R21 Curriculum and Syllabus
MSc. in Remote Sensing & GIS
with specialization in
"Remote Sensing & GIS"

JIS University
Agarpara, Kolkata

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PMT1002	Mathematics for Remote Sensing	4	0	0	4
2	CC	PRS1001	Fundamental of Remote Sensing and Digital Image Processing	4	0	0	4
3	CC	PRS1002	Geographic Information System (GIS) and GNSS	4	0	0	4
4	CC	PRS1003	Fundamentals of Photogrammetry	4	0	0	4
5	EC-1	-	Elective Course-1	4	0	0	4
PRACTICAL							
6	CC	PRS1101	Remote Sensing and GIS Lab	0	0	4	2
MANDATORY NON-CGPA							
7	MC	PRS1501	Seminar	0	0	2	1
8	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**20**	**0**	**8**	**24**

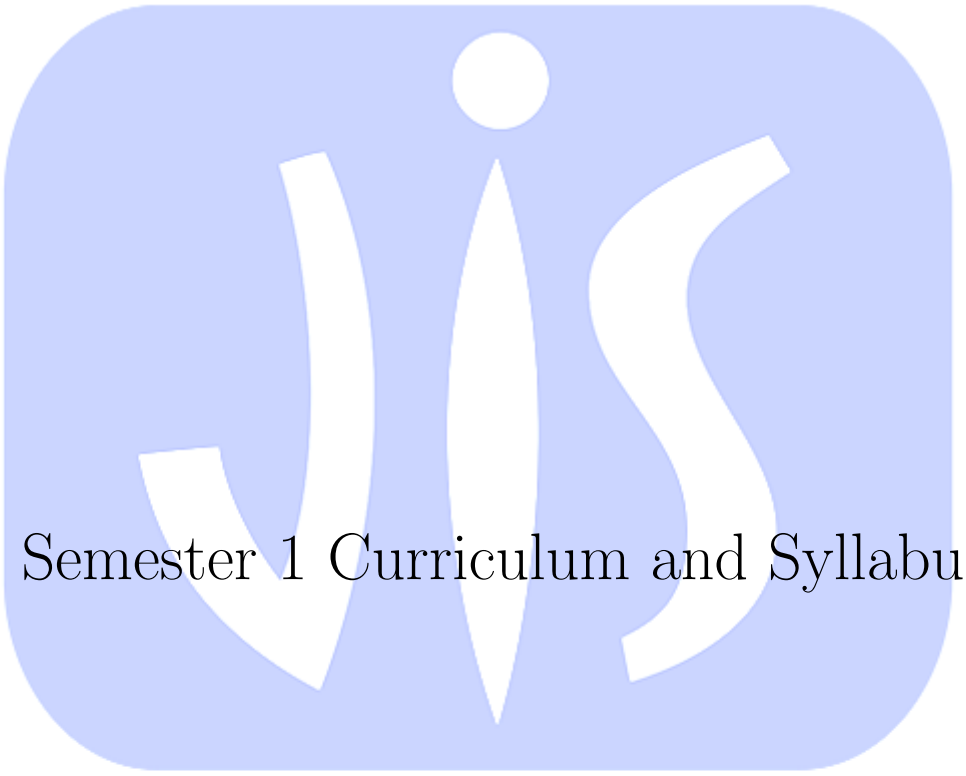
SEMESTER-<<#>>							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
PRACTICAL							
EMBEDDED(THEORY + PRACTICAL)							
BLENDED(MOOC + INTERNAL ASSESSMENT)							
SESSIONAL(ONLY INTERNAL EVALUATION)							
MANDATORY NON-CGPA COURSE							
TOTAL							

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PMT2001	Mathematice-II	4	0	0	4
2	CC	PRS2001	Advanced Digital Image Processing	4	0	0	4
3	CC	PRS2002	Advanced GIS & Cartography	4	0	0	4
4	EC-2	-	Elective Course -2	4	0	0	4
PRACTICAL							
5	CC	PRS2101	Advanced Remote Sensing and Photogrammetry Lab	0	0	4	2
6	CC	PRS2102	Survey & Cartography Lab	0	0	4	2
MANDATORY NON-CGPA							
7	MC	PRS1501	Seminar	0	0	2	1
8	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**16**	**0**	**12**	**22**

SEMESTER-<<#>>							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
PRACTICAL							
EMBEDDED(THEORY + PRACTICAL)							
BLENDED(MOOC + INTERNAL ASSESSMENT)							
SESSIONAL(ONLY INTERNAL EVALUATION)							
MANDATORY NON-CGPA COURSE							
TOTAL							

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PRS3001	Quantitative Geoinformatics	4	0	0	4
2	CC	PRS3002	Geoinformatics in Watershed Management	4	0	0	4
3	CC	PRS3003	Geoinformatics in Natural Hazards and Disaster Management	4	0	0	4
PRACTICAL & SESSIONAL							
5	CC	PRS3101	Application of Remote Sensing & GIS Lab	0	0	4	2
8	CC	PRS3201	Dissertation-I	0	0	4	2
9	CC	PRS3202	Seminar-I	0	0	4	4
MANDATORY NON-CGPA							
6	MC	PRS1501	Seminar	0	0	2	1
7	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**12**	**0**	**16**	**22**

SEMESTER-<<#>>							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
PRACTICAL							
EMBEDDED(THEORY + PRACTICAL)							
BLENDED(MOOC + INTERNAL ASSESSMENT)							
SESSIONAL(ONLY INTERNAL EVALUATION)							
MANDATORY NON-CGPA COURSE							
TOTAL							



Semester 1 Curriculum and Syllabus

UNIVERSITY

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PMT1002	Mathematics for Remote Sensing	4	0	0	4
2	CC	PRS1001	Fundamental of Remote Sensing and Digital Image Processing	4	0	0	4
3	CC	PRS1002	Geographic Information System (GIS) and GNSS	4	0	0	4
4	CC	PRS1003	Fundamentals of Photogrammetry	4	0	0	4
5	EC-1	-	Elective Course-1	4	0	0	4
PRACTICAL							
6	CC	PRS1101	Remote Sensing and GIS Lab	0	0	4	2
MANDATORY NON-CGPA							
7	MC	PRS1501	Seminar	0	0	2	1
8	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**20**	**0**	**8**	**24**

Course Code	PMT1002			
Course Title	Mathematics for Remote Sensing			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the basic knowledge of matrix algebra, function of several variables and Improper integral. At the end of the course, the students will be able to apply numerical methods to obtain approximate solutions to various problems in Remote Sensing and GIS.

Course Outcome:

CO1: To recall the distinctive characteristics of matrix algebra and vectors calculus

CO2: To understand the theoretical working of limit, continuity, derivative and integration.

CO3: To apply effective mathematical tools for the solutions of ordinary differential equations in different RS and GIS models.

CO4: To examine the nature of system using the concept of matrix algebra and vector space.

CO5: To apply numerical methods to obtain approximate solutions to various problems in Remote Sensing and GIS such as interpolation, integration, the solution of linear and nonlinear equations, and the solution of system of linear equations.

Course Content:

Module 1: Basic Calculus **[10L]**

Limits and Continuity: Introduction, Limit of a function, Definition of limit of a function - definition), examples. Differentiation: Partial derivatives, Total differential, Conditions for a function to be a maximum or a minimum at a point, Errors and approximation, Successive Differentiation. Integration: Elementary integration, Integration by parts, Simple definite integrals.

Module 2: Differential Equations **[06L]**

Differential Equations: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, exact equations, application.

Module 3: Vector Algebra **[10L]**

Vector Algebra: Position vector, scalar product, vector product, geometrical interpretation, gradient of scalar function, divergence and curl of vector function. Vector

Spaces: Definition and Examples, Subspaces, Linear dependence, Basis and Dimension, Sum and Direct Sum, Quotient spaces, Linear Transformations: Kernel and Image of a Linear Transformation, Rank and Nullity of a Linear Transformation

Module 4 : Matrices and Determinant **[12L]**

Matrices and Determinant: Introduction to matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem Simple problems on practical applications of RS and GIS

Module 5 : Numerical Methods **[12L]**

Numerical Methods: Errors in approximation, Absolute, Relative and percentage errors. Solution of algebraic and transcendental equations: Bisection method, Newton Raphson method, Systems of simultaneous Equations: Inversion method, Gauss elimination method, Gauss Jordon method, LU decomposition method, Iterative methods: Jacobi method and Gauss-Seidel method. Numerical Integration: General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Expression for corresponding error terms.

Text/Reference Books:

1. P.K. Sharma, "Remedial Mathematics (1^{st} Edition)", Nirali Prakashan.
2. M.C. Potter, J. Goldberg, "Mathematical Methods (2^{nd} Edition)", Prentice Hall.
3. K.E. Atkinson, "An Introduction to Numerical Analysis (2^{nd} Edition)", Wiley-India.
4. S.D. Conte, Carl de Boor, "Elementary Numerical Analysis - An Algorithmic Approach (3^{rd} Edition)", McGraw-Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	-	-	2	-	-	-	3
CO2	3	2	-	1	2	1	1	1	-	-	-	3
CO3	1	2	2	1	-	-	1	1	-	-	-	3
CO4	3	2	1	1	-	1	-	2	-	-	-	3
CO5	2	2	1	1	1	-	1	-	-	-	-	3

Course Code	PRS1001			
Course Title	Fundamental of Remote Sensing and Digital Image Processing			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the optical, thermal and microwaves based Remote Sensing and applications for solving real life problems. The students will be able to disseminate basic concepts and applications of Electromagnetic Spectrum in Remote Sensing, Energy Balance and Data acquisition platforms, sensors and their characteristics.

Course Outcome:

CO1: To understand the basic concepts of Remote Sensing and Digital Image Processing and its application

CO2: To understand different type of sensors and their characteristics

CO3: To explain the principles of thermal and microwave satellites, sensors and their nature of the data

CO4: To understand the appropriate use of satellite data for different applications

CO5: To apply remote sensing in different thematic studies

Course Content:

Module 1: Introduction to Remote Sensing **[12L]**

Introduction: History of Remote Sensing, Remote sensing components, Sources of Energy, EMS and Radiation, Black body and associated laws, Stefan-Boltzman law, Wien's law, Kirchhoff's law etc., Interaction of EMR with Atmosphere—Scattering, Refraction, Absorption, Transmission, Atmospheric windows, Interaction of EMR with Earth Surface—Spectral reflectance curves, Radiation Calculation, Spectral, Spatial, Temporal and Radiometric resolutions.

Module 2: Platforms and Sensors **[08L]**

Platforms and Sensors: Orbital movement and Earth coverage. Sun-synchronous and Geosynchronous satellites, Active and passive sensors, PAN, Multi High resolution and Hyper spectral Sensors, Thermal and Microwave sensors, Sensors characteristics. Satellites and their Specifications: LANDSAT, Pleiades, SPOT5/6/7, ENVISAT, WorldView, Quickbird, GeoEye, Sentinel-1/2, ASTER, RADARSAT, IRS, IKONOS, Cartosat etc.Referencing scheme of satellite system (path/row calculation). .

Module 3: Thermal and Microwave Remote sensing **[12L]**

Thermal and Microwave Remote sensing: Infrared Scanners, Scatterometer, Thermal Properties of Terrain, Thermal IR Environmental Considerations, Thermal Infrared and Thermal Scanners, Microwave Remote sensing concepts: Backscattering, Range Direction, Azimuth Direction, Incident Angle, Depression Angle, Polarization, Dielectric Properties, Surface Roughness and Interpretation, Speckle and Its Reduction, Applications of optical, thermal and microwave remote sensing.

Module 4 : Digital data products and their characteristics [06L]

Digital data products and their characteristics: Digital data Formats: BIL, BSQ, BIP, TIFF, Geo-TIFF, HDF, NetCDF, Ground segment organization, Pre-processing, Referencing Scheme, Data product generation, Data product output medium, Open Data Sources, Colour image generation, Initial data statistics, Histogram and Scatter plot, Mosacing.

Module 5 : Ground Truthing and Remote Sensing Applications [10L]

Ground Truthing and Remote Sensing Applications: Importance of Ground Truthing in Remote Sensing, Ground Truth Radiometer (GTR), Radiometric Calibration, Digital and Analog Methods, Spectral Response Patterns: Soil, Vegetation, Rocks and Water, RS Applications in Agriculture, Forestry, Land cover/Land use, RS Applications in Water resources and Earth Science.

Text/Reference Books:

1. R.C. Gonzales and R.E. Woods, "Digital Image Processing (2^{nd} Edition)", Pearson Education.
2. T.M. Lillesand and R.W. Kiefer "Remote Sensing and Image Interpretation (4^{th} Edition)", John Wiley.
3. P.M. Mather "Computer Processing of Remotely Sensed Images (1^{st} Edition)", John Wiley.
4. J.R. Jensen "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education.
5. J. George "Fundamentals of Remote Sensing", Universities Press.
6. S.K. Sinha "Fundamental of Remote Sensing and GIS", Ayushman Publication House.
7. Q. Weng "Advances in Environmental Remote Sensing: Sensors, Algorithms, and Applications", CRC Press.
8. F.F. Sabins "Remote Sensing: Principles and Applications (3^{rd} Edition)", Waveland Press Inc.
9. R.G. Reeves "Manual of Remote Sensing", American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia, USA.
10. C.B. Jones "Geographical Information Systems and computer Cartography", CRC Press.
11. G. Joseph, and C. Jeganathan "Fundamentals of Remote Sensing (3^{rd} Edition)", University Press.
12. R.A. Schowengerdt "Remote Sensing – Models and Methods for Image Processing", Academic Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	1	-	-	-	-	1	3
CO2	3	1	2	-	2	1	-	-	-	-	1	3
CO3	3	3	2	2	-	-	-	-	-	1	1	3
CO4	3	2	1	2	1	1	-	-	-	-	-	3
CO5	3	-	2	1	1	-	-	-	-	1	-	3

Course Code	PRS1002			
Course Title	Geographic Information System (GIS) & GNSS			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the raster and vector data analysis and applications for solving real life problems. The students will be able to disseminate basic concepts and applications of spatial and non-spatial database in GIS, concept of co-ordinate system in Geo-tagging any data.

Course Outcome:

CO1: To understand the basic concepts of coordinate system and spatial and non-spatial database in GIS

CO2: To know different types of spatial database, their editing and management

CO3: To explain the principles of various uses of raster and vector data overlay analysis

CO4: To know the appropriate use of ground-based survey techniques

CO5: To apply GNSS technique in spatial analysis

Course Content:

Module 1: Introduction **[12L]**

Introduction: Spatial and Non-spatial Data, Basic Database Management System, Co-ordinate reference system, Spheroid, Datum, Projection, Introduction to GIS, Types of Data in GIS, Geographical data models: Raster and vector models, Data Structure: Attribute structuring - data storage strategies, Data indexing, Geometric structuring, Topology- Concepts, Rules, spatial queries.

Module 2: Capture and Edit **[08L]**

Capture and Edit: Digitizing, digitizing into layers, Scanning, Errors and quality control of raster data: Spatial data, quality of GIS output, Sources of error in spatial data, Factors affecting the reliability of spatial data, Faults stemming, Accuracy tolerance, The epsilon band, Root mean square error, Error propagation analysis.Statistical approach to error propagation in numerical modelling. .

Module 3: Raster and Vector Operations and Integration **[10L]**

Raster and Vector Operations and Integration: Local, Focal, Zonal and Global Operations, AND, OR, NOT integration, overlay with attributes, attribute passing, Map

logic – Boolean and logical operators, arithmetic operators, overlaying quadtrees, query operations. Neighbourhood operations in raster: Spatial aggregation Filters (low pass and high pass). Slope and aspect, Spread computation, Seek Computation, Buffering, View shed analysis, Network analysis.

Module 4 : Surveying **[12L]**

Survey: Types of survey, Leveling Booking and reduction methods, Numerical on leveling, Traversing, Basic construction and adjustments, Numerical on traverse computation. Principles of Total Station survey.

Module 5 : GNSS **[06L]**

GNSS : History, Fundamental concepts, What makes GNSS – satellites, receivers, post processing software's, Sources of error in a GNSS system, Different terminology used in GPS survey, How it works – concepts, measuring distance, Accuracy of receivers, Surveying with GNSS – space segment, codes used, GNSS constellation, ground control segment, user segment, Modes of operation – single point positioning, relative positioning, kinematic positioning, static positioning, Differential GPS.

Text/Reference Books:

1. P.A. Burrough and R.A. McDonnell, "Principles of Geographical Information systems", Oxford University Press.
2. C.P. Lo and K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education.
3. P.A.Longley, M.f.Goodchild, D.J.Maguireand D.W. Rhind, "Geographical Information system and Science (3^{rd} Edition)", John Wiley.
4. S. Sekhar and H. Xiong, "Encyclopedia of GIS", Springer International Publishing.
5. T. P. Kanetkar, S. V. Kulkarni, "Surveying and Levelling Vol I and II", Vidyarthi Griha Prakashan.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	2	-	-	2	-	1	2
CO2	2	3	3	-	-	2	-	-	2	-	2	2
CO3	2	2	2	1	2	2	-	-	2	-	1	2
CO4	2	2	2	-	2	2	-	-	2	-	1	2
CO5	2	2	2	2	1	2	-	-	2	-	1	2

Course Code	PRS1003			
Course Title	Fundamentals of Photogrammetry			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the fundamentals of aerial photogrammetry, satellite/aerial photo interpretation, and both analogue and digital approaches to photogrammetry. Completion of the course students will also able to recognize contemporary breakthroughs and the significance of satellites and unmanned aerial vehicles (UAVs) in landscape modelling and mapping.

Course Outcome:

CO1: To describe the standard digital photogrammetric operations

CO2: To understand the historic developments in the field of Photogrammetry

CO3: To design planimetric measurements (both manually and digitally) from a given Aerial, Satellite and UAV derived High Resolution Images

CO4: To operate Stereoscopes, anaglyph glasses and digital workstations for Photogrammetric purposes

CO5: To understand flight planning requirements, advantages and limitations so as to get desired scale and accuracy for a given situation where natural resources or thematic mapping requirement to be fulfilled

Course Content:

Module 1: Introduction to photogrammetry **[08L]**

Introduction to photogrammetry: Historic development, types, significance. Areal Camera: optical aspects and components of aerial camera, types of aerial camera, Camera calibration. Fundamentals of Air Photo: Controlling factors of aerial photography; Classification of air photo, elements of air photo, applications of air photo.

Module 2: Basic Geometry of air photo **[08L]**

Basic Geometry of air photo: Geometric aspects of air photo; determination of scale, photographic resolutions; photographic displacement, height determination from displacement; Exterior and interior orientation, bundle block adjustment, space intersection and space resection; aerial flight planning. .

Module 3: Stereoscope and stereoscopy **[08L]**

Stereoscope and stereoscopy: Basic concepts, types of stereoscopes, needs of stereoscopy and stereo pair; floating mark principal and stereoscopic depth perception, stereoscopic parallax; depth, height, co-ordinate determination from parallax.

Module 4 : Photographic film and filter **[12L]**

Photographic film and filter: Aerial films, types of aerial films; general characteristics of photographic emulsions; Concepts of film exposer, film density, film speed, opacity and transmittance, film resolution; characteristics curve; Black and white film emulsion, spectral sensitivity of black and white film, black and white film processing, negative to positive sequence of black and white film; film filters, types; Colour film, concept of colour, spectral sensitivity of colour film, processing of colour film; colourer film, spectral sensitivity of colour IR film, colour IR film processing.

Module 5 : Terrain modelling with UAV **[12L]**

Terrain modelling with UAV: Digital Photogrammetric Images from UAV and associated concepts, UAV flight planning, coverage types, processing methods, Recent trends in its application, automated aerial triangulation: concepts, solutions, analysis, Photogrammetry work-stations, Review of available software.Principles of Digital Photogrammetry: Hardware and software requirements, Image measurement, Orientation procedure, Epipolar geometry, Aerotriangulation, Block adjustment, Satellite stereo images, Mosaics of DTM and ortho images

Text/Reference Books:

1. F.H. Moffitt and E.M. Mikhail, "Photogrammetry (3^{rd} Edition)", Harper and Row Publisher.
2. P.R. Wolf and B.A. Dewitt, "Elements of Photogrammetry", McGraw-Hill.
3. T. Luhmann, S. Robson, S. Kyle and J. Beohm, "Close Range Photogrammetry and 3D Imaging", Gruyter Inc.
4. E.M. Mikhail, J.S. Bethal and J.C. McGlove, "Introduction to Modern Photogrammetry", John Wiley and Sons.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	3	-	2
CO2	2	2	1	2	1	2	3	2	2	-	-	2
CO3	2	2	1	2	1	2	-	-	2	3	-	2
CO4	2	1	2	2	1	2	-	-	-	-	-	2
CO5	3	2	2	2	1	3	-	-	1	-	-	2

Course Code	PRS1004			
Course Title	Basic Remote Sensing & GIS and its application			
Category	EC-1			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn the basic concepts and principles of various components of remote sensing. They will able to disseminate concepts and applications of Electromagnetic Spectrum in Remote Sensing, Energy Balance and Data acquisition platforms, sensors and their characteristics and will get an exposure to GIS and its practical applications.

Course Outcome:

CO1: To understand the concepts of Electromagnetic energy, spectrum and spectral signature curves in the practical problems.

CO2: To understand the concepts of satellite and sensor parameters and characteristics of different platforms.

CO3: To understand the concepts of DBMS in GIS.

CO4: To analyze raster and vector data and modelling in GIS.

CO5: To understand GIS in land use, disaster management and resource information system.

Course Content:

Module 1: Remote Sensing [10L]

Remote Sensing: Definition -Historical Components of Remote Sensing Principles methods of remote sensing - Active and Passive remote sensing - Remote Sensing platforms -Electromagnetic radiation- Spectrum- Block body radiation – planks law – Stefan – Boltzmann law – satellites classification – based on orbit- sun synchronous and Geosynchronous based on purpose Earth Resources satellites, communication satellite Weather satellites Spy satellites Sensors Description of sensor in landscape, spot, IRS series and current satellites- Radar SLAR-and SAR.

Module 2: EMR Interactions [10L]

EMR Interactions: Interaction with atmosphere Scattering of EMR Raleigh, Mie, Non Selective and Raman Scattering Bach scattering Speckle EMR Interaction with water and Ozone Atmospheric windows and its significance EMR interaction with the earth surface materials Radiance, irradiance, Absorbed and Transmitting energy – reflectance- Specular- and diffuse surface- Spectral signature – and curves EMR interaction with soil Resolution Spectral, Spatial, Radiometric, and Temporal.

Module 3: Resources Engineering [09L]

Resources Engineering: Characteristics of Digital satellite image enhancement Filtering Applications of Aerial photographs and satellite imageries – merits – Limitations – Water resources – watershed management – Urban Studies – Flood Management-Fishing Forestry etc.,

Module 4 : Geographic Information System **[10L]**

Geographic Information System: GIS – Components of GIS – Hardware, Software and Organisational Context – Data – Spatial and NonSpatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters

Module 5 : Miscellaneous Topics **[09L]**

Miscellaneous Topics: Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Urban Applications- Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems

Text/Reference Books:

1. A. Reddy, "Remote Sensing and Geographical Information Systems", BS Publications.
2. P.H. Anand, "Principles of remote Sensing and Geographical Information Systems", Sri Venkateswara Publishers.
3. T.M. Lillesand and R.W. Kiefer, "Remote sensing and Image, Interpretation", John Wiley.
4. P.A. Burrough, "Principle of GIS for land resource assessment", Oxford University.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	1	2	1	-	-	-	-	2	2
CO2	2	2	2	-	-	1	-	-	-	-	2	2
CO3	2	1	2	1	2	1	-	1	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2
CO5	2	-	3	-	2	1	-	1	-	-	1	2

Course Code	PRS1101			
Course Title	Remote Sensing & GIS Lab			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	2
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the usage of diverse remote sensing data for extracting geo-spatial information. Completion of the course students will also able to execute various analogue and digital information extraction techniques, both manually and using computers.

Course Outcome:

CO1: To interpret Satellite multispectral images and Survey of India Toposheets

CO2: To investigate various radiometric and spatial enhancement techniques and create land cover map using different clustering techniques using DIP methods.

CO3: To understand different image processing software.

CO4: To acquire knowledge the strength and applications of Arc model builder to automate image processing.

CO5: To understand the basic image visualization techniques to interpret and identify different terrestrial features.

Suggestive List of Experiments:

1. Manipulation on Remote Sensing data **[1 day]**
   Introduction to different types of remote sensing data products

2. Visualization of RS Data **[2 days]**
   Visual Analysis of a satellite data.
   Demo on different types of remote sensing-based software.

3. Image corrections **[4 days]**
   Initial Statistics Extraction from RS data
   Map Projection.
   Working with optical data (Landsat & ASTER).
   True colour composite; False colour composite (FCC) etc.
   Working with Digital Elevation Model (DEM).

4. Geometric Corrections **[2 days]**
   Image and scanned Map registration.
   Resampling processes.

5. Digitization in ArcGIS **[1 day]**
   Digitization and editing of features.

6. Map compositions **[2 days]**
   Map preparation and composition.

Text/Reference Books:

1. R.C. Gonzales and R.E. Woods, "Digital Image Processing (2^{nd} Edition)", Pearson Education.

2. T.M. Lillesand and R.W. Kiefer "Remote Sensing and Image Interpretation (4^{th} Edition)", John Wiley.

3. P.A. Burrough and R.A. McDonnell, "Principles of Geographical Information systems", Oxford University Press.

4. C.P. Lo and K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	2	3	2	-	-	1	-	2	3
CO2	2	2	2	2	1	2	-	-	1	-	2	3
CO3	2	2	2	-	-	2	-	-	-	1	2	3
CO4	2	2	2	1	1	2	-	-	1	-	2	3
CO5	2	2	2	1	-	2	-	-	-	1	2	3

Course Code	PRS1501			
Course Title	Seminar			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

CO1: To improve oral and written communication skills

CO2: To apply principles of ethics and respect in interaction with others.

CO3: To acquire the ability of independent learning and collaborative study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	-	-	-	-	-	-	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	-	-	2

Course Code	PRS1502			
Course Title	Skill-X			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

CO1: To acquire a better insight into the subject

CO2: To identify current, real-world issues.

CO3: To develop scientific inquiry skills to design and carry out scientific investigations.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	1	-	-	3
CO2	-	-	-	-	2	-	-	-	1	-	-	3
CO3	-	-	3	-	2	-	-	-	2	-	-	3

Semester 2 Curriculum and Syllabus

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PMT2001	Mathematice-II	4	0	0	4
2	CC	PRS2001	Advanced Digital Image Processing	4	0	0	4
3	CC	PRS2002	Advanced GIS & Cartography	4	0	0	4
4	EC-2	-	Elective Course -2	4	0	0	4
PRACTICAL							
5	CC	PRS2101	Advanced Remote Sensing and Photogrammetry Lab	0	0	4	2
6	CC	PRS2102	Survey & Cartography Lab	0	0	4	2
MANDATORY NON-CGPA							
7	MC	PRS1501	Seminar	0	0	2	1
8	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**16**	**0**	**12**	**22**

Course Code	PMT2001			
Course Title	Mathematics II			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the basic knowledge of probability and statistics and their application in Remote Sensing data analysis. At the end of the course, the students will be able to apply geostatistical methods to analyse satellite based images and other remote sensing products.

Course Outcome:

CO1: To recall the distinctive characteristics of probability and statistics

CO2: To understand the basic probability theories and their application.

CO3: To apply effective statistical tools to extract information from different satellite images.

CO4: To learn different interpolation techniques to interpret the remote sensing data.

Course Content:

Module 1: Basic Probability Theory **[14L]**

Classical and Axiomatic definition of Probability (elementary properties), Conditional probability, Baye's theorem and related problems. Probability Distributions: Definition of random variable; Continuous and discrete random variables; Probability density function, probability mass function for single variable only; Distribution function and its properties (without proof), Examples; Definitions of Expectation, Variance, properties and examples. Some important discrete distributions: Binomial, Poisson. Continuous distributions: Normal; Determination of Mean, Variance and standard deviation of the distributions, Application to RS.

Module 2: Statistical Concepts in RS **[12L]**

Meaning, Scope and importance of Statistics, application of Statistics in RS; Collection of data - sampling methods; random and systematic method; source of data - primary and secondary Organization of data - array, frequency, class intervals, histograms, and distribution, Presentation of Data: Tables, Diagrams, Grouped data and ungrouped data, Geographical data: discrete and continuous series, scales of measurement, Measures of Central Tendency - mean, median, mode, quartiles, Moments, Skewness, Kurtosis, Measures of Dispersion – absolute dispersion, relative dispersion Correlation: meaning, scatter diagram, standard deviation, variance, Measures of correlation – Karl Pearson's method (two variables ungrouped data), Spearman's rank correlation methods.

Module 3: Descriptive Statistics **[08L]**

Descriptive Statistics- Data Visualization-Sampling distribution-Confidence Interval-Hypothesis Testing- Correlation; Simple linear Regression-Method of Least Square-Analysis of variance, Chi-square test, t-test, F-test, Z-test.

Module 4: Geo-statistics **[06L]**

Mean centre of population and temporal shift, Bi-variate Multiple correlation and regression, Correlation analysis Scatter Diagram Residual mapping, T-test, Z-Score, Root Mean Square Error, Principal Component analysis.

Module 5: Statistical applications in GIS **[08L]**

Surface Modeling: Spatial autocorrelation, Role of Interpolation, Methods of Interpolation – Global and Local Deterministic Methods, Moving Averages, Inverse Distance Interpolation, Optimal Interpolation using Geostatistics, Variogram and its use for Interpolation, Interpolation by Kriging – Ordinary Kriging, Block Kriging, Non-Linear Kriging, Stratified Kriging, Co-Kriging, Universal Kriging, Probabilistic Kriging Factor and cluster analysis.

Text/Reference Books:

1. P.K. Sharma, "Remedial Mathematics (1^{st} Edition)", Nirali Prakashan.
2. M.C. Potter, J. Goldberg, "Mathematical Methods (2^{nd} Edition)", Prentice Hall.
3. K.E. Atkinson, "An Introduction to Numerical Analysis (2^{nd} Edition)", Wiley-India.
4. S.D. Conte, Carl de Boor, "Elementary Numerical Analysis - An Algorithmic Approach (3^{rd} Edition)", McGraw-Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	-	-	2	-	-	-	3
CO2	3	2	-	1	2	1	1	1	-	-	-	3
CO3	1	2	2	1	-	-	1	1	-	-	-	3
CO4	3	2	1	1	-	1	-	2	-	-	-	3

Course Code	PRS2001			
Course Title	Advanced Digital Image Processing			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	50			
Pre-requisites	None			

Learning Objective:

In this course students will learn about the basic principles of digital image processing. They will able to design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement)and advanced image analysis (e.g., image compression, image segmentation image representation).

Course Outcome:

CO1: To implement basic image processing algorithms to process satellite images

CO2: To have the ability to design point wise intensity transformations to meet stated specifications.

CO3: To understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.

CO4: To Understand the role of alternative color spaces, and the design requirements leading to choices of color space.

Course Content:

Module 1: Digital Image Fundamentals **[10L]**

Elements of visual perception: Structure of human eye; Image formation in the eye; Brightness adaptation discrimination.
Image Sensing and acquisition: Image acquisition using a single sensor; Image acquisition using sensor strips; Image acquisition using a sensor array; A simple image formation model.
Image sampling and quantization: Basic concepts in sampling and quantization; Representing digital image; Spatial and intensity resolution; Image re sampling and interpolation.
Basic relationship between pixels: Neighbours of a pixel; Adjacency, connectivity, regions and boundaries; Distance measures

Module 2: Intensity Transformation and Spatial Filtering **[14L]**

Some basic intensity transformation functions: Contrast Stretching; Image Negatives; Log Transformation; Power-Law (Gamma) Transformation; Piecewise-linear Transformation Functions.
Histogram Processing: Histogram Equalization; Histogram Matching (Specification); Local Histogram Processing; Using Histogram Statistics for Image Enhancement.

Fundamentals of Spatial Filtering: The mechanics of spatial filtering; Spatial Correlation and Convolution; Vector representation of Linear Filtering; Generating Spatial Filter Masks.
Smoothing and sharpening Spatial Filtering: Smoothing linear filters; Order-statistics (Nonlinear) filters; Using the second derivative for Image Sharpening-The Laplacian; Unsharp Masking and High-boost Filtering; Using first-order derivatives for (Nonlinear) image sharpening-The Gradient.
Other Filtering Operation: Inverse filtering; Minimum Mean Square Error (Wiener) Filtering; Constrained Lease Square Filtering; Geometric Mean Filter.

Module 3: Digital Image Classification **[08L]**

Supervised Classification: Training Sites Selection and Statistical, Information Extraction, Principal Component Analysis (PCA), Discriminate Functions.
Classifier: Maximum Likelihood, Euclidian Distance, Mahalanobis Distance, Parallelepiped. Unsupervised Classification. Classification. Accuracy Assessment and Error Matrix

Module 4: Colour Image Processing **[08L]**

Colour Models: The RGB colour model; The CMY and CMYK colour models; The HIS colour models.
Pseudo colour Image Processing: Intensity Slicing; Intensity to Colour Transformations.
Colour Transformations: Formulation; Colour Components; Colour Slicing; Tone and Colour Corrections; Histogram Processing.
Smoothing and Sharpening: Colour Image Smoothing; Colour Image Sharpening

Module 5: Image Compression **[10L]**

Fundamentals: Coding redundancy; Spatial and temporal redundancy; Irrelevant information; Measuring Image Information; Fidelity Criteria; Image Compression models; Image formats; Containers and Compression Standards.
Some basic compression models: Huffman Coding; Golomb Coding; Arithmetic Coding; LZW Coding; Run-Length Coding; Symbol-Based Coding; Bit-Plane Coding; Black Transform Coding.

Text/Reference Books:

1. R.C. Gonzalez, R.E. Woods, "Digital Image Processing (3^{rd} Edition)", Pearson.
2. S Jayaraman, S. Essakkirajan, T. Veerakumar, "Mathematical Methods", Tata McGrow Hills.
3. A. McAndrew, "Introduction to Digital Image Processing with Matlab", Thomson Course Technology.
4. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India.
5. J.C. Russ and J.C. Russ, "Introduction to Image Processing Analysis", CRC Press.
6. J.R. Jensen "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education.
7. J.C. Russ and F.B. Neal "The Image Processing Handbook (7^{th} Edition)", CRC Press.
8. G.S. Srivastava "An Introduction to Geoinformatics", McGraw Hill Education.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	-	-	2	-	-	-	3
CO2	3	2	-	1	2	1	1	1	-	-	-	3
CO3	1	2	2	1	-	-	1	1	-	-	-	3
CO4	3	2	1	1	-	1	-	2	-	-	-	3

Course Code	PRS2002			
Course Title	Advanced GIS & Cartography			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	50			
Pre-requisites	None			

Learning Objective:

The objective of this course is to gain an understanding of basic cartographic issues and GIS concepts, and their use in a specific GIS application. Moreover, after completion of the course students have gained understanding of the purposes of cartography, recognize the elements of cartographic representation, and how maps work.

Course Outcome:

CO1: To perform sophisticated raster and vector GIS analysis in a GIS environment.

CO2: To explore and solve spatial problems using GIS techniques and technology.

CO3: To develop a broad appreciation of spatial analysis techniques and application areas.

CO4: To experiment with different symbologies to develop qualitative, quantitative and multivariate traditional and non-traditional maps.

Course Content:

Module 1: Spatial data generation through interpolation **[6L]**

Spatial Analysis: Concept and objectives, Spatial interpolation- Concepts, Types, Important interpolation techniques used in GIS- IDW, Spline, Trend surface analysis, Voronoi Polygon, TIN Interpolation accuracy estimation, Applications of spatial interpolation; Terrain Mapping and analysis- Concepts of DEM, DTM and DSM.

Module 2: Web GIS **[10L]**

Web GIS: Basics of Computer Networking, Network communication models, Internet protocols, Information exchange process, Basic requirement of Distributed GIS, Distributed web mapping architecture from OGC, Web server, Map server, Application services, Database Middleware, Static map publishing, Interactive web mapping, Introduction, WMS, WFS , WCS, Commercial web mapping programs.

Module 3: Python Fundamentals **[10L]**

Python language fundamentals: Introduction, Working with data types and structures, Working with numbers, Working with variables and naming, Writing statements and expressions, Using strings, Using lists, tuples and dictionary, Working with Python objects, Using functions, Using methods, Working with strings, Working with lists, Working with paths, Working with modules, Controlling workflow using conditional statements, Controlling workflow using loop structures, Getting user input, Commenting scripts,

Module 4: Python in Geospatial analysis **[06L]**

Geo-processing using Python, Explore Manipulate spatial data, Working with rasters, Listing rasters, Describing raster properties, Working with raster objects, Working with the ArcPy Spatial Analyst module, Using raster functions to work with NumPy arrays

Module 5: Digital Cartography **[14L]**

Introduction: Concept, development, advantages and disadvantages.
Data sources: Digital Database, Cartographic database concepts. Geographical variables and their specifications, Graphic design: Components of graphic map design, Lettering of maps, Methods and guidelines, Theory of colour and pattern, Choosing colour and patterns, Isarithmic mapping. Introduction to digital cartography, Types of Maps, Map Scale, Line thinning algorithms, Changing cartography environment, Processing Cartographic data: Data ordering, Compilation, Cartographic generalization, Symbolisation of qualitative data, Symbolisation of quantitative data: Point, Line, Area, Volume. Map reproduction.

Text/Reference Books:

1. M.S. Monmonier, "Computer Assisted Cartography: Principles and Prospects", Prentice Hall.
2. A. H. Robinson, "Elements of Cartography (6^{th} Edition)", John Wiley & Sons.
3. E. Raise, " Principles of Cartography", McGraw-Hill.
4. R.G. Cromley, "Digital Cartography", Prentice-Hall.
5. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing.", Pearson Education.
6. P.A. Burrough, "Principles of Geographic Information System for Land Resources Assessment.", Oxford University Press.
7. K. Chang "Introduction to Geographic Information Systems (5^{th} Edition)", McGraw-Hill.
8. D. J. Peuquet, D. F. Marble, "Introductory Readings in Geographic Information System", Taylor and Francis.
9. D. O'Sullivan, D. J. Unwin, "Geographic Information Analysis", Wiley.
10. M. Worboys, M. Duckham, "A Computing Perspective", CRC Press.
11. P. A. Longley, M. Goodchild, D, Maguire, D. Rhind, "Geographic Information System and Science", Wiley.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	-	2	-	-	-	3
CO2	2	2	-	1	2	-	1	1	-	1	-	3
CO3	1	3	-	2	-	-	1	1	-	-	-	3
CO4	3	2	1	1	-	1	-	2	-	-	-	3

Course Code	PRS2003			
Course Title	GIS, GNSS and its Applications			
Category	EC-2			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the raster and vector data analysis and applications for solving real life problems. The students will be able to disseminate basic concepts and applications of spatial and non-spatial database in GIS, concept of co-ordinate system in Geo-tagging any data.

Course Outcome:

CO1: To understand the basic concepts of coordinate system and spatial and non-spatial database in GIS

CO2: To know different types of spatial database, their editing and management

CO3: To explain the principles of various uses of raster and vector data overlay analysis

CO4: To know the appropriate use of ground-based survey techniques

CO5: To apply GNSS technique in spatial analysis

Course Content:

Module 1: Introduction **[06L]**

Spatial and Non-spatial Data, Basic Database Management System, Co-ordinate reference system, Spheroid, Datum, Projection, Introduction to GIS, Types of Data in GIS, Data sources. Conversion on data.

Module 2: Geographical data models **[08L]**

Geographical data models: Raster and vector models, Data Structure: Attribute structuring - data storage strategies, tabular, hierarchical, relational, network, database organization, object orientation, Data indexing, Geometric structuring, Topology- Concepts, Rules, spatial queries, Various GIS software.

Module 3: Raster and Vector Operations and Integration **[18L]**

Raster and Vector Operations and Integration: Local, Focal, Zonal and Global Operations, AND, OR, NOT integration, overlay with attributes, attribute passing, Map logic – Boolean and logical operators, arithmetic operators, overlaying quadtrees,
Neighborhood operations in raster: Spatial aggregation, Filters (low pass and high pass).Slope and aspect, Spread computation, Seek Computation, Buffering, View shed analysis.
Application specific explanation of various tools in the software.

Module 4: Digital Cartography **[08L]**

Digital Cartography, Cartographic data, Map scale, Types of Maps, graphic map design, Data ordering, Compilation, Cartographic generalization, Symbolisation of qualitative data, Symbolisation of quantitative data.

Module 5: GNSS **[08L]**

GNSS : Fundamental concepts, What makes GNSS – satellites, receivers, How it works – concepts, measuring distance, Accuracy of receivers, Surveying with GNSS – space segment, codes used, GNSS constellation, ground control segment, user segment, Modes of operation – single point positioning, relative positioning, kinematic positioning, static positioning, Differential GPS.

Text/Reference Books:

1. P.A. Burrough and R.A. McDonnell, "Principles of Geographical Information systems", Oxford University Press.
2. C.P. Lo and K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education.
3. P.A.Longley, M.f.Goodchild, D.J.Maguireand D.W. Rhind, "Geographical Information system and Science (3^{rd} Edition)", John Wiley.
4. S. Sekhar and H. Xiong, "Encyclopedia of GIS", Springer International Publishing.
5. T. P. Kanetkar, S. V. Kulkarni, "Surveying and Levelling Vol I and II", Vidyarthi Griha Prakashan.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	2	-	-	2	-	1	2
CO2	2	3	3	-	-	2	-	-	2	-	2	2
CO3	2	2	2	1	2	2	-	-	2	-	1	2
CO4	2	2	2	-	2	2	-	-	2	-	1	2
CO5	2	2	2	2	1	2	-	-	2	-	1	2

Course Code	PRS2101			
Course Title	Advanced Remote Sensing and Photogrammetry Lab			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	2
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

This course aims to make the student learn practical aspects related to the usage of diverse remote sensing data for extracting needed geospatial information. Students will also learn to Utilise various analogue and digital photogrammetry based extraction techniques, both manually and using computers.

Course Outcome:

CO1: To interpret Satellite multispectral images and Survey of India Toposheets

CO2: To investigate various radiometric and spatial enhancement techniques and create land cover map using different clustering techniques using DIP methods.

CO3: To understand different image processing software.

CO4: To understand and process several declassified dataset.

CO5: To Use photogrammetric techniques and tools under Digital Environment so as to create digital surface models using various Satellite data..

Suggestive List of Experiments:

1. Manipulation on Remote Sensing data **[2 days]**
   Study of the various contrast enhancement techniques.
   Spectral Enhancement (Ratio images and PCA)Techniques.

2. Spatial Enhancement of RS Data **[1 day]**
   Low Pass Filtering High Pass Filtering Techniques

3. Image Classification **[3 days]**
   Unsupervised Classification
   Supervised Classification Accuracy Evaluation.

4. Digital Elevation Model (DEM) and Orthorectification **[3 days]**
   DEM and Orthorectification of satellite data using ERDAS LPS.
   DEM and Orthorectification of declassified data using ERDAS LPS.

5. Introduction to Google Earth Engine **[3 days]**
   Code for Satellite data selection Download
   Code for NDVI, NDSI, NDWI etc.
   Code for classification.

Text/Reference Books:

1. R.C. Gonzales and R.E. Woods, "Digital Image Processing (2^{nd} Edition)", Pearson Education.
2. T.M. Lillesand and R.W. Kiefer "Remote Sensing and Image Interpretation (4^{th} Edition)", John Wiley.
3. P.A. Burrough and R.A. McDonnell, "Principles of Geographical Information systems", Oxford University Press.
4. C.P. Lo and K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	2	3	2	-	-	1	-	2	3
CO2	2	2	2	2	1	2	-	-	1	-	2	3
CO3	2	2	2	-	-	2	-	-	-	1	2	3
CO4	2	2	2	1	1	2	-	-	1	-	2	3
CO5	2	2	2	1	-	2	-	-	-	1	2	3

Course Code	PRS2102			
Course Title	Survey and Cartography Lab			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	2
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

The objective of surveying laboratory is to make student familiar and competent enough to draw map in suitable scale by using different surveying instruments like total station, global positioning system (GPS), geographical information system (GIS). Additionally, at the end of the course, the student will dominate all the knowledge about the correct use of basic cartography and possesses the skills needed for reading, interpretation and use in the field of topographic, technical and thematic cartography,

Course Outcome:

CO1: To gain knowledge about Survey field techniques.

CO2: To development of contour map of given area.

CO3: To interpret and usage of geospatial data and maps;.

CO4: To produce audience-appropriate maps using geospatial data, geospatial software, and vector graphics editing software.

CO5: To explain the purpose of cartography and recognize the elements of cartographic representation.

Suggestive List of Experiments:

1. Total Station Survey **[5 day]**
   Introduction to Total Station Survey
   Determination of Area using Total Station
   Traversing using Total Station.
   Contouring using Total Station.
   Determination of Remote height using Total Station.

2. GPS Survey **[3 days]**
   Introduction to GPS.
   Operation Systems.
   GPS measurements.

3. Cartography **[4 days]**
   Construction of different types of scales.
   Preparation of UTM grid; Base Map; Designing and Symbolization.
   Analog to Digital Conversion; Analysis of Toposheet.
   Updation of maps from Satellite Imagery.

Text/Reference Books:

1. M.S. Monmonier, "Computer Assisted Cartography: Principles and Prospects", Prentice Hall.
2. A. H. Robinson, "Elements of Cartography (6^{th} Edition)", John Wiley & Sons.
3. E. Raise, " Principles of Cartography", McGraw-Hill.
4. R.G. Cromley, "Digital Cartography", Prentice-Hall.
5. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing.", Pearson Education.
6. P.A. Burrough, "Principles of Geographic Information System for Land Resources Assessment.", Oxford University Press.
7. K. Chang "Introduction to Geographic Information Systems (5^{th} Edition)", McGraw-Hill.
8. D. J. Peuquet, D. F. Marble, "Introductory Readings in Geographic Information System", Taylor and Francis.
9. D. O'Sullivan, D. J. Unwin, "Geographic Information Analysis", Wiley.
10. M. Worboys, M. Duckham, "A Computing Perspective", CRC Press.
11. P. A. Longley, M. Goodchild, D, Maguire, D. Rhind, "Geographic Information System and Science", Wiley.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	2	3	2	-	-	1	-	2	3
CO2	2	2	2	2	1	2	-	-	1	-	2	3
CO3	2	2	2	-	-	2	-	-	-	1	2	3
CO4	2	2	2	1	1	2	-	-	1	-	2	3
CO5	2	2	2	1	-	2	-	-	-	1	2	3

Course Code	PRS2501			
Course Title	Seminar			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

CO1: To improve oral and written communication skills

CO2: To apply principles of ethics and respect in interaction with others.

CO3: To acquire the ability of independent learning and collaborative study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	-	-	-	-	-	-	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	-	-	2

Course Code	PRS2502			
Course Title	Skill-X			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

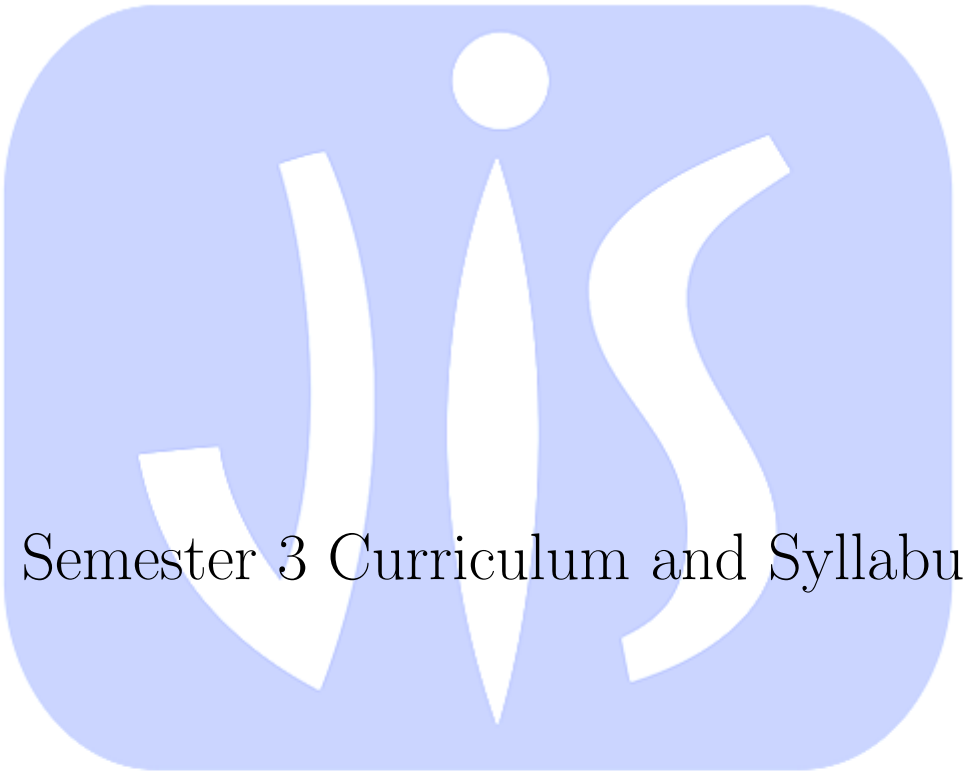
CO1: To acquire a better insight into the subject

CO2: To identify current, real-world issues.

CO3: To develop scientific inquiry skills to design and carry out scientific investigations.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	1	-	-	3
CO2	-	-	-	-	2	-	-	-	1	-	-	3
CO3	-	-	3	-	2	-	-	-	2	-	-	3



Semester 3 Curriculum and Syllabus

UNIVERSITY

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
THEORY							
1	CC	PRS3001	Quantitative Geoinformatics	4	0	0	4
2	CC	PRS3002	Geoinformatics in Watershed Management	4	0	0	4
3	CC	PRS3003	Geoinformatics in Natural Hazards and Disaster Management	4	0	0	4
PRACTICAL & SESSIONAL							
5	CC	PRS3101	Application of Remote Sensing & GIS Lab	0	0	4	2
8	CC	PRS3201	Dissertation-I	0	0	4	2
9	CC	PRS3202	Seminar-I	0	0	4	4
MANDATORY NON-CGPA							
6	MC	PRS1501	Seminar	0	0	2	1
7	MC	PRS1502	Skill-X	0	0	2	1
TOTAL				**12**	**0**	**16**	**22**

Course Code	PRS3001			
Course Title	Quantitative Geoinformatics			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	50			
Pre-requisites	None			

Learning Objective:

In this course students will learn about the basic concepts of analytical Geoinformatics. The students will also learn about quantitative modelling and statistical implementation and new and challenging Geoinformatics approaches to deal with real problems.

Course Outcome:

CO1: To explain various quantitative aspects of Geoinformatics

CO2: To integrated application of spatial technology in planning and decision making.

CO3: To understand the environmental monitoring using satellite image-based analysis.

CO4: To Understand the classical geometry for the spatial integrity.

CO5: To Understand the statistical analysis for logical output.

Course Content:

Module 1: Geometry of the Earth **[05L]**

Shape of the Earth: Conceptualisation of Planet Earth- The Earth's physical surface, Concept of Geoid, Reference Ellipsoid/Spheroid.Ellipsoidal model, Oblate Spheroid, Reference Spheroid and Concept of datum.Typical Datum used in geospatial analysis, Indian Geodetic Datum, Indian Mean Sea Level. Introduction to different spheroid / ellipsoid systems with special reference to Everest and WGS-84 - Geometric Constants.

Module 2: Coordinate system used in Geoinformatics **[05L]**

Coordinate System used in Geodesy: Geodetic and Geocentric Coordinate System, Earth Cantered Earth Fixed Coordinate System; Spherical trigonometry – concept of great circle and spherical triangle and trigonometry, Coordinate Transformations; Coordinate System used by Survey of India (, , H), Map Projections: Defining Map, Projection Systems, Azimuthal, Conical and Cylindrical projections with emphasis on Lambert Conformal Conic (LCC) and Universal Transverse Mercator (UTM) projection.

Module 3: Spatial data analysis **[10L]**

Spatial Analysis: Concept and objectives, Spatial interpolation- Concepts, Types, Important interpolation techniques used in GIS- IDW, Kriging, Spline, Trend surface

analysis, Concept of Semivariogram, Voronoi Polygon, TIN Interpolation accuracy estimation, Applications of spatial interpolation; Terrain Mapping and analysis- Concepts of DEM, DTM and DSM, Watershed and View shed analysis, Terrain Mapping, Least Cost Path analysis; Network Analysis: layer-based and object-oriented approaches to network analysis, Nature and utility of network data models, basic representations of node and link tables, Network Data representation, analysis and modelling (multidimensional GIS-T models), Applications and problems – Shortest routeing, travelling salesman problem, vehicle routing problem, Closest facility, facility location allocation and spatial interaction models., Utility Network analysis.

Module 4: Quantitative modelling for information generation - 1 **[07L]**

GIS Models and Modelling: Concepts of GIS models and modelling, Objectives, Typical GIS data models, Elements of GIS modelling, Typical GIS modelling. Quantitative Remote Sensing: Optical Image band organization for information extraction, Supervised image enhancement and extraction of environmental variables, Study in geometry of spectra plot, image simulation and predictive approach, SAM, SVM and LSMM for information extraction; Thermal and Microwave image analysis for environmental monitoring.

Module 5: Quantitative modelling for information generation - 2 **[17L]**

Multi-criteria Decision Analysis: Elements and Structure of MCDA and SDSS, Multi-objective and Multi-attribute analysis, Evaluation Criteria; Decision Alternatives and Constraints; Quantitative Models to calculate criteria weight and alternative rank estimation- Ranking and Rating (SMART), Entropy method, Analytical Hierarchy Process (AHP), Fuzzy AHP, TOPSIS method, CRITIC.
Spatial Statistics in GIS: Pattern Analysis - Nearest neighbour, Ripley's K function, Spatial Autocorrelation, Cluster Analysis: Hotspot Analysis, LISA, Measuring Geographical Distribution - Mean Centre, Directional Ellipse, Standard Distance, Modelling Spatial relationship – GWR, OLS, Multiple correlation and Regression.
Statistical Mapping: Dot map, Choropleth Mapping and types, Isopleth Mapping, Dasymetric Mapping, Atlases and Hyper maps, Anamorphic Mapping.

Text/Reference Books:

1. J.B. Campbell, "Introduction to Remote Sensing (3^{rd} Edition)", The Guilford Press.
2. R.K. Gupta, S. Chander, "Principles Of Geoinformatics", Jain Brothers.
3. A. Ghassem, "Theory and Applications of Optical Remote Sensing", John Wiley and Sons.
4. C.P.Lo, A.K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall of India.
5. D.J. Magwire, M.F. Goodchild and D.M. Rhind Ed, "Geographical Information Systems: Principles and Applications", Longman Group, U.K.
6. J.R. Jensen "Remote Sensing of the Environment – An Earth Resources Perspective", Pearson Education.

7. J.C. Russ and F.B. Neal "The Image Processing Handbook (7^{th} Edition)", CRC Press.

8. Kang-tsung Chang "Introduction to Geographic Information Systems", Tata McGraw Hill, New Delhi.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	-	-	2	-	-	-	3
CO2	3	1	-	1	2	1	1	1	-	-	-	2
CO3	1	2	1	2	-	-	1	1	-	-	-	1
CO4	2	1	2	1	-	-	1	1	-	-	-	3
CO5	2	2	2	2	-	-	1	1	-	-	-	3

Course Code	PRS3002			
Course Title	Geoinformatics in Watershed Management			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	50			
Pre-requisites	None			

Learning Objective:

In this course students will learn about the basic concepts of water resource, its types and mapping using Remote Sensing techniques. The course will also enhance student's knowledge about watershed management and planning and make the students learn Geoinformatics approaches to deal with water quality monitoring and analysis and regional planning related to water resource sustainability

Course Outcome:

CO1: To Explain various types of water resources and its monitoring and mapping

CO2: To apply geoinformatics in watershed management and planning.

CO3: To understand the water characterization using geoinformatics.

CO4: To know water quality monitoring and analysis.

CO5: To Understand Environmental risk assessment related to water resources like soil loss, drought, flood etc.

Course Content:

Module 1: Concept of Watershed **[04L]**

Concept and definition of watershed; Quantitative characterisation of Watershed; classification of Watershed; Watershed deterioration and consequents; Watershed restoration.

Module 2: Watershed Management and Planning **[08L]**

Watershed management: Problems and prospects; Objectives and principles of Watershed management; Components of Watershed management; Watershed prioritization; Land capability and watershed based land use planning; Hydro-geomorphic interpretation techniques for targeting ground water potential Zones; Budgeting water in a watershed.

Module 3: Watershed Conservation measures **[14L]**

Soil erosion control and conservation; Rain water conservation and harvesting; Micro irrigation system; People's participation in watershed management; Introduction to India-WRIS Bhuvan Project; River Valley Project (RVP); Hill Area Development

Programme (HADP); National Watershed Development Programme for Rainfed Agriculture (NWDPRA); Watershed management programmes, guideline and policies in India; West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP); Role of NGOs in watershed development.

Module 4: Application of Geoinformatics in Watershed Management [14L]

Overview of RS and GIS applications in watershed management; Digital Terrain analysis for watershed characterization; Geospatial modelling for soil erosion assessment in watershed; Land use modelling, planning and site suitability analysis; Dam site selection and canal alignment, Drought flood assessment and potentiality zonation, soil moisture mapping; Crop water, Crop yield and acreage estimation; CROPWAT modelling.

Module 5: Water resource management [08L]

Surface water mapping and monitoring; surface run-off estimation using SCS CN method; Ground water targeting; Water harvesting site selection and artificial recharge zonation; Water quality assessment and indexing.

Text/Reference Books:

1. V.R.Desai, A. Mishra, A. Kumar, "Watershed planning and management ICAR lecture series", www.agrimoon.com.
2. John G. Lyon, "GIS for Water Resource and Watershed Management", (1^{st} Edition)", CRC Press.
3. Xuan Zhu, "GIS for Environmental Applications: A practical approach", (1^{st} Edition)", Routledge.
4. J.V.S. Murthy, "Watershed Management", (2^{nd} Edition)", , New Age Publishers.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	2	1	1	2	2
CO2	2	1	-	1	-	1	1	1	-	-	-	2
CO3	1	2	1	2	2	-	1	-	-	1	1	1
CO4	2	-	2	1	1	-	1	1	1	-	-	2
CO5	2	2	-	2	1	-	1	1	-	1	-	2

Course Code	PRS3003			
Course Title	Geoinformatics in Natural Hazards and Disaster Management			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	4	0	0	4
Total Contact Hours	50			
Pre-requisites	None			

Learning Objective:

In this course students will learn about the basic concepts of disaster, its causes and its historical background. The course will enhance student's knowledge about disaster management planning and make the students learn Geoinformatics approaches to deal with disaster risk reduction and management.

Course Outcome:

CO1: To Explain various types of disasters and influencing factors

CO2: To Interpret and discriminate different stages of disaster management planning and utility of Remote Sensing and GIS tools in every stage.

CO3: To understand the administrative structure of disaster management in India.

CO4: To understand the ethical and humanitarian values.

CO5: To apply integrated geospatial techniques in disaster management and disaster risk Reduction .

Course Content:

Module 1: Fundamental Overview of natural hazards and disaster [08L]

Introduction to natural hazards, impact and mitigation in Global and Indian context; Types of hazards and disasters, characterization, zonation of hazards, Hazard Inventory, Hazard assessment at different scale, Natural and human induced disasters; Introduction to vulnerability and risk, Risk assessment, Multi hazard risk assessment, socio-economic and physical aspects of vulnerability and elements of risk mapping, assessment, and reduction strategies.

Module 2: Disaster Management and Institutional Framework-I [10L]

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, building design and construction in highly seismic zones, retrofitting of buildings.

Module 3: Disaster Management and Institutional Framework-II [10L]

Community preparedness: Pre and Post disaster preparedness, Stakeholder participation, Effectiveness of Social capital; Institutional arrangements for disaster management: NDMA, SDMA, DDMA, NDRF; Strengthening of NDMA and SDMA; Survival skill adopted during and after disaster.

Module 4: Application of Geoinformatics in Hazard **[10L]**

Overview of RS and GIS applications in Hazard and Disaster susceptibility zonation, mapping and management; Flood hazard susceptibility zonation using Interval Rough number (IRN), Analytical Network Process (ANP), HEC RAS, Multi Attribute Border Approximation Comparison (MABAC).

Module 5: Disaster susceptibility zonation and mapping **[08L]**

Landslide hazard susceptibility zonation using Frequency Ratio Model (FRM), Ordered Weighted Average Model (OWAM), Analytical Hierarchical Process (AHP); Drought assessment using SEBAL and different drought indices; Mapping of Coastal vulnerability due to extreme events and coastal erosion using optical and Microwave RS data and Digital shoreline analysis system (DSAS).

Text/Reference Books:

1. Brian Tomaszewski, "Geographic Information Systems (GIS) for Disaster Management", Routledge.
2. Bai Tian, "GIS Technology Applications in Environmental and Earth Sciences", CRC Press.
3. R.K. Gupta, Subhash Chander, "Principles Of Geoinformatics", Jain Brothers.
4. Joseph L. Awange, John B. Kyalo Kiema, "Environmental Geoinformatics: Monitoring and Management", Springe.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	2	1	1	2	2
CO2	2	-	-	1	-	1	1	1	1	-	-	1
CO3	1	1	1	-	2	-	1	-	1	1	1	1
CO4	2	-	1	1	-	-	1	1	-	-	2	2
CO5	2	2	-	2	-	-	1	1	-	1	-	2

Course Code	PRS3101			
Course Title	Application of Remote Sensing & GIS Lab			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	2
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

This course aims to make the student learn practical aspects related to the usage of diverse remote sensing data for watershed management, hazards and susceptibility zonation mapping and environmental monitoring.

Course Outcome:

CO1: To understand the application of Satellite images in watershed management

CO2: To investigate the man-made and natural hazard potential of a region.

CO3: To understand the different environmental effects on the society.

CO4: To map Forest cover, Feature space, Surface urban heat island using satellite data.

CO5: To perform Utility Network analysis, Cluster Analysis: Hotspot Analysis using satellite data.

Suggestive List of Experiments:

1. • Delineation of Watershed from DEM and SOI toposheets. **[4 days]**
   • Watershed morphometric analysis from DEM, Surface interpolation techniques, Land capability mapping, Crop yield and acreage estimation, Water quality assessment and zonation.
   • Watershed prioritization:, Run-off calculation using SCS CN method.
   • Land use and Land cover modelling, Flood potential zonation, Drought assessment.

2. • Land slide hazard potentiality zonation and mapping Flood inundation zonation and mapping **[4 days]**
   • Land degradation mapping using DEM difference and MCDM
   • Human Vulnerability mapping, Coastal erosion mapping, Water poverty analysis and mapping
   • Forest degradation and disturbance zonation

3. • Feature space mapping, Geometric analysis of Bi-variate feature space plots **[5 days]**
   • environmental monitoring, Forest cover mapping, Land use Mix analysis, Above ground Biomass estimation.
   • Surface urban heat island mapping, Patch analysis techniques,
   • Comparative analysis between hard classification techniques,
   • Aerosol optical thickness mapping (AOT) mapping, Utility Network analysis, Pattern Analysis.
   -

Text/Reference Books:

1. John G. Lyon, "GIS for Water Resource and Watershed Management", (1^{st} Edition)", CRC Press.

2. Xuan Zhu, "GIS for Environmental Applications: A practical approach", (1^{st} Edition)", Routledge.

3. Brian Tomaszewski, "Geographic Information Systems (GIS) for Disaster Management", Routledge.

4. Bai Tian, "GIS Technology Applications in Environmental and Earth Sciences", CRC Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	2	3	2	-	-	1	-	2	3
CO2	2	2	2	2	1	2	-	-	1	-	2	3
CO3	2	2	2	-	-	2	-	-	-	1	2	3
CO4	2	2	2	1	1	2	-	-	1	-	2	3
CO5	2	2	2	1	-	2	-	-	-	1	2	3

Course Code	PRS3201			
Course Title	Dissertation-I			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	2
Total Contact Hours	48			
Pre-requisites	None			

Course Outcome:

CO1: To improve oral and written communication skills

CO2: To apply principles of ethics and respect in interaction with others.

CO3: To acquire the ability of independent learning and collaborative study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	-	-	-	-	-	-	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	-	-	2

Course Code	PRS3202			
Course Title	Seminar-I			
Category	Core Course			
LTP & Credits	L	T	P	Credits
	0	0	4	4
Total Contact Hours	48			
Pre-requisites	None			

Course Outcome:

CO1: To improve oral and written communication skills

CO2: To apply principles of ethics and respect in interaction with others.

CO3: To acquire the ability of independent learning and collaborative study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	-	-	-	-	-	-	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	-	-	2

Course Code	PRS3501			
Course Title	Seminar			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

CO1: To improve oral and written communication skills

CO2: To apply principles of ethics and respect in interaction with others.

CO3: To acquire the ability of independent learning and collaborative study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	2
CO2	-	-	-	-	-	-	-	3	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	-	-	2

Course Code	PRS3502			
Course Title	Skill-X			
Category	Mandatory Non-CGPA Course			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Course Outcome:

CO1: To acquire a better insight into the subject

CO2: To identify current, real-world issues.

CO3: To develop scientific inquiry skills to design and carry out scientific investigations.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	1	-	-	3
CO2	-	-	-	-	2	-	-	-	1	-	-	3
CO3	-	-	3	-	2	-	-	-	2	-	-	3