

**UNIVERSITY OF PUNE**  
**DEPARTMENT OF GEOGRAPHY**

**Credit System (P. G. B. Sc. (Applied) in GIS and Remote Sensing): Details of the Courses and Credits – 2014**

COURSE CODE	COURSE TITLE	CREDITS per Course	Credits to be completed	
			Course-wise	semester-wise
	<b>SEMESTER I</b>			
	Concepts in Geography (Non-credit course)			
GR 101	Introduction to Remote Sensing	4	<b>4</b>	
GR 102	Introduction to Geographic Information System	4	<b>4</b>	
GR 103	Cartography and Map Interpretation	3	<b>3</b>	
GR 104	Spatial Data Processing - I	3	<b>3</b>	
GR 105	Aerial Photo and Image Interpretation	3	<b>3</b>	
GR 106	Programming in C and C++	3	<b>3</b>	
	<b>Total credits in the semester</b>	<b>20</b>	<b>20</b>	<b>20</b>
	<b>SEMESTER II</b>			
GR 201	Digital Image Processing	3	<b>3</b>	
GR 202	Spatial Analysis	3	<b>3</b>	
GR 203	Application of GIS and RS Techniques	4	<b>4</b>	
GR 204	Image Data Processing	3	<b>3</b>	
GR 205	Spatial Data Processing - II	3	<b>3</b>	
GR 206	Programming in .NET and ArcObject	4	<b>4</b>	
	Pilot Project (Non-credit course)			
	<b>Total credits in the semester</b>	<b>20</b>	<b>20</b>	<b>20</b>
	<b>SEMESTER III</b>			
GR 301	Project Work	10	<b>10</b>	
	<b>Total credits in semester III</b>	<b>10</b>	<b>10</b>	<b>10</b>
	<b>TOTAL CREDITS</b>	<b>OFFERED</b>		<b>REQUIRED</b>
		<b>50</b>		<b>50</b>

## Semester I

Code No: GR: 101		Title: Introduction to Remote Sensing	
No. of Credits: 4		No. of Periods: 60	
Sr. No.	Topics	Sub-topics	Lectures
1	Introduction to Remote Sensing	Concepts, definition, history development, stages in RS-EMR, EMR spectrum, theories of EMR, types of RS and Laws of Radiation	15
2	Interaction of EMR	Interaction with Earth's atmosphere	12
3	Spectral Signature	Interaction with soil, water and vegetation	8
4	Platforms, Sensors, Orbits	Types of platform, types of sensors, cameras and satellite orbits	10
5	Aerial photography	Introduction to aerial photography and basic photogrammetry	12
6	Data products	Satellite data generation, formats and Aerial photography products	3

### Books:

1. Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India
2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
3. Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W. H. Freeman and Company, San Francisco
4. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
5. Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford
6. Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London
7. Anji Reddy, M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication, Hyderabad

Code No: GR: 102		Title: Introduction to Geographic Information System	
No. of Credits: 4		No. of Periods: 60	
Sr. No.	Topics	Sub-topics	Lectures
1	Introduction to GIS	Definitions, evolution, components and objectives	6
2	Hardware & Software requirements	Hardware: Basic blocks of computer, processor, memory, Secondary storage devices, input/output devices, Binary numbers. Software: Operating System, application, compilers, editors. Overview of GIS software packages	7
3	Spatial data	Types of geographic data, levels of measurements. Concepts of space and time, layers coverage. Spatial data models, Representation of geographic features in vector, raster data models. Concept of arc, node, vertices and topology. Object oriented models: advantages and disadvantages. Computer representation for storing spatial data: Block code, Run-length encoding, Chain coding, Quadtree. Issues governing choice of models.	12
4	Non-Spatial data	Advantages of Data base Management System. Conceptual implementation models, Hierarchical, Network, Relational models. RDBMS: components, concept, database schema, tables and relationships. Database design Normalization (1NF, 2NF, 3NF forms) Data definition manipulation using SQL, SQL-query processing, operations on tables, integrity constraints, database security, role of database administrator (DBA). Metadata	12
5	Spatial data input	Digitization, error identification. Errors: Types, sources, correction. Editing and topology building	8
6	Concepts of GPS	History, types, navigation systems and applications	15

**Books:**

1. Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester
2. Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi
3. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
4. Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore
5. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
6. Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York
7. Heywood, I., Cornelius, S., Carver, S. (2011): An Introduction to Geographical Information Systems, Pearson Education, New Delhi
8. Ahmed, E. L. Rabbany (2002): Introduction to Global Positioning Systems, Artech House, Boston

Code No: GR: 103		Title: Cartography and Map Interpretation	
No. of Credits: 3		No. of Periods: 45	
Sr. No.	Topics	Sub-topics	Lectures
1	Map scale	Types conversions, vertical exaggeration, enlargement and reduction	5
2	Map projections	Concept, Classification, types and uses	9
3	Representation of statistical data	Choropleth, Isopleths and Dot method. Unimodal, two dimensional and three-dimensional diagrams	10
4	Introduction to Survey of India topographical maps	Numbering, scales, grid reference, signs and symbols, color system	5
5	Relief representation techniques	Profiles, Identification and representation of landforms from toposheets of fluvial, coastal, Aeolian and glacial landscapes	8
6	Interpretation of maps	Study and interpretation: SOI toposheet, cadastral and thematic maps	8

**Books:**

1. Singh, R. L. (1979): Elements of Practical Geography, Kalyani Publishers, New Delhi
2. Tamaskar, B. G., Deshmukh, V. M. (1974): Geographical Interpretation of Indian Topographical Maps, Orient Longman Ltd., Bombay
3. Croxton, F. E., Cowden, D. J., Klein, S. (1975): Applied General Statistics, Prentice-Hall of India, New Delhi
4. Frank, H. Althoen, S. C. (1994): Statistics Concepts and Applications, Cambridge University Press
5. Robinson, A. H., Morrison, J. L., Muehrcke, P. C., Kimerling, A. J. Guptill, S. C. (1995): Elements of Cartography, Wiley, New York
6. Yeates, M. (1974): An Introduction to Quantitative Analysis in Human Geography, McGraw-Hill, New York
7. Ramamurthy, K. (1982): Map Interpretation, Rex Printers, Madras
8. Vaidyanadhan, R. (1968): Index to a set of sixty Topographic Maps: Illustrating Specified Physiographic Features from India, Council of Scientific and Industrial Research, Ministry of Education, Government of India
9. Gupta, K. K. Tyagi, (1992): Working with maps, Survey of India Publication, DST, New Delhi
10. Understanding Map Projection (2003-2004): GIS by ESRI, Redlands

Code No: GR: 104		Title: Spatial Data Processing	
No. of Credits: 3		No. of Practicals: 15	
Sr. No.	Topics	Sub-topics	Practicals
1	Overview of ArcGIS	Arcmap, ArcCatalog and Arctool box	2
2	Attribute data input	Creation of schema, tables, data definition, data input, data updating, queries on tables, simple-complex query with two or more tables using SQL. Queries using Union, Intersection, Join etc operations. Use of MS-Excel and MS Access	5
3	Spatial data input	Vector data formats with file extensions. Scanning, on-screen digitization, editing, topology creation, line and area measurements, data attribution	5
4	GPS	GPS Survey, data import, processing and mapping	3

(Note: For 3 credits 3 hrs. practicals per week)

**Books:**

1. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
2. Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The ARC/INFO Method, ESRI Press, Redland
3. Ahmed, E. L., Rabbany (2002): Introduction to Global Positioning System, Artech House, Boston
4. Kresse, W. and Danko, D. (2002): Springer Handbook of Geographic Information, Springer Drecht, London
5. Bao, J., Tsui, Y. (2005): Fundamentals of Global Positioning System Receivers, John Wiley Sons, Inc., Hoboken

Code No: GR: 105		Title: Aerial Photo and Image Interpretation	
No. of Credits: 3		No. of Practicals: 15	
Sr. No.	Topics	Sub-topics	Practicals
1	Measurements	Geometry of aerial photographs, determination of scale, height on aerial photograph	4
2	Aerial Photo and image Interpretation	Interpretation of aerial photos: Single, vertical stereo pairs. Interpretation of satellite imagery: derived from PAN, LISS, WiFs, OCM sensors. Study and visual interpretation of satellite images for physical features, urban, forest and agricultural uses	5
3	Introduction to Digital Photogrammetry	Concepts and techniques of Digital Photogrammetry	4
4	Field work	Study tour: Identification of features in the field using aerial photographs and/or satellite images	2

(Note: For 3 credits 3 hrs. practicals per week)

**Books:**

1. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
2. Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India
3. Agarwal, C. S. Garg, P. K. (2000): Remote Sensing, Wheeler A. H., New Delhi
4. Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford
5. Wolf, P .R. (1974): Elements of Photogrammetry, McGraw Hill Inc., Kogaknscha

Code No: GR: 106		Title: Programming in C and C++	
No. of Credits: 3		No. of Periods: 45	
Sr. No.	Topics	Sub-topics	Lectures
1	Computer Fundamentals	Characteristics and limitations, Computer Architecture: Computer block diagram, Flow chart, Operating System, data storages. Networking: LAN, MAN, WAN, various topologies like Ring, Bus, Star, Networking devices like hub, repeaters, switch, bridge, router. Web Concepts: OSI Model, URL, Ports, Firewall, DNS, IP address, proxy, Session, cookies. Client and server architecture: Various protocols like Http, https, FTP, SMTP, POP3. Distributed computing: Introduction to Distributed networking and Cloud computing	8
2	C Language	Introduction to C: History of Programming language, importance of computer languages, Understanding Compiler. Input /Output functions: Console input output, Formatted input output. Data types and operators: types and uses of various operators. Control structures: Various looping mechanism, types of loops. Introduction to Array: Understanding Array, Working with Single multidimensional array. Limitations of array, Structure Unions. Introduction to functions: Need of function, defining, calling function, different types of functions. Understanding of pointer. File handling: Reading and writing the data to file	20
3	C++ Language	Introduction to OOP: Importance of OOP Understanding Classes, objects, Methods and properties. Characteristic of OOP: Abstraction, Inheritance, Polymorphism, Encapsulation. OOP and POP: Difference between OOP and POP Constructors and destructors: Creating classes and objects. Memory allocation of Objects. Heap and stack memory. Managing input /Output File handling: C++ stream classes, formatted I/O manipulators Access modifiers: modifying access of Classes, methods using public, private keywords. Functions and Operators: Function overloading and Overriding, Operator precedence, Operator overloading, Friend and virtual function	17

**Books:**

1. Kernighan, R. (1998): C Programming Language, (ANSI C Version), Prentice Hall, New Jersey
2. Balagurusamy, E. (2006): Object Oriented Programming with C++, Tata McGraw Hill, New Delhi
3. Balagurusamy, E. (2002): Programming in ANSI C, Tata McGraw Hill, New Delhi
4. Kanetkar, Y. (2000): Let US C++, BPB publications, New Delhi
5. Kanetkar, Y. (2001): Let Us C, BPB Publications, New Delhi

**Semester II**

Code No: GR: 201		Title: Digital Image Processing	
No. of Credits: 3		No. of Periods: 45	
Sr. No.	Topics	Sub-topics	Lectures
1	Introduction to digital image processing	Digital images: Types Sources of errors: Atmospheric, radiometric and geometric. Image rectification: geometric correction, radiometric correction, noise removal	15
2	Image enhancement 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	15
3	Digital image classification	Classification scheme: Supervised classification: Training sites selection and statistical information extraction, Discriminate functions. Classifier : Maximum Likelihood, Euclidian distance, Mahalanobis distance, Parallelopiped. Unsupervised classification. Classification accuracy assessment and error matrix	15

Books:

1. Richards, J. A, Jia, X. (1999): Remote Sensing and Digital Image Processing, Springer, Verlag Berlin
2. Cha, B., Dattaa, D., Majumdar (2001): Digital Image Processing Analysis, Prentice-Hall of India, New Delhi
3. Nag, P. Kudrat, M. (1998): Digital Remote Sensing, Concept Publishing Company, New Delhi
4. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
5. Lillesand, T. M., Kiefer, R. W. Chipman, J. W.(2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
6. Sabins, F. F. (1996): Remote Sensing: Principles an Interpretation, W. H. Freeman Company, New York



Code No: GR: 202		Title: Spatial Analysis	
No. of Credits: 3		No. of Periods: 45	
Sr. No.	Topics	Sub-topics	Lectures
1	Introduction to Spatial analysis	Significance of spatial analysis. Overview of tools for analysis	3
2	Spatial analysis - Vector based	Overlay operations: Point-in-polygon, Line-in-polygon, polygon-in-polygon. Single layer operations: Feature identification, extraction, classification manipulation. Multilayer operation: Union, intersection, symmetrical difference, update, merge, append and dissolve	8
3	Spatial analysis - Raster based	Map algebra, grid based operations, local, focal, zonal and global functions, cost surface analysis, optimal path and proximity search	7
4	Network analysis	Concepts, evaluation of network complexity using Alpha-gamma indices. C-matrices for evaluating connectivity of the network. Network data model. Path analysis. Linear referencing and segmentation. Types of network analysis: Optimum cyclic path, vehicle routing, path determination and cost-path analysis. Geocoding	8
5	Point pattern analysis	Methods for evaluating point patterns: clustered and random distribution	3
6	Surface analysis	Interpolation methods: Trend surface analysis, IDW, kriging, measures of arrangement and dispersion, autocorrelation, semi-variogram, DEM, TIN, slope, aspect, hillshade and viewshed	8
7	Spatial modeling	Role of spatial model, explanative, predictive and normative models. Correlation-regression analysis in model building. Handling complex spatial query and case studies	8

**Books:**

1. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
2. Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York
3. Makrewski, J. (1999): GIS Multi-criteria Analysis, John Wiley and Sons, New York
4. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York
5. Longley, P. A., Goodchild, M. F., Maguire, D. J. Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester
6. Lo, C. P. Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi

Code No: GR: 203		Title: Application of GIS and RS Techniques	
No. of Credits: 4		No. of Periods: 60	
Sr. No.	Topics	Sub-topics	Lectures
1	Geosciences	Geosciences: Concepts of geomorphology, landform analysis, drainage basin morphometry, slope mapping, integrated approach for landslide hazard zonation models and mapping. Aerial photo and satellite data interpretation	12
2	Water resources	Watershed hydrology, physical processes in watershed, principles of remote sensing in water resource assessment, river valley project, planning, organization and design of spatial and non-spatial data in water resource engineering. Hydrological modelling	12
3	Forest	Forest: Image processing for forest, vegetation classification mapping, forest inventory, sampling techniques, Growing stock estimation, biomass estimation, forest management, fire risk zonation, land evaluation for forestry, RS of forest ecosystem	12
4	Marine and atmospheric sciences	Fundamentals of Marine Ecology, Bio-resource monitoring and mapping, coastal bathymetry. Ocean Color mapping, SST mapping, potential fishing zone mapping. Fundamental principles of climatology, structure, chemical composition of the atmosphere, aerosols, general Circulation, climate modelling, meteorological satellites. Forecasting of natural calamities. Air Pollution Modeling	12
5	Agriculture and soils	Spectral characteristics of crop, crop inventory, crop yield modelling, physiographic, soil mapping, crop water management, agro-ecological zoning, land evaluation	12

**Books:**

1. SPRS Technical Commission VII (2002): Symposium on Resource Environmental Monitoring, ISRS Annual Convention, IIRS, Dehradun
2. Deekshatulu, B. L. (1990): Description and use of Land use/Landcover, NRSA, Hyderabad
3. Sudershana, R. Mitra, D. Mishra, Roy, P.S., Rao, D. P. (2000): Subtle Issues in Coastal Management, IIRS, Dehradun
4. Harris, J. E. (1990): Earthwatch – The Climate from space, Ellishorwood Ltd., Midsower Norton
5. Lal, D. S. (1998): Climatology, Chaitanya Publishing House, Allahabad
6. Escalante, R. B. (2012): Remote Sensing- Advances techniques and Platforms, Intech, Rijeka Croatia
7. Escalante, R. B. (2012): Remote Sensing Application, Intech, Rijeka Croatia
8. Roy, P.S., Dwivedi, R. S. (2010): Remote Sensing Application  
www.nrsc.gov.in/Learning- Center, E Book. html
9. NRSA (2002): Symposium Tutorial on Sustainable Agriculture (Volume of Lectures), Hyderabad

Code No: GR: 204		Title: Image Data Processing	
No. of Credits: 3		No. of Practicals: 15	
Sr. No.	Topics	Sub-topics	Practicals
1	Familiarization with image processing system	Loading of image data, identification of objects on visual display, study of histograms and layer information	1
2	Image enhancement techniques	Linear and non- linear contrast enhancement, Band rationing, edge enhancement, high and low pass filtering, density slicing	3
3	Image registration	Registration of bases map/ topomap, image to map, image to image	3
4	Image Classification	Classification : Supervised, unsupervised and use of different algorithms	3
5	Accuracy analysis	Producer, user accuracy, overall and mapping accuracy, Kappa Coefficient	2
6	Vector layers	Generation of Vector layer, editing and topology building, area and perimeter estimation	2
7	Presentation	Map composition	1

(Note: For 3 credits 3 hrs. practicals per week)

**Books:**

1. ERDAS (2010): ERDAS field Guide, ERDAS incorporation, Norcross, GA, USA
2. [http://geospatial.intergraph.com/Libraries/Tech\\_Docs/Erdas\\_Field\\_Guide.sflb.ashx](http://geospatial.intergraph.com/Libraries/Tech_Docs/Erdas_Field_Guide.sflb.ashx)
3. Gupta, R. P. (2003): Remote Sensing Geology, Springer, Verlag Berlin

Code No: GR: 205		Title: Spatial Data Processing - II	
No. of Credits: 3		No. of Practicals: 15	
Sr. No.	Topics	Sub-topics	Practicals
1	Geodatabase in ArcCatalog and ArcMap	Feature dataset, feature classes, Import of data, spatial data formats, shape/coverage files and layers, data frames, maps, managing TOC	2
2	Georeferencing Data	Coordinate systems, datum conversions, Map projections, types, storing- viewing projection information	2
3	Working with layers in ArcMap	Building templates, classification, displaying qualitative and quantitative values, labeling features and map creation.	2
4	Editing data	Selecting features, simple editing functions, creating new features, modifying, schema changes	1
5	Spatial and non-spatial data	Spatial: linking features attributes, ways to view data, metadata Non-spatial : understanding tables, field types, table manipulations, table relationship, joins, relates, creation of graphs and reports	3
6	Spatial Analysis	Query by attribute and location, identifying spatial and non-spatial data, geoprocessing wizard, spatial analysis functions, Multi Criteria Analysis using Boolean logic	3
7	Network analysis	Network utility, creating network model, shortest path, geocoding	1
8	Presenting data	Map design, map composition	1
9	Project work		*

(Note: For 3 credits 3 hrs. practicals per week)

**Books:**

1. Mitchell, A. (1999): The ESRI guide to GIS analysis, Redlands
2. Zeiler, M. (1999): The ESRI guide to Geodatabase design, Redlands
3. ESRI (2003): Introduction to ArcGIS- I, Course Lectures, GIS Education Solutions
4. Booth, B., Shaner, J., MacDonald, A., Sanchez, P. Pfaff, R. (2004): ArcGIS, Geodatabase Workbook, Redlands
5. Melania, H. M., Rhonda, P., Minami, M., Hatakeyama, A. M. (2004): ArcGIS, Using ArcMap, ESRI Press, Redlands
6. Environmental Systems Research Institute, Inc. (1998): Understanding GIS: The Arc/Info Method, ESRI Press, Redlands

Code No: GR: 206		Title: Programming in .NET and ArcObject	
No. of Credits: 4		No. of Periods: 60	
Sr. No.	Topics	Sub-topics	Lectures
1	.NET Language	Introduction: .Net architecture. CLR, CLS, CTS, JIT compiler C # .net: Introduction to C# .net. Syntax used in defining classes, methods, variables Interface abstract class: Understanding abstract classes, access modifiers and interface. Creating and using Custom interfaces, Sample programs Implementing OOP: Introductions to classes used in .net, Implementing OOPs characteristics, Working with windows forms application, console application, building logic in the sample application. Event handling: handling various events in Windows forms application Exception handling: Usage of Try, catch and finally block. .Net interoperability: Working with managed and unmanaged code	35
2	ArcObject	SDK development environment, basic customizations, deploying and sharing customizations, Maps and layers, workspaces, geometry operators, graphic elements, Cursors, geoprocessing and Engine SDK	25

Books:

1. Evjen, B., Hollis, B., Rockford, L. (2006): Professional VB.NET (2003), Wiley Publishing Inc. USA
2. Holzner, S. (2010): Visual Basics.NET Programming Black Book, Paraglyph Press USA Dreamtech Press
3. <http://www.ebooksdownloadfree.com/Miscellaneous/C-Black-Book-BI20346.html>
4. [http://www.tutorialspoint.com/csharp/csharp\\_tutorial.pdf](http://www.tutorialspoint.com/csharp/csharp_tutorial.pdf)
5. [www.completesharptutorial.com](http://www.completesharptutorial.com)
6. [http://help.arcgis.com/en/sdk/10.0/arcobjects\\_net/conceptualhelp/index.html](http://help.arcgis.com/en/sdk/10.0/arcobjects_net/conceptualhelp/index.html)
7. <https://www.dur.ac.uk/resources/its/info/guides/93AMLGIS.pdf>
8. <http://ebookily.org/pdf/arcobject-c>

### Semester III

Code No: GR: 301		Title: Project Work
No. of Credits: 10		
<b>Sr. No.</b>	<b>Topics to be covered</b>	
1	Problem identification and literature review	
2	Data acquisition / collection	
3	Field work	
4	Data processing	
5	Results and interpretation	
6	Report writing	
7	Presentation	