGraw, J. R. (1993) "An introduction to statistical problems solving in Geography". WCB, Oxford.
3. Matthew, H. and Foster, I. (1989) "Geographical data: sources, presentation and analysis". Oxford university press, Oxford.
4. Zia-ud-Din, M. (1990) "Elementary statistics". S. Chand, New Delhi.



**Geog: 613**

**Credit Hours: 3**

### **GIS Programming**

**Learning Objectives:** *This course attempts to provide a foundation for application development using VBA. This course produces the skills to create typical GIS programming tasks.*

**CONTENTS:** Introduction to GIS programming, fundamentals of geo-processing, fundamentals of Python, using variables, naming conventions and reserved words, testing and printing variable values, Looping and control structures, Debugging, optional and required parameters, Objects, properties and methods, Object Model Diagrams, The geo-processor object, Functions and parameters, passing and returning values, Multiple inputs and complex parameter passing, Selections and sets, SQL basics, Writing results to disk, various formats and switches, other useful modules, Presentations

#### **References**

1. Bugg, K.E (2003) “*GIS Programming: Prepare for the Gathering Storm*” GEO.
2. Kropla, B. (2005) “*MapServer: Open Source GIS Development*”. Apress, Co. ISBN: 1590594908
3. Ralston, B. A. (2002) “*Developing GIS Solutions with MapObjects and Visual Basic*”. Onword Press, New York. ISBN: 0766854388
4. Rigaux, P. Scholl, M. and Voisard, A. (2001) “*Spatial Databases: With Application to GIS*” Morgan Kaufmann; 2nd edition. ISBN: 1558605886.

**Geog: 614**

**Credit hour: 2**

### **Research Methods**

**Learning objective:** *To make students aware about the research methods of formulating research project proposal, data collection, writing, analysing and display of data.*

#### **CONTENTS:**

Introduction, Selection and Formulation of Research Problems, Research Design, Scientific concept, Scientific Hypothesis in social Research, Sampling, Methods, instruments and Techniques of data collection, Analysis and interpretation of data, Presentation of data.

#### **Reference**

1. Chaudry, M.I. (1984) “*Social Theory (Research and problems)*”. Aziz publisher, Lahore.
2. Giber, N (1993) “*Research Social Life*”. Sage Publication, London.
3. Neuman, W. L. (2005) “*Social Research Methods: Quantitative and Qualitative Approaches*”. Allyn & Bacon/Longman publishers, London.
4. Roddy ,C. R. (1987) “*Research Methodology in social sciences*”. Days publishing House, New Dehli.
5. Verma, V. (1988) “*Methodology of Research and Techniques*”. Unmole publishers, New Delhi.