Department of Geography, University of Pune

Structure for PG B.Sc. (Applied) Course in GIS and Remote Sensing

Semester I:

Course Code	Course Title	Credits per course	Total credits
	Concepts in Geography	*	
GR101	Introduction to Remote Sensing	4	
GR102	Introduction to Geographic Information System	4	
GR103	Practicals in Remote Sensing	4	
GR104	Practicals in GIS and GPS	4	
GR105	Practical in Cartography and Map Interpretation	4	
			20

Semester II:

GR201	Digital Image Processing	4	
GR202	Spatial Analysis	4	
GR203	Applications in Remote Sensing and GIS	4	
GR204	Practicals in Digital Image Processing	4	
GR205	Practicals in Spatial Analysis	4	
			20

Semester III:

GR301	Project Work	10	
			10

* Non-credit course

Semester I

Code No: GR: 101 Title: Introduction to Remote Sensing

No. of Credits: 4

Sr. No.	**Topics**
1	Principles of remote sensing: Definition, historical perspective, development of RS in India, Stages in RS EMR and EMR spectrum, EMR quantities Theories of EMR, Concept of black body, Laws of radiation, Hemispheric reflectance, transmittance, absorptance
2	Interaction of EMR with the earth surface: reflection, transmission, Spectral signatures Interaction of EMR with the atmosphere: scattering, absorption, refraction, Atmospheric windows and types of RS
3	Physical basis of Signature, Signature in the Reflective OIR Region Vegetation. Soil, Water bodies/Ocean
4	Fundamentals of aerial photography: Scale, resolution, projection, flight planning, overlaps, Geometric characteristics of aerial photographs, Measurement of scale and height on aerial photographs
5	Platforms and Orbits: Platforms: ground-based, air-borne, space-borne Orbits: Geostationary and Sun-synchronous
6	Sensors: Quality of image in Optical Systems, Imaging Mode, Photographic Camera, Television Cameras, Opto Mechanical Scanners, Opto Mechanical Scanners operated from satellites, Pushbroom and Whiskbroom cameras, Hyper Spectral imaging
7	Data products, Data formats, Ground Segment Organisation, Data Product generation, Referencing Scheme, valu-added Products Photo products and Digital products

Books

1. George Joseph (2004), Fundamentals of Remote Sensing, Universities Press (India) Private Limited.
2. Lillesand T. M., Kiefer R. W (2000), Remote Sensing and Image interpretation, John Wiley & Sons Inc.
3. Campbell James, Introduction to Remote Sensing, Taylor & Francis London.
4. Agarwal C.S (2000), Remote Sensing, Wheeler A. H and Co. Ltd.
5. Photogrammetry and Remote Sensing (2000), Lecture notes, Module **I** , IIRS
6. Agarwal C.S. and Garg, P. K. (2000): Remote Sensing, A. H. Wheeler and Co. Ltd., New Delhi.

Code No. GR: 102 Title: Introduction to Geographic Information System

No. of Credits:4

No.	Topics
1	Overview of GIS: Definitions, Evolution, Components, Objectives
2	Hardware requirements: Basic blocks of Computer, Processor, memory, RAM/ROM, Secondary storage devices. Input/Output devices, Peripherals, Binary number system, data & instructions, Working of computer. Software requirements: Operating systems, Application compilers, editors. Overview of GIS software packages
3	Geographic data: Types of data, Levels of measurements
4	Spatial data: Concept of space & time, layers & coverages, spatial data models, Representation of geographic features (point, line, polygon) in vector & Raster models, Concept of arc, nodes, vertices and Topology. Object oriented models: advantages & disadvantages, Computer Representation for storing spatial data, block code, run length code, Chain code, Quadtree tessellation, Issues governing choice of models.
5	Non-Spatial data: Advantages of Data base management systems. Conceptual & Implementational models, Hierarchical, Network & Relational models. RDBMS: components, concept, Data base schema, Tables, relationships-one to one, one to many, many to many. Data base design & Normalization, (1NF, 2NF, 3NF forms) Data definition & manipulation using SQL SQL – query processing, operations on tables, Union, Intersection., Product, Natural Join., Integrity constraints, data base security, Role of Data Base Administrator (DBA)

Books:

1. Burroughs, P. A (1986): Principles of Geographical Information Systems for land Resources Assessment, Oxford University Press
2. Bernhardsen, Tor (1999): Geographic Information Systems: An Introduction, John Wiley and Sons
3. Clarke, Keith C. (1999): Getting Started with Geographic Information Systems, Prentice Hall
4. Demers, Michael N. (2000): Fundamentals of Geographic Information Systems, John Wiley
5. Haywood, Ian (2000): Geographical Information Systems, Longman
6. Chang, Kang-taung (2002): Introduction to Geographic Information Systems, Tata McGraw-Hill

Code No. GR: 103 Title: Practicals in Remote Sensing

No. of Credits: 4

No.	Topics
1	Determination of scale and height on aerial photograph
2	Interpretation of single vertical aerial photographs
3	Interpretation of stereopair of aerial photographs
4	Reference system of IRS satellites, Data products, Data formats
5	Interpretation of multi-spectral satellite images acquired from PAN, LISS 1, LISS 2, LISS3, LISS4, WiFS sensors & merged products
6	Study tour: Identification of features in the field using aerial photographs and satellite images

Books:

1. George Joseph (2004), Fundamentals of Remote Sensing, Universities Press (India) Private Limited
2. Lillesand T. M., Kiefer R. W (2000), Remote Sensing and Image interpretation, John Wiley & Sons Inc.
3. Agarwal C.S. and Garg, P. K. (2000): Remote Sensing, A. H. Wheeler and Co. Ltd., New Delhi.

Code No. GR: 104 Title: Practicals in GIS and GPS

No. of Credits: 4

No.	Topics
1	Use of DBMS: MS Excel and Access: Database generation, Editing, Querying
2	Autocad Map: Digitization, cleaning layers and building topology, Internal and external data attachment, Querying
3	Arcview: Digitization, attribute data attachment, Spatial and Attribute Query, Map Composition
4	GPS: Concepts, types, modes of coordinate collection, GPS survey, inputting GPS data into computer.

Books:

1. Ahmed E I and Rabbany (2003), Introduction to Global Positioning System, Artech House Boston London
2. Roy P. S., (2000), Geographical Information Science, Reference Material, Volume I, IIRS, 2000.

Code No. GR: 105 Title: Practicals in Cartography and Map Interpretation

No. of Credits: 4

No.	Topics
1	Map scales: types and conversion, vertical exaggeration, enlargement and reduction Map projections: Concept, classification, uses, types: Polyconic projection; Mercator projection, UTM
2	Geographical data: types, sources, methods of representation for point, line, areal data Representation of statistical data I) on maps by Choropleths, Isopleths, Dots II) by unimodal, two-dimensional and three-dimensional diagrams
3	Relief representation techniques, Identification and representation of landforms: fluvial, coastal, aeolian and glacial landscapes Introduction to SOI topographical maps-numbering, scales, grid reference, signs and symbols, colour system Study and interpretation of SOI maps
4	Statistical methods: Geographic data - Discrete and continuous series, scale of measurements, frequency distribution, Moments of distribution, Probability, Matrix algebra Concept of covariance, correlation and regression: Bivariate-linear, exponential and power, residual mapping, testing of hypothesis

Books:

1. R. L Singh (1979), Elements of Practical Geography, Kalyani Publishers.
2. Tamaskar B. G., Deshmukh V. M., (1974), Geographical Interpretation of Indian Topographical Maps, Orient Longman Ltd.
3. Croxton F. E., Cowden, D. J. and Klein, S. (1975), Applied General Statistic, Pretice- Hall India.
4. Frank, H. and Althoen, S.C. (1994), statistics Concepts and Applications, Cambridge University Press.
5. Yeates, M. (1974), An Introduction to Quantitative Analysis in Human Geography, McGrraw- Hill.
6. Ramamurthy, K. (1982), Map Interpretation, Rex Printer, Madras.
7. Vaidyanadhan, R. (1968), Index to a set of sixty topographic maps illustrating specified physiographic feature.
8. Gupta K K and Tyagi, V.C (1992), Working with maps, Survey of India Publication.
9. Understanding Map Projection, GIS by ESRI, 2003-2004, USA

Code No. GR: 201 Title: Digital Image Processing

No. of Credits: 4

No.	Topics
1	Introduction to digital image processing: Image processing systems: hardware and software
2	Image rectification: Geometric Correction, Radiometric Correction,
3	Image rectification: Noise removal, Atmospheric Correction
4	Image enhancement techniques: Contrast enhancement: Linear and Non-linear, Density Slicing
5	Spatial filtering: Low frequency and High frequency Edge enhancement, Band Ratioing
6	Digital image classification: Unsupervised Supervised: Maximum Likelihood, Parallelpiped, Minimum Distance to Mean
7	Classification accuracy assessment, Error Matrix

Books:

1. Richards J. A, Xiuping Jia (1999), Remote Sensing Digital Image Processing, Springer Verbg Berline Heidelberg My.
2. Chanda B., Dattaa D , Majumdar (2001), Digital Image Processing and Analysis, Prentice- Hall of India
3. Prithvish Nag and M. Kudrat (1998), Digital Remote Sensing, Concept Publishing Company, New Delhi- 110059
4. Lecture notes module II, Image Analysis and Interpretation, IIRS

Code No. GR: 202 Title: Spatial Analysis

No. of Credits: 4

No.	Topics
1	Introduction to Spatial analysis: Significance of spatial analysis. Overview of tools for analysis
2	Spatial analysis Vector based: Overlay operations, point in polygon, line in polygon, polygon in polygon, Single layer operations: feature identification, extraction, classification and manipulation. Multilayer operations: Union, Intersection, Difference
3	Spatial analysis Raster based: Map algebra, grid based operations, Local, Focal , Zonal & Global functions, Cost surface analysis, Optimal path and proximity search
4	Network analysis: Concepts, evaluation of network complexity using alpha, gamma indices. C- matrices for evaluating connectivity of the network. network data model.
5	Point pattern analysis: Methods for evaluating point patterns: clustered and random distribution
6	Surface analysis: Interpolation methods, DEM, TIN, variance filter, slope and aspect, relief and hill shading
7	Spatial modeling: Role of spatial model, explanative, predictive and normative models. Correlation-regression analysis in model building. Handling complex spatial query, Case studies.

Books:

1. Roy P. S (2000), Geographical Information Science, Vol. I, IIRS.
2. Demers M.N (2000), Fundamentals of Geographic Information Systems, Second Edition, John Wiley & Sons.
3. Burrough P. A. MacDonneli R. A. (2000), Principles of Geographical Information Systems, Oxford University Press.
4. Makrewski Jacek (1999), GIS and Multi-criteria Analysis, USA.

Code No. GR: 203 Title: Applications in Remote Sensing and GIS

No. of Credits: 4

No.	Topics
1	Forest resource management: Scope, nature, methods, themes, issues and case studies
2	Agriculture and soil management: Scope, nature, methods, themes, issues and case studies
3	Water resource management: Scope, nature, methods, themes, issues and case studies
4	Human settlement planning: Scope, nature, methods, themes, issues and case studies
5	Geosciences: Scope, nature, methods, themes, issues and case studies
6	Disaster Management: Scope, nature, methods, themes, issues and case studies

Books:

1. Application of RS and GIS in Geosciences, Lectures notes by CSSTEAP, IIRS.
2. Application of RS and GIS in Water Resources, Lectures notes by CSSTEAP, IIRS.
3. Application of RS and GIS in Agriculture and Soil, Lectures notes by CSSTEAP, IIRS.
4. Remote Sensing for sustainable Development, Proceedings of National Symposium organized by ISRS and RSAC, Nov 1992, Published by ISRS.
5. Proceeding of National Symposium on RS for Agricultural Application held at New Delhi, Dec 1990, ISRS/IARI.
6. Proceedings of ISPRS Commission VII Symposium Resource and Environmental Monitoring ,Hyderabad, Dec2002.
7. National Agricultural Drought Assessment and Monitoring System, India, Summary Report, Sept 2001
8. Remote Sensing and GIS Application in Urban and Regional studies by Subudhi A P, Sokhi B S, Roy P S, IIRS, 2001
9. Natural Disaster and their Mitigation by PS Roy, Published by IIRS, 2000
10. Biodiversity Characteristics at Landscape Level in North East using satellite Remote And Geographical Information System by Roy P S., IIRs, 2002
11. Forest Cover Assessment in Asia by P.S. Roy, IIRS, 2002
12. Biodiversity and Environment by P.S. Roy, IIRS, 2000
13. Subtle Issues in Coastal Management by Sudershana R, Mitra D, Mishra , Roy P.S., Rao D.P., IIRS, 2000
14. Spatial Technologies for Natural Hazards Management (Proceedings of ISRS National Symposium Nov 21-22,2000, IIT Kanpur)
15. Application of RS and GIS in Disaster Management, Lectures notes by CSSTEAP, IIRS.
16. Forest Resource Management, Lectures notes by CSSTEAP, IIRS.

Code No. GR: 204 Title: Practicals in Digital Image Processing

No. of Credits: 4

No.	Topics
1	Familiarization with image processing system
2	Loading of image data, identification of objects on video display, study of histograms
3	Image enhancement techniques: contrast enhancement, band ratioing, edge enhancement, filtering, density slicing
4	Image registration: image to map, image to image
5	Image classification techniques: supervised and unsupervised
6	Accuracy analysis
7	Ground data collection for training sets for classification of image

Books:

1. ERDAS IMAGINE Field guides Printed by United States of America.
2. ERDAS IMAGINE Tour guides Printed by United States of America.

Code No. GR: 205 Title: Practicals in Spatial Analysis

No. of Credits: 4

No.	Topics
1	Geodatabase in Arc catalog: Feature dataset, feature classes, import of data, spatial data formats, Shape/coverage files and layers, data frames, maps, managing TOC, displaying qualitative/ quantitative values, labeling features.
2	Working with layers: Building templates, classification, map creation,
3	Georeferenced data: coordinate systems, datum conversions, Map projections, types, storing-viewing projection information.
4	Editing data: Selecting features, simple editing functions, creating new features, modifying, schema changes
5	Spatial data: Linking features and attributes. geodatabase data format, ways to view data, metadata etc. Aspatial data: Understanding tables, field types, table manipulations, table relationships, joins and relates, creation of graphs and reports
6	Spatial analysis: Query, Identifying, measuring, query by location/attribute Geoprocessing wizard, spatial analysis functions Multi-criteria analysis
7	Network analysis: Network utility, creating network model, shortest path
8	Presenting data: Map Layout and map composition

Books:

1. The ESRI guide to GIS analysis by Andy Mitchell 1999.
2. The ESRI guide to Geodatabase design by Michael Zeiler 1999.
3. GIS Education Solutions from ESRI, Introduction to ArcGIS- **I**, Course Lectures, 2003 Published by ESRI.
4. ArcGIS 9, Building A Geodatabase by Andrew Perencsik, Simon Woo, Bob Booth, Scott Crosier, Jill Clark, Andy MacDonald, 1999-2004, USA.
5. ArcGIS 9, Geodatabase Workbook by Bob Booth, Jeff Shaner, Andy MacDonald, Phil Sanchez, Rhonda Pfaff, 2004, USA.
6. ArcGIS 9 , Using ArcMap by Melanie Harlow, Rhonda Pfaff, Michael Minami, Alan Hatakeyama, Andy Mitchell et al 2000-2004, USA.
7. ArcGIS 9, Editing in ArcMap by Rhonda Pfaff, Bob Booth, Jeff Shaner, Scott Crosier, Phil Sanchez, Andy MacDonald, 2000-2004, USA.
8. ArcGIS 9, Using ArcCatalog by Aleta Vienneau, Jonathan Bailey, Melanie Harlow, John Banning, Simon Woo, 2003-2004, USA.