SAVITRIBAI PHULE PUNE UNIVERSITY
DEPARTMENT OF GEOGRAPHY
Credit System (P. G. B. Sc. (Applied) in GIS and Remote Sensing): Details of the Subjects and Credits – 2020

SEMESTER I				
Core Courses				
Subject Code	**Subject Title**	**Credits Per Subject**	**Credits To Be Completed**	
			Subject-Wise	**Semester-Wise**
GR 101	Fundamentals of Remote Sensing & Photogrammetry	4	4	
GR 102	Fundamentals of GIS and GPS	3	3	
GR 103	Practical in Spatial Data Processing	3	3	
GR104	Database Management Systems: Concept & Methods	3	3	
GR109	Concepts in Geography (Non-credit course)			
Elective Courses				
	Any two of the following courses			
GR 105	Open Source GIS	3	3	
GR 106	Applied statistics and computing	3	3	
GR 107	Introduction to Python	3	3	
GR108	Cartography and Data representation	3	3	
	Total credits in the semester	**19**	**19**	**19**

SEMESTER II				
Core Courses				
Subject Code	**Subject Title**	**Credits Per Subject**	**Credits To Be Completed**	
			Subject-Wise	**Semester-Wise**
GR 201	Digital Image Processing: Theory	2	2	
GR 202	Geospatial analysis: Theory	3	3	
GR 203	Practical in Digital Image Processing	3	3	
GR 204	Practical in Geospatial analysis	3	3	
GR 205	Application in RS & GIS	3	3	
GR 206	Advance Surveying and field work	3	3	
GR 207	Project Work	4	4	
	Total credits in the semester	**21**	**21**	**21**

Semester I

Code: GR 101 Fundamentals of Remote Sensing and Photogrammetry

No. of Credits: 04 **No. of Lectures: 60**

Sr. No.	Topic	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, basic of solar radiation	8
2	Interaction of EMR:Interaction with Earth's Atmosphere and Atmospheric window	8
3	Spectral Signature:Interaction with Soil, Water and Vegetation	6
4	Platforms, Sensors, Orbits:Types of Platform, Types of Sensors, Cameras and Satellite Orbits	8
5	Data Products: Satellite Data Generation, Type of data Formats and Aerial Photography Products, FCC & TCC images and its applications	8
6	Aerial Photography: Introduction to Aerial Photography and Basic Photogrammetry	4
7	Measurements: Geometry of Aerial Photographs, Determination of Scale, Height on Aerial Photograph	4
8	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	4
9	Field Work/Study Tour: Identification of Features in the Field Using Aerial Photographs and/or Satellite Images	4

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
8. Wolf, P .R. (1974): Elements of Photogrammetry, McGraw Hill Inc., Kogaknscha

Code: GR 102	**Fundamentals of GIS and GPS**	
No. of Credits: 03		**No. of Lectures: 45**
Sr. No.	**Topic**	**Lectures**
1	Introduction to GIS:Definitions, Evolution, Components and Objectives	3
2	Hardware & Software Requirements: Hardware: Basic Blocks of Computer, Processor, Memory, Secondary Storage Devices, Input/Output Devices, Binary Numbers. Software: Operating System, Application, Compliers, Editors. Overview of GIS Software Packages	5
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, Quad tree.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	5
6	Concepts of GPS: Spherical trigonometry, History, Types, Navigation Systems and Applications , Introduction to IRNSS	8

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., Cornelisus, 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: GR 103	**Practical in Spatial Data Processing**	
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Overview of ArcGIS: Arc map, Arc catalog and ArcToolBox	1
2	Attribute Data Input:Creationof Schema, Tables, Data Definition, and 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	2
3	Spatial Data Input:VectorData Formats with File Extensions. Scanning, On-Screen Digitization, Editing, Topology Creation, Line and Area Measurements, Data Attribution	2
4	Geodatabasein Arccatalog and Arcmap:Feature Dataset, Feature Classes, Import of Data, Spatial Data Formats, Shape/Coverage Files and Layers, Data Frames, Maps, Managing TOC	3
5	Georeferencing Data:Coordinate Systems, Datum Conversions, Map Projections, Types, Storing- Viewing Projection Information	3
6	Working with Layers in Arcmap:Building Templates, Classification, Displaying Qualitative andquantitative Values, Labeling Features and Map Creation.	1
7	GPS: GPS Survey, Data Import, Processing and Mapping	3

Note: a) For 4 credits 4 hours practical per week.
b) The concerned teacher may add some points related to the subject.

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: GR 104 Database Management Systems: Concept and Methods		
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Introduction: DBMS, RDBMS, SQL Database Security Concept and Advantages of RDBMSand ER Modeling.	2
2	Controlling User Access: Control Database Access, Privileges, Creating User, Concept of Role, Creating, Granting Privileges to Role, Revoking Privileges. Changing Password	3
3	Managing Schema Object: Data Types, DDL, DML, DCL Constraints: Types of Constraints, Primary Key, Foreign Key, Check Constraint, Not Null, Altering Constraint, Concept of Backup Recovery. Overview of Index.	3
4	Manipulating Dataset using SQL Statement: Basic Select Statement, Selecting Specific Column, Using Arithmetic Expressions, Defining Column Alias, using Where Clause	2
5	Restricting & Sorting Data: using Comparison Condition (=,<=,>=Etc), Using Logical Operator: AND, OR, NOT, using BETWEEN, LIKE Conditions Rule of Precedence,using Order by Clause	5

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: GR 105	**Open Source GIS**	
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Open source GIS: basic concepts, Conventional Vs, Database modeling with open source GIS, Introduction to Open source software	4
2	Open Geospatial Consortium, Introduction to QGIS, Generation of vector layers, Retrieving properties of vector and raster datasets, Attribution, Map composition	4
3	Open source GIS platforms, software, Libraries.	3
4	Application of Open source GIS	4

Note: a) For 3 credits 3 hours practical per week.
b) The concerned teacher may add some points related to the subject.

Books:

1. Markus Neteler And Helena Mitasova (2007): Open Source GIS: A GRASS approach, Springer-Verlag Berlin, Heidelberg
2. Andrew Cutts, Anita Graser (2018): Learn QGIS , https://www.packtpub.com/application-development/learn-qgis-fourth-edition

Code: GR 106	**Applied statistics and computing**	
No. of Credits: 03		**No. of Practical:15**
Sr. No.	**Topic**	**Practical**
1	Geographic Data: Sources, Types, Discrete and Continuous Series, Scales of Measurements.	3
2	Organization of Data: Frequency Distribution, Moments of Distribution, Measures of Central Tendency.	4
3	Matrices: Matrix Algebra: Types and Properties of Matrices. Addition, Subtraction, Multiplication and Inverse.	4
4	Correlation and Regression:Correlation: Concepts and Methods Regression: Bi-Variate, Linear, Exponential, Logarithmic, Power-Law.	4

Note: a) For 3 credits 3 hours practical per week.
b) The concerned teacher may add some points related to the subject.

Books:

1. Hammond, R. and McCullagh, P.(1991):Quantitative Techniques in Geography,ClarendonPress,Oxford
2. Gregory, S.(1978):Statistical Methods for Geographers, Longman, London
3. Frank, H. andAlthoen, S.C. (1994): Statistics: Concepts Applications, Cambridge University Press, Cambridge
4. Ebdon, D. (1977): Statistics in Geography, Basil Blackwell, Oxford
5. Rogerson, P.A.(2010): Statistical Methods for Geography, Sage Publications, London

Code: GR 107	**Introduction to Python**	
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Introduction to Python, Installation	1
2	Basic Data Type, Syntax, structures	3
3	Operators, conditional statements, Functions	3
4	Libraries, Data frames, operations with data frames	2
5	Reading files/data, data manipulation, visualization	4
6	Modules and Packages	2

Note: a) For 3 credits 3 hours practical per week.
b) The concerned teacher may add some points related to the subject.

Books:

1. Lutz, M. (2010). Programming Python: powerful object-oriented programming. " O'Reilly Media, Inc."
2. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
3. Beazley, D., & Jones, B. K. (2013). Python Cookbook: Recipes for Mastering Python 3. " O'Reilly Media, Inc."
4. https://wiki.python.org./moin/BeginnersGuide/nonprogrammers.

Code: GR 108 Cartography and Data representation		
No. of Credits: 03		**No. of Practical:15**
Sr. No.	**Topic**	**Practical**
1	Map Scale:Types and Conversion, Map Projection:Concept, Classification, Uses and Types of Projections Interpretation of Maps:Study and Interpretation: SOI Toposheet. Concepts of Cadastral and Thematic Maps	3
2	Data and Data Types: Nominal, Ordinal, Interval, Ratio Representation of Statistical Data: Choropleths, Isopleths, Dots Unimodal, Two-Dimensional and Threedimensionaldiagrams	3
3	Map Generalization: Recent Development in Map Visualization, Animation, Multimedia, Interactive Map	3
4	Representation of Natural Features: Profiles, Identification and Representation of Different. Natural Features Like fluvial, Coastal, Aeolian and Glacial Landforms	3
5	Representation of Different Manmade Features: Settlement, Transportation, Landuse	3

Note: a) For 3 credits 3 hours practical per week.

b) The concerned teacher may add some points related to the subject.

Books:

1. Singh, R. L.(1979): Elements of Practical Geography, KalyaniPublishers,New Delhi
2. Croxton, F. E., Cowden, D. J., Klein, S. (1975): Applied General Statistics, Prentice-Hall of India, New Delhi
3. Frank, H. Althoen, S. C.(1994): Statistics Concepts and Applications, Cambridge University Press
4. Yeates, M.(1974): An Introduction to Quantitative Analysis in Human Geography, McGraw-Hill, New York

Code: GR 109	**Concepts of Geography**	
No. of Credits: Non- credits course		**No. of Lectures: 10**
Sr. No.	**Topics**	**Lectures**
1	Introduction: Geography as a Discipline.	2
2	Concepts: Place (physical and cultural attributes), Space, Environment interconnection, Sustainability, Location (Relative / Absolute), Region, Spatial Interaction.	2
3	Approaches: Systematic, Regional, Environmentalism and Possibilism.	2
4	Definition, Concepts, Nature and Scope of Physical Geography (Geomorphology and Climatology).	2
5	Definition, Concepts, Nature and Scope of Human Geography (Economic, Population and Settlement).	2

Books:

1. Elements of Cartography, Sixth Edition by Robinson A. H. Morrison J. L., Muehacke P.C., Published By John Wiley & sons, 1995.
2. A Complete Course of Certificate Geography, Part I by Nigam V. N., Published by pitambat Publication Comp., 1983
3. Geographical Interpretation of Indian Topographical Maps by Tamaskar B. G., Deshmukh V. M., Orient Longman Ltd, 1974
4. John R. Weeks (1999) : Population- An Introduction to Concepts and Issues, Wadsworth Pub.Co. Ca USA.
5. Knowled R. and Wareing J. (1998): 'Economic and Social Geography', Rupa and Co., N. Delhi
6. Sundaram, K. P. and Dutta, Rudra (2001), Indian Economy.
7. Population Reference Bureau:' World Population data Sheet, 2000', Washington DC.
8. Hudson, R. S. (1970):'A Geography of Settlements', McDonald and Sons, London.
9. Chisholm, M. (1962):' Rural Settlements and Landuse' London.
10. Short, John R. (1984) : ' An Introduction to Urban Geography', Routledge and Regan Paul, London.

Semester II

Code: GR 201	**Digital Image Processing: Theory**	
No. of Credits: 03		**No. of Lectures: 45**
Sr. No.	**Topic**	**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	12
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 ImageClassification: Classification Scheme: Supervised Classification: Training Sites Selection and Statistical Information Extraction, Discriminate Functions. Classifier: Maximum Likelihood, Euclidian Distance, Mahalanobis Distance, Paralellopiped, Unsupervised Classification. Classification Accuracy Assessment and Error Matrix	10
4	Object oriented classification : Segmentation, Object oriented vs. pixel based classification, Algorithms for classification	8

Note: a) For 3 credits 3 hours practical per week.
b) The concerned teacher may add some points related to the subject.

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: GR 202	**Geospatial analysis: Theory**	
No. of Credits: 03		**No. of Lectures: 45**
Sr. No.	**Topic**	**Lectures**
1	Introduction to Spatial Analysis:Significance of Spatial Analysis.Overview of Tools For Analysis	2
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	5
3	Spatial Analysis - Raster Based:Map Algebra, Grid Based Operations, Local, Focal, Zonal and Global Functions, Cost Surface Analysis, Optimal Path and Proximity Search	5
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	5
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	10
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
8	Introduction to Spatial Analysis using 'R'	2

Note: a) For 3 credits 3 hours practical per week.

b) The concerned teacher may add some points related to the subject.

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: GR 203 Practical in Digital Image Processing

No. of Credits: 03 **No. of Practical: 15**

Sr. No.	Topic	Practical
1	Familiarization with Image Processing System:Loading of Image Data, Identification of Objects on Visual Display, Study of Histograms and Layer Information	2
2	Familiarization with Image Processing System: Loading of Image Data, Identification of Objects on Visual Display, Study of Histograms and Layer Information.	2
3	Image Enhancement Techniques: Linear and Non- Linear Contrast Enhancement, Band Rationing, Edge Enhancement, High and Low Pass Filtering, Density Slicing	1
4	Image Registration: Registration of Bases Map/Topomap, Image to Map, Image to Image	2
5	Image Classification: Classification : Supervised, Unsupervised and Use of Different Algorithms, Change Detection	2
6	Accuracy Analysis: Producer, User Accuracy, Overall and Mapping Accuracy, Kappa Coefficient	2
7	Vector Layers: Generation of Vector Layer, Editing and Topology Building, Area and Perimeter Estimation	2
8	Presentation: Map Composition	2

Note: a) For 4 credits 4 hours practical per week.
b) The concerned teacher may add some points related to the subject.

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
3. Gupta, R. P. (2003): Remote Sensing Geology, Springer,Verlag Berlin

Code: GR 204	**Practical in Geospatial analysis**	
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Editing Data: Selecting Features, Simple Editing Functions, Creating New Features, Modifying, Schema Changes	2
2	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	2
3	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
4	Network Analysis: Network Utility, Creating Network Model, Shortest Path, Geocoding	3
5	Surface Analysis: DEM	2
6	Presenting Data: Map Design, Map Composition	3
7	Project Work	*

Note: a) For 4 credits 4 hours practical per week.
b) The concerned teacher may add some points related to the subject.

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: GR 205	**Application in RS & GIS**	
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Geosciences: Landform Analysis, Drainage Basin Morphometry, Slope Mapping, Integrated Approach for Landslide Hazard Zonation Models and Mapping.	2
2	Water Resources: Watershed Hydrology, Physical Processes in Watershed, River Valley Project, Hydrological Modeling	2
3	Forest: Image Processing for Forest, Vegetation Classification Mapping, Forest Inventory, Forest Management, Land Evaluation for Forestry	2
4	Marine and Atmospheric Sciences: Fundamentals Of Marine, Oil Spills, Ecology, Ocean Color Mapping, SST Mapping, Potential Fishing Zone Mapping.	1
5	Fundamental Principles of Climatology, Aerosols, Climate modeling, Meteorological Satellites, Forecasting of Natural Calamities, Climate change detection	2
6	Agriculture and Soils: Spectral Characteristics of Crop, Crop Inventory, Crop Yield Modeling, Physiographic, Soil Mapping, Crop Water Management, Agro-Ecological Zoning	2
7	Biodiversity: Concept Of Ecology and Biodiversity, Biodiversity Mapping, Assessment of Biodiversity Hotspots, Wildlife Habitat Suitability Analysis, Species Inventory	2

Note: a) For 3 credits 3 hours practical per week.

b) The concerned teacher may add some points related to the subject.

Books:

1. SPRS Technical Commission VII(2002): Symposium on Resource Environmental Monitoring, ISRS Annual Convention, IIRS, Dehradun
2. Deekshatulu, B. L.(1990): Description and useofLand use/Landcover, NRSA, Hyedrabad
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 Plateforms, 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

Code: GR 206 Advance Surveying and field work		
No. of Credits: 03		**No. of Practical: 15**
Sr. No.	**Topic**	**Practical**
1	Introduction to Total Station: Principle and Function. Process of data collection and analysis.	2
2	Use of Total Station in Topographical Survey, Application of Total Station in Various Fields	3
3	Introduction to Differential GPS (dGPS) and UAV: Principle and Functions	3
4	Use of dGPS in Topographical Survey, Application of dGPS Points in DEM Generation from Stereo Images	7

Note: a) For 3 credits3 hours practical per week.
b) The concerned teacher may add some points related to the subject.

Books:

1. Jeff, H. (1995): Differential GPS Explained, Trimble Navigation
2. Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
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. Lawrence, L. and Alex, L. (2008): GPS Made Easy: Using Global Positioning Systems in the Outdoors, Rocky Mountain Books, Calgary
5. Stinespring, B. M. (2000): The Experimental Evaluation of a DGPS Based Navigational System for the ARIES AUV, Monterey, California: Naval Postgraduate School; Springfield

Code: GR 207	**Project Work**
No. of Credits: 04	**Topics to be covered**
1	Problem identification and literature review
2	Data acquisition / collection
3	Field work
4	Data processing
5	Results and interpretation
6	Report writing and presentation