P.G.Diploma in Spatial Technologies

SYLLABUS

(Revised Syllabus w.e.f the academic year 2024-25 under the CBCS)

CENTRE FOR GEOINFORMATICS
The Gandhigram Rural Institute (Deemed to be University)
(Ministry of Education, Govt. of India)
Accredited by NAAC with 'A' Grade (3rd Cycle)
Gandhigram – 624 302
Dindigul District, Tamil Nadu

CENTRE FOR GEOINFORMATICS

THE GANDHIGRAM RURAL INSTITUTE (DEEMED TO BE UNIVERSITY)
GANDHIGRAM – 624 302

I. Programme Code : PSTD

II. Programme : P.G.Diploma in Spatial Technologies

OBE Elements for **P.G.Diploma in Spatial Technologies** programme

Programme Educational Objectives (PEO)

PEO1: Succeed in getting employment in their field of interest related to spatial issues and has acquire skills to critically assess, analyse and solve spatial problems.
PEO2: Grow in their professional career through higher education in their field of interest.
PEO3: Cater to the needs of the industry in order to contribute for the development of the society
PEO4: Become an entrepreneur

Programme Outcomes (PO)

PO1: Become knowledgeable in the field of spatial technologies and apply the principles of the same to the needs of the Employer / Institution / Enterprise / Society.
PO2: Gain hands on experience in the Digital Image Processing (DIP), GIS, GPS
PO3: Understand and analyse the spatial problems
PO4: Learn spatial analytical tools / software as per current trends / needs
PO5: Learn open source software for GIS / DIP
PO6: Improve problem solving skills.

Programme Specific Outcome (PSO)

PSO1: Apply the knowledge of Spatial Technologies in the domain of spatial decision making
PSO2: Solve the complex problems in the field of spatial technologies with an understanding of the societal, legal and cultural impact of the solution.
PSO3: Create micro level analysis through Extension activities.
PSO4: Explore the students to various open software and data.

Eligibility: A pass in any UG degree

Scheme of Examination of the Programme
P.G.Diploma in Spatial Technologies
(Revised Syllabus w.e.f the Academic year 2024 – 2025 under the CBCS)

Semester	Category	Course Code	Title of the Paper	No. of Credits	Theory hours	Practical	Duration of ESE (Hours)	Evaluation Marks		Total Marks
								CFA	ESE	
I	Major Courses	24PSTD0101	Introduction to Spatial Technologies	4	4	-	3	40	60	100
		24PSTD0102	Remote Sensing and Digital Image Processing	4	4	-	3	40	60	100
		24PSTD0103	Principles of Cartography	4	4	-	3	40	60	100
		24PSTD0104	Geographical Information System	4	4	-	3	40	60	100
		24PSTD0105	Global Navigation Satellite System	3	3	-	3	40	60	100
		24PSTD0106	PRACTICAL - I: Geographical Information System	2	-	4	3	60	40	100
		24PSTD0107	PRACTICAL -II: Remote Sensing & Digital Image Processing	2	-	4	3	60	40	100
	1st Semester Total			**23**	**19**	**8**	**-**			
II	Major Courses	24PSTD0208	IT for Spatial Technologies	3	3		3	40	60	100
		24PSTD0209	Spatial Technologies in Resource Management	4	4		3	40	60	100
		24PSTD0210	Spatial Technologies in Disaster Management	4	4		3	40	60	100
		24PSTD0211	Dissertation	4		8	3	75	125	200
	DCE	24PSTD02DX	Elective – Discipline Centric	3	3		3	40	60	100
	MC	24PSTD02MX	Modular course	2	2	-		50	-	50
	AUC	24ENGP00C1	Communication and Soft Skills	2	2			50	-	50
	MC	24GTPP04M1	Human Value and Professional Ethics	2	2			50	-	50
	2nd Semester Total			**24**	**20**	**8**				
	Grant Total (I + II)			**47**	**39**	**16**				

Major Course

Semester	Category	Course Code	Title of the Paper	No. of Credits
I	Major Courses	24PSTD0101	Introduction to Spatial Technologies	4
		24PSTD0102	Remote Sensing and DIP	4
		24PSTD0103	Principles of Cartography	4
		24PSTD0104	Geographical Information System	4
		24PSTD0105	Global Navigation Satellite System	3
		24PSTD0106	PRACTICAL - I: Geographical Information System	2
		24PSTD0107	PRACTICAL -II: Remote Sensing & Digital Image Processing	2
			1st Semester Total	**23**
II	Major Courses	24PSTD0208	IT for Spatial Technologies	3
		24PSTD0209	Spatial Technologies in Resource Management	4
		24PSTD0210	Spatial Technologies in Disaster Management	4
		24PSTD0211	Dissertation	4
			2nd Semester Total	**15**

Elective – Discipline Centric

Discipline Centric courses - 24PSTD02DX	
24PSTD02D1	Earth, Atmospheric, Ocean and Planetary Sciences
24PSTD02D2	Spatial Technologies for Watershed Management
24PSTD02D3	Open source data and software
24PSTD02D4	Spatial Technologies for Agriculture
24PSTD02D5	Spatial Technologies for Forestry
24PSTD02D6	Spatial Technologies for Water Resource Management
24PSTD02D7	Spatial Technologies for Urban Planning and Utility Management

Modular Course

Modular Course 24PSTD02MX	
24PSTD02M1	Spatial Modeling
24PSTD02M2	Spatial Decision Support System
24PSTD02M3	LiDAR and its Applications
24PSTD02M4	Drone Image Processing
24PSTD02M5	Web Technology for Spatial Technologies

Name of the Programme	**P.G.Diploma in Spatial Technologies**		
Year of Introduction	2007		
Year of Revision	2024		
Semester-wise Courses and Credit distribution	I	II	Total
No. of Courses	7	8	15
No. of Credits	23	24	47

Semester	I	Course Code	**24PSTD0101**
Course Title	**Introduction to Spatial Technologies**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Core course		
Scope of the Course (may be more than one)	• Basic Skill • Skill Development		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives (Maximum: 5)	The Course aims to • Introduce spatial technologies as an advanced tool consisting of various modern technologies used for mapping and managing the earth resources.		

UNIT	Content	No. of Hours
I	Meaning and Scope of Spatial Technologies – Science and Technologies involved: Cartography – Geodesy – Geology - Remote Sensing - GIS - Photogrammetry - Information & Communication Technologies- GNSS- Digital Image Processing - Map as decision tool.	10
II	Earth – Origin, Interior, Age, size, shape and Physiography of the Earth - Atmosphere: Origin and nature, Composition and layers of the atmosphere. Fundamental principles of acquiring earth related information: geodetic information - lat - long - time - altimetry – bio-physical and bio-chemical information.	15
III	Basic principles of surveying – Classification and applications- Scales - Conventional signs - Survey instruments, survey methods - traversing, trilateration and triangulation - conventional, electronic (total station).	15
IV	Aerial and Satellite based survey techniques (Photogrammetry, RADAR, LiDAR) - survey using GNSS & UAV.	10
V	Application of Spatial Technologies: Rural Development, Civil Engineering, Disaster Management, Geosciences, Agriculture, Forestry, Soil, Land, Water, Meteorology, Military, Transport, Environmental studies, Banking, Health, Telecommunication, Electricity, Coastal, Oil & Gas Industries etc.,	10

References

Text Books:

1. Chandra A.M., Geoinformatics, New Age International Publishers, New Delhi, 2016.
2. LO. C.P., and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi, 2006.

<table>
<tr><td></td><td>Reference Books:
1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015.
2. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt .Ltd., New Delhi, 2017.
3. Arthur H. Robinson et al. Elements of Cartography (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2016.
4. Misra, R.P.and Ramesh, A, Fundamentals of Cartography, Concept Publishing Company, New Delhi, 2002.
5. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017</td></tr>
<tr><td></td><td>E-Resources:
1. https://courses.lumenlearning.com/geophysical/chapter/the-composition-and-structure-of-earth/
2. https://www.britannica.com/topic/evolution-of-the-atmosphere-1703862
3. https://ncert.nic.in/textbook/pdf/kegy303.pdf
4. http://bbsbec.edu.in/wp-content/uploads/2020/01/com.pdf
5. http://www.gitta.info/Generalisati/en/image/Signs.pdf
6. https://www.icsm.gov.au/education/fundamentals-mapping/surveying-mapping/surveying-methods
7. https://www.researchgate.net/publication/291833102_GIS_Scope_and_Benefits
8. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/remote-sensing-technology
9. http://sdeuoc.ac.in/sites/default/files/sde_videos/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez%2C%20R.%20Woods-ilovepdf-compressed.pdf
10. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/photogrammetry</td></tr>
<tr><td>Course Outcomes</td><td>On completion of the course, students should be able to do,</td></tr>
<tr><td></td><td>CO1 Understand the basic information about to earth, atmosphere and principles of acquiring earth related information
CO2 Understand the meaning, scope and science & technologies involved in Spatial Technologies.
CO3 Understand and analyze the basics principles of surveying using conventional and modern tools and technologies
CO4 Apply various methods of aerial and photogrammetry techniques of surveying.
CO5 Apply tools of Spatial Technologies in various applications.</td></tr>
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Mapping of COs with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	2	2	2	2	2
CO 5	3	3	3	3	3

Semester	I	Course Code	**21PSTD0102**
Course Title	**Remote Sensing and Digital Image Processing**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Core Course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives	The Course aims to • understand the basic concepts of remote sensing and photogrammetry • understand the systems and techniques of data acquisition, LiDAR, Hyperspectral remote sensing and data products of different satellites.		

UNIT	Content	No. of Hours
I	Remote Sensing: History and development - Electro Magnetic Spectrum - Components and types of remote sensing – Energy interaction with atmosphere and Earth features - Resolutions - Platforms – Sensors - Scanning & Orbiting Mechanism of Satellites and Data Acquisition. Optical Remote Sensing: Basic concepts – Optical sensors and scanners Image interpretation – Visual Interpretation elements	10
II	Aerial photography: Definition – types – Flight Planning - Geometry of vertical aerial photograph, Scale of flat & variable terrain, relief displacement. Types of Mosaic- Stereoscopic parallax – Aerial triangulation – Ortho photo - Digital photogrammetry – UAV and low altitude payloads in different spectral regions	10
III	Basics of Thermal, Microwave & Hyperspectral Remote Sensing – LiDAR - Types of satellites sensors and data products of IRS, LANDSAT, SPOT, ERS, IKONOS, QuikBird, ORBVIEW, WORLD VIEW RISAT, RADARSAT, Sentinel 1A&1B, NISAR, ALOS PALSAR – SRTM, AVIRIS, CASI, MODIS, Hyperion and others.	10
IV	Digital Image Processing : Digital data – Data type and file Formats – Stages – Pre Processing : Radiometric and Geometric distortions – Noise removal. Image enhancement- Single & Multi band Enhancement. Contrast Manipulation – Spatial Feature Manipulation – Multi image Manipulation	8

V	Image classification: Supervised – Unsupervised – Hybrid – Fuzzy. Accuracy Assessment – Post Classification – Smoothing –Image fusion and change detection. Hyperspectral & Microwave image processing techniques	10
References	Text Books: 1. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017. 2. Paul R. Wolf., Elements of Photogrammetry, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2014.	
	Reference Books: 1. Basudeb Bhatta, Remote Sensing and GIS (2nd Edition), Oxford University Press, New Delhi, 2017. 2. John R.Jensen, Remote Sensing of the Environment: An Earth Resource Perspective (2nd Edition), Pearson India Education Services Pvt Ltd, Noida, 2018. 3. Ravi P. Gupta, Remote Sensing Geology (2nd Edition), Springer (India) Pvt. Ltd., 2014. 4. M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems (4th Edition), BS Publications, Hyderabad, 2019. 5. Cracknell A.P and Hayes L.W.B., Introduction to Remote Sensing, The Traylor and Francis, London, 2003. 6. Chandra A.M and Ghosh. S.K., Remote Sensing and Geographic Information System (2nd Edition), Narosa Publishing House Pvt. Ltd., New Delhi, 2017. 7. Jean-Paul Donnay et al., Remote Sensing and Urban Analysis, Taylor & Francis, New York, 2010. 8. Mikhail et al., Introduction to Modern Photogrammetry, Wiley India Pvt.Ltd, New Delhi,2013.	
	E-Resources: 1. https://ncert.nic.in/textbook/pdf/kegy307.pdf 2.https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf 3.https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesremot esensing.pdf 4.https://www.electronicshub.org/different-types-sensors/ 5.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M027029/ET/1517207018AERIALPHOTOGRAPHY(2.pdf 6.https://www.slideshare.net/virajain/lecture-1aerial-photogrammetry 7.http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M028382/ET/1521702258Divyani_Digi_Photogrammetry(2.pdf	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Understand the basic concepts of remote sensing.
	CO2	Understand aerial photography, types, planning and execution.
	CO3	Understand the basics & principles of thermal, microwave, hyperspectral remote sensing and sensor characteristics of different satellite products.
	CO4	Rationalise statistical outlook of satellite image and different classification approaches.
	CO5	Apply the knowledge of Remote sensing in various thematic studies.

Mapping of Cos with PSOs :

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	3	3	3	1	1
CO 5	2	2	2	1	1

Semester	I	Course Code	**24PSTD0103**
Course Title	**Principles of Cartography**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	45%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives	The Course aims to • explain the basic principles and importance of cartography, map projection, data visualization, map design and layout and various techniques of map production and reproduction.		

UNIT	Content	No. of Hours
I	**Basics:** Definition – nature, scope and its role – Types of map – Principles, Characteristics - Components of Digital Cartography - Benefits – disadvantages of digital cartography - Conventional mapping Vs Digital Mapping; Web cartography - Nano cartography. Trends, challenges, and opportunities in digital cartography.	10
II	**Map projection:** Basics and importance of Projections in digital mapping - Uses and types of projection - Conical – Azimuthal - Cylindrical – map scale	15
III	**Source & Data Collection:** Primary & Secondary Sources, types and methods of collecting geospatial data - Traditional and modern methods of field data collection - Open Data Portals (Exploring sources like Open Street Map, USGS Earth Explorer, and other open data repositories) - Data Quality and Standards - Metadata and Documentation - Sensor Networks and IoT - Data Collection Tools and Software.	15
IV	**Visualization of data**: Conventional signs and symbols - Typography and font selection, Color theory in cartography, Labeling and annotation guidelines – 2D visualization (Choropleth – Chorochromatic – Isopleth - Choroschematic) – 3D visualization (TIN, DEM, DSM, DTM, Hill Shading, Hatching, visibility analysis, slope, aspect) – 4D visualization (creation of movies, animation) – virtual reality map – Big Data Visualization - Designing maps for web and mobile platforms - Layout Design	10

V	**Data Management, Analysis & Future Trends** : Geospatial Databases **-** Data Integration and Interoperability - Spatial Analysis - Geospatial Data Standards - Geospatial Artificial Intelligence (GeoAI) Smart Cities and IoT (role of digital cartography in smart city initiatives) – various ways of sharing of geospatial data with users.	10
References	Text Books: 1. Arthur H. Robinson et al. Elements of Cartography, John Wiley & Sons, New York, 2002.	
	Reference Books: 1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015. 2. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt .Ltd., New Delhi, 2017. 3. Arthur H. Robinson et al. Elements of Cartography (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2016. 4. Misra, R.P.and Ramesh, A, Fundamentals of Cartography, Concept Publishing Company, New Delhi, 2002. 5. Lillesand, Kiefer and Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017	
	E-Resources: 1. Fundamentals of General Cartography, http://164.100.133.129:81/econtent/Uploads/Fundamentals_of_General_Cartography.pdf 2. Cartography – a tool for spatial analysis, https://www.pdfdrive.net/cartography-a-tool-for-spatial-analysis-39693639.html	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Understand the basic information about to earth, atmosphere and principles of acquiring earth related information
	CO2	Understand the meaning, scope and science & technologies involved in Spatial Technologies.
	CO3	Understand and analyze the basics principles of surveying using conventional and modern tools and technologies.
	CO4	Apply various methods of Geodata visualization for analysis.
	CO5	Apply tools of Spatial Technologies in various applications.

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	1	1	2
CO 2	3	2	1	1	3
CO 3	3	2	1	1	2
CO 4	3	3	1	1	3
CO 5	3	2	1	1	2

Semester	I	Course Code	**24PSTD0104**
Course Title	**Geographical Information System**		
No. of Credits	**4**	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20 %
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • introduce Geographical Information System • provide knowledge on various methods of data input, types of errors and its correcting methods. • gain knowledge on analysis such as surface, hydrology and network. • acquire knowledge on various GIS data modeling and analysis. • know about various forms of GIS output and their method of visualization		

UNIT	Content	No. of Hours
I	GIS: Definition–components–characteristics of Spatial Data– sources of GIS data – spatial data models/ structure-raster and vector–representation of spatial data in GIS: Layer based – tile Based – object oriented based.	7
II	Data Input methods: Keyboard – scanning – digitization: manual – semi-automatic–automatic,–electronic data transfer. Errors in Spatial data and attribute data– edge matching – rubber sheeting. Integration of spatial and non-spatial (attribute) data.	9
III	Basic tools of GIS: Measurement – Query – Proximity Analysis Spatial Analysis – I: Spatial interpolation: TIN – Thiessen Polygon–IDW – Kriging – Spline – trend surface- Spatial moving average–extrapolation. Surface Analysis: DEM–Slope–Aspect-Hill Shade–visibility/ viewshed analysis. Hydrological Analysis: Fill – flow direction – flow accumulation –	10

	flow length–basin.	
IV	MCE: Estimation of weights: ranking – rating – pair-wise comparison method. Spatial Analysis – II: Reclassification – Overlay: Vector Overlay: Erase – Update – Union – Intersect; Raster Overlay: Point-in-polygon – Line-in-polygon – Polygon-on-Polygon: Arithmetic operators – map algebra. Building an integrated database: Weighted overlay– weighted Sum – fuzzy membership – fuzzy overlay Network modeling: Arc – Node–vertices–Analysis: travelling sales person problem – location-allocation modelling – route tracing – service area – closest facility – OD cost matrix.	12
V	Model building - Cartographic Output: Maps as output – cartograms: definition – types of cartograms - non-cartographic output: Tables and Charts – Linked display – spatial multimedia – delivery mechanism: Hardcopy output– softcopy output: monitors – slide shows – virtual reality – map as a decision tool.	10
References	Text Book: 1. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt. Ltd., New Delhi, 2017.	
	Reference Books: 1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015. 2. Kang-tsung Chang, Introduction to Geographic Information Systems (4th Edition), McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2013. 3. John R. Jensen and Ryan R. Jensen, Introductory Geographic Information Systems, Pearson Education Pvt. Ltd., New Delhi, 2018. 4. LO. C.P., and Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi, 2006. 5. M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems (4th Edition), BS Publications, Hyderabad, 2019.	
	E- Resources: 1. Michael J de Smith, Michael F Goodchild and Paul A Lougley, Geospatial Analysis (6th Edition), 2020, https://spatialanalysisonline.com/HTML/index.html. 2. Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, 2016, https://www.pdfdrive.com/gis-fundamentals-a-first-text-on-geographic-information-systems-e188660361.html. 3. Michael D. Kennedy, Michael F. Goodchild & Jack Dangermond, Introducing Geographic Information Systems with ArcGIS: A Workbook Approach to Learning GIS, 2013, https://www.pdfdrive.com/introducing-geographic-information-systems-with-arcgis-a-workbook-approach-to-learning-gis-e156925406.html.	
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the basics of GIS CO2. Understand the various methods of data input, errors and correction. CO3. Analyze, evaluate and create various GIS based models. CO4. Generate multi criteria evaluation & network analysis CO5. Understand and create different types of GIS outputs	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	1	1	1	1	1
CO 2	1	1	2	1	1
CO 3	3	3	2	1	3
CO 4	2	2	2	1	2
CO 5	2	2	2	1	2

Semester	I	Course Code	**24PSTD0105**
Course Title	**Global Navigation Satellite System**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives	The Course aims to • Understand the working principles of GNSS, GNSS systems • Analyze and correct the GNSS errors • Create database on geo co-ordinates using various GNSS techniques • Apply GNSS in various fields		

UNIT	Content	No. of Hours
I	History of GNSS - Advantages and limitations of GNSS- Segments of GNSS: Control segment - Space segment - User segment - Geo positioning - Uses of GNSS	9
II	GPS systems - NAVSTAR GPS – GALILEO – GLONAAS – IRNSS – MTSAT - Beidou – Compass - GPS receivers based on: data type and yield - realization of channel – user community - Signal structure: carrier ranging, ranging code and navigational message	10
III	Basic modes of GPS surveying: Differential GPS surveying vs static GPS surveying. Rapid static positioning technique - Reoccupation technique - Stop & go technique. Kinematic positioning technique - Relative advantages and disadvantages - Data transfer and analysis	10
IV	Sources of error: Ionospheric and atmospheric delays - satellite and receiver clock error - anti spoofing - selective availability - multi path - dilution of precision - Error correction - Number and geometry of visible satellites - location of GPS receiver - distance between base station and rover receiver - signal to noise ratio - occupation time at a point - differential correction - WAAS, LAAS	9
V	GPS applications - Siting and routing - surveying - navigational application - vehicle tracking - mobile computing - military application - Precision Farming	10
References	Text Books: 1. Sathees Gopi et al., Advanced Surveying: Total Station, GPS, and Remote Sensing (2nd Edition), Pearson India Education Services Pvt.	

	Ltd., Noida, 2019.	
	Reference Books: 1. Hofmann – Wellenhof, Lichtenegger and Collins, GPS: Theory and Practice (5th Edition), Springer Wien, New York, 2015. 2. Alfred Et al., GPS Satellite Surveying (4th Edition), Wiley India Pvt. Ltd., New Delhi, 2018. 3. Michael Kennedy, 'The Global Positioning System and GIS: An Introduction', Taylor and Francis Inc. New York, 2002. 4. Satheesh Gopi, Global Positioning System Principles and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.	
	E-Resources 1. http://www.maps-gps-info.com/ed-resources.html 2. http://www.gisdevelopment.net/tutorials/tuman004.htm 3. http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Understand fundamental of GNSS.
	CO2	Understand fundamental of GNSS.
	CO3	Analyze the errors and various correction methods
	CO4	Create a database on geo coordinates
	CO5	Apply GNSS in various fields.

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	3	3	3	1	1
CO 4	2	2	2	1	1
CO 5	3	3	3	1	1

Semester	I	Course Code	**24PSTD0106**
Course Title	**Practical I – Cartography & Geographical Information System**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • apply the tools of AutoCAD and ArcGIS in creating, analyzing and evaluating geospatial data • create a model • map design and layout		

UNIT	**Content**	**No. of Hours**
I	Introduction to commercial and open-source GIS software. (AutoCAD, ArcGIS, QGIS etc) Map Appreciation - Map interpretation – spatial entities – data dictionary.	10
II	Georeferencing - projections – Database creation. Spatial and attribute data entry, editing and joining them. Working with tables and layer properties.	12
III	Methods of data analysis I: Measurement - Buffer – overlay– spatial interpolation – reclass – TIN – DEM. Methods of data analysis II: Network – surface – hydrology.	15
IV	Map algebra – MCE - Building models - Map Design and Layout Spatial Statistical Tools – Central Feature, Mean Centre, Median Center, Standard Distance, Correlation, Ordinary Least Square – Geographical Weighted Regression, Spatial autocorrelation.	15
V	Building models - Map Design and Layout	10

Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Apply the tools of AutoCAD, ArcGIS, QGIS etc.
	CO2	Analyze the data in GIS with appropriate tools
	CO3	Create new models
	CO4	Design and layout a map
	CO5	Learn to build models in GIS

Mapping of Cos with PSOs :

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	1	3	2	3	3
CO 2	1	3	2	3	2
CO 3	1	3	2	3	2
CO 4	1	3	2	3	3

Semester	I	Course Code	**24PSTD0107**
Course Title	**Practical –II Remote Sensing and Digital Image Processing**		
No. of Credits	2	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	30%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • provide hands on experience on visual interpretation of different satellite images and digital image processing techniques.		

UNIT	Content	No. of Hours
I	1. Study of various visual Remote Sensing Equipments 2. Decoding of different aerial and satellite data 3. Interpretation of Black & White and Multi-color images 4. Interpretation of optical, thermal and microwave images 5. Generation of various thematic maps using image. 6. Preparing maps using Total Station & DGPS	12
II	7. Stereovision Test and Anatomy of pocket & Mirror Stereoscopes. 8. Interpretation of Aerial photographs 9. Decoding, Marking & Transfer of Principal Points, Base line drawing, Flight line marking, 3D Observation, Tracing details, Transfer the details to base map.	12
III	10. Reading and displaying satellite data from BIL, BSQ and BIP formats 11. Layer stacking and Band Combination 12. Georeferencing the base image, Image to Image, Map to Image 13. Extracting / Subset, Area of Interest (AOI) 14. Measuring distance and area. 15. Mosaic	12
IV	16. Preprocessing - Geometric correction of satellite image 17. Enhancement using different filtering techniques, Image	12

	Fusion 18. Principal Component Analysis (PCA) 19. Band ratio, NDWI, NDSI, RVI, TNDVI, PRI, NDVI etc. 20. Classification (Supervised, Unsupervised, SVM, etc) 21. Accuracy Assessment 22. Change detection 23. Terrain Analysis	
V	24. Layout Preparation 25. Hyper spectral Image Analysis – (BBL, Band Combination, Destriping, Spectral Angle Mapping, End member extraction, Spectral Unmixing) 26. 3D visualization 27. SAR Image Processing	12

Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Interpret aerial photographs, satellite images
	CO2	Transfer of information from image to base map
	CO3	Preprocessing and enhancement of satellite data
	CO4	Apply unsupervised and supervised classification techniques and Apply & Analyze the accuracy
	CO5	Apply change detection technique.

Mapping of Cos with PSOs :

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	3	3

Semester	II	Course Code	**24PSTD0208**
Course Title	**IT for Spatial Technologies**		
No. of Credits	**3**	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	30 %
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-1: (Remember) • K-2: (Understand) • K-3: (Apply) • K-4: (Analyze)		
Course Objectives	The Course aims to • Provide basic knowledge about hardware and software used in Geoinformatics, • Provide basic knowledge on Python programming.		

UNIT	Content	No. of Hours
I	**Introduction to Computers and IT:** Overview of Information Technology - Components of a computer system: hardware and software - Introduction to operating systems - Computer Hardware: Types of computer hardware - Input and output devices - Storage devices and memory - Processors and performance. Computer Software: Types of software: system software, application software, and utility software - Software development lifecycle - Software installation and management. Data Management and Databases: Basics of data management - Introduction to relational databases - Spatial databases and their importance.	9
II	**Basics of Networking and the Internet:** Introduction to computer networks - Types of networks: LAN, WAN, MAN - Basics of the internet: history, structure, and protocols - Internet services: email, web browsing, and cloud computing. Web Technologies for Spatial Data: Introduction to web technologies - Web GIS: concepts and applications - Popular Web GIS platforms (e.g., GeoServer, MapServer). Cloud Computing for Spatial Data: Introduction to cloud computing -Cloud-based GIS solutions - Advantages of using cloud computing for spatial data management. Big Data and Spatial Analysis: Introduction to big data - Big data technologies and tools - Applications of big data in spatial analysis.	12
III	**Python:** Introduction OOPS Concept – Application of OOPS – Introduction - Variables - Expressions - Statements - Operators - Conditionals Statements - Functions.	12

IV	Iteration- Strings - Lists - Tuples - Dictionaries - Module and Packages - Files and exceptions. Library : Geemap - Arcpy- Pandas - Geopandas - Geemap - RSGISLib - GDAL/OGR - Folium - ipyleaflet - Scikit - Matplotlib - NumPy - PyProj- PyTorch - Keras - TensorFlow - Theano – SciPy – LiDAR. Reading Satellite images.	9
V	Class and objects - Class and methods - Sets of objects - Inheritance - Linked lists - Stacks - Queues – Trees.	9
References	References: 1. Introduction to Information Technology By EFRAIM TURBAN, R. KELLY RAINER and RICHARD E.POTTER Published by John Wiley & Sons. 2. Computer Networks by Andrew S. Tanenbaum Gottrfriield, B.S.: Programming with C, Tata McGraw Hill Publishing Co. Ltd. Programming in C by Jamwal Shubhnandan, Pearson Publications 3. How to Think like a Computer Scientist Learning with Python, Allen Downey, Jeffrey Elkner and Chris Meyers, Green Tea Press..	
	E-Resources: 1. Python Programming: https://nptel.ac.in/courses/106/106/106106145/	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1 — Understand about computer hardware and software	
	CO2 — Understand about the Internet and net works	
	CO3 — Create simple program in Python language.	
	CO4 — Create program to manipulate strings and data structures and Understand packages in Python	
	CO5 — Create program for class and objects and other data structure.	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	2	3	3
CO 2	1	3	2	2	3
CO 3	2	3	2	3	2
CO 4	1	2	3	2	3
CO 5	1	2	2	3	2

Semester	II	Course Code	**24PSTD0209**
Course Title	**Spatial Technologies in Resource Management**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	30%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • apply various tools of spatial technologies in different fields.		

UNIT	Content	No. of Hours
I	Soil – importance – problems - soil erosion estimation using RUSLE - Soil salinity mapping. Land Classification System – FAO- USDA - land capability assessment – Land use / Land cover classification. Land use planning: Rural and urban - Land Reclamation – Land Information System.	10
II	Introduction – Water Conservation - water quality monitoring - Ground water investigation - artificial recharge zone identification – surface water harvesting structure - flood prediction model - Climate Change Impact on Water Resources - Integrated Water Resource Management (IWRM).	9
III	Agriculture: Spectral properties of crops - crop canopy - identification & inventory - Yield modeling - crop production forecasting - crop condition assessment and monitoring - Microwave RS for crop inventory & case studies - Precision farming. Forestry: Forest taxonomy - inventory of forestlands - forest types and density mapping - factors for degradation of forest - Forest change detection and monitoring - Forest fire mapping & damage assessment -Wildlife Corridor Identification and Management.	10
IV	Infra structure demand analysis - Transportation planning – mapping transportation - network – classification - Transportation interaction models – intelligent transportation systems – optimum route – traffic and parking studies - accident analysis. Water utility - electrical utility - telecommunication – tower	10

	spotting – Sitting a new facility - customer loyalty studies - health information system - Solid and liquid waste management - Crime Analysis: mapping crime data - hot spot analysis.	
V	Environmental types and components – Pollution: Air – Water – Soil and Noise – Environmental Impact Assessment - Environmental Information System - Environmental and ecological concerns – resource development in remote areas - impacts of anthropogenic activities Oceanography: Major issues/problem – wetland classification - Thematic maps on coastal resources – site suitability analysis for aquaculture – Fishery – coral reef – Coastal Regulation zone – Coastal aquifer modeling– Integrated coastal Zone Management.	9
References	Text Books: 1. Fundamentals of Remote Sensing, George Joseph. Universities Press (India) Pvt Ltd, 3-5-819 Hyderguda, Hyderabad 500 029. 2003. 433 pp.	
	Reference Books: 1.Nitish Dogra, Sangeet Srivastava, Climate Change and Disease Dynamics in India, The Energy and resources Institute (TERI), New Delhi, 2012. 2.Narayan Singh and Amit Kumar Thakur, Climate Change and Environmental Issues, The Energy and resources Institute (TERI), New Delhi, 2018. 3.Joshi PK and Singh TP., Spatial Technologies for Climate Change Studies, The Energy and resources Institute (TERI), New Delhi, 2013. 4. Amim Hammad, Hassan karimi, Telegeoinformatics: Location-based Computing and Services, CRC Press, 1st Edication, 2004 5. Allah Brimicomber, GIS Environmental Modeling and Engineering, Taylor and Francis, 2003 6. Savigny D De and Wijeyaratne.P.GIS for Health and Environment, Stylus publication, 1994. 7. Paul A Longley, Michael F Goodchild, David J Maguire, David W Rhind, Geographical Information Systems, Volume I and II, John Wiley and Sons, Inc., 1999. 8. Juliana Maantay, John Ziegler and John Pickles, GIS for the Urban Environment, ESRI Press, 2006.	
	E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.) 1. https://www.pdfdrive.com/geostatistical-and-geospatial-approaches-for-the-characterization-of-natural-resources-in-the-environment-challenges-processes-and-strategies-d175603772.html 2. https://www.isprs.org/proceedings/xxxv/congress/comm7/papers/83.pdf 3. https://www.zef.de/fileadmin/user_upload/ApplicationsofRemoteSensingandGISinNaturalResourceManagement.pdf 4. https://egyankosh.ac.in/bitstream/123456789/39604/3/MGY-001-E-B4.pdf 5. https://www.esds.co.in/blog/gis-applications-in-utility-sector/ 6. https://www.researchgate.net/publication/329963373_Application_of_GIS_in_Planning_of_Facilitate_Infrastructure 7. https://www.esri.com/content/dam/esrisites/sitecore-archive/Files/Pdfs/library/brochures/pdfs/transportation-infrastructure.pdf 8. https://www.pdfdrive.com/landscape-analysis-and-visualisation-spatial-models-for-natural-resource-management-and-planning-lecture-notes-in-geoinformation-and-cartography-d184489152.html	

Course Outcomes	On completion of the course, students should be able to do CO1. Apply Spatial Technologies in Land resource management CO2. Apply Spatial Technologies in Water Resources Management CO3. Apply Spatial Technologies in Agriculture and Forestry CO4. Apply Spatial Technologies in Utility management CO5. Apply Spatial Technologies in Environmental and Oceanography

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester	II	Course Code	**24PSTD0210**
Course Title	**Spatial Technologies in Disaster Management**		
No. of Credits	4	No. of contact hours per Week	4
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	80%
Category	• Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • apply various tools of Spatial Technologies in disaster management.		

UNIT	Content	No. of Hours
I	Nature, characteristics and types of Disasters – Causes and effects of Disaster – Disaster Profile of India – Disaster Management cycle.	12
II	Disaster Management; Earthquakes: Causes and effects – measurements - earthquake zones of the world and India – vulnerability and microzonation; Volcanoes: Causes and effects – volcanic zones of the world and in India - volcanic hazards; Landslides: Causes and effects – landslide prone zones in India – GIS case studies for earthquake, volcano and landslide.	10
III	Drought : Types – factors influencing drought – variable identification – vegetation index – land use / ground water level changes – soil erosion –delimiting drought prone areas – short term and long term effects; Desertification: Processes – over utilization of water and land resources – GIS based management strategies – GIS case studies for drought and desertification.	10
IV	Cyclone: Origin and types - effects on land and sea – damage assessment; Flooding: Topography, land use and flooding – Space-time integration – GIS based parameters and layers – flood prone area analysis and management – risk assessment – GIS case studies for cyclones and floods.	10
V	Atmospheric Disasters: Ozone layer depletion – green house / global warming –acid rain – snow melt – sea level rise – related problems; Nuclear, Chemical /Industrial and Mining Disasters: Types – consequences – major disasters of the world and India; Marine Disasters: Oil spill and chemical pollution – coastal zone	9

	management strategies – GIS case studies.	
References	Text Books (with chapter number & page number, wherever needed): 1. Parag Diwan, A Manual on Disaster Management, Pentagon Earth, New Delhi, 2010. 2. Brian Romaszewski, Geographical Information Systems (GIS) for Disaster Management, CRC Press, New York, 2019. 3. Peter Van Oosterom et al., Geo-Information for Disaster Management, Springer (India) Pvt. Ltd., New Delhi, 2008.	
	Reference Books: 1. Sisizlatanova & Andrea Fabbrijonathanli, Geometrics solutions for Disaster management, Springer Verlag, 2007. 2. C.EmdadHaque, Mitigation of natural Hazards & disasters, Klwuer Academic publishers group, 2005. 3. Linda C. Bottersll & ponald A.wilhite, From Disaster response to Risk management. Klwuer Acadamic publishers group, 2005. 4. Gerard Blokdijk, Disaster recovery planning and services, Gennaio publishers, 2008. 5. Mohamed Gad Large scale disasters : prediction, control and mitigation, Cambridge university press, 2008	
	E-Resources: 1..https://www.pdfdrive.com/geoinformatics-applications-in-disaster-management- nidm-d15299133.html 2.https://www.researchgate.net/publication/345179571_Geographical_Information_ System_GIS_for_Disaster_Management 3.https://www.isprs.org/proceedings/XXXIII/congress/part7/1609_XXXIII-part7.pdf 4. .https://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/files/ch60.pdf	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Understand the concept of disaster
	CO2	Explain different types of disasters
	CO3	Apply the various ways to prevent and prepare for drought
	CO4	Understand the methods of emergency preparedness of Cyclones
	CO5	Understand the concept of Spatial Technologies in Atmospheric disaster

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester	II	Course Code	**24PSTD0211**
Course Title	**Dissertation**		
No. of Credits	4	No. of contact hours per Week	8
New Course / Revised Course	-	If revised, Percentage of Revision effected	-
Category	• Core Course • Industrial Placement		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills • Field Placement / Field Project • Internship		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • Apply knowledge of spatial technologies in real world spatial problems and create/ develop models.		

UNIT	**Content**	**No. of Hours**
I	▪ Identification of a problem in consultation with internal guide ▪ Executing the work as per the instructions of both internal and external guide while incorporating any of the following activities or combination of activities ▪ Designing of Geoinformatics ▪ GIS implementation and application ▪ Remote Sensing application ▪ GNSS application ▪ Spatial modeling or such other related topics, which will give focus to Geoinformatics implementation ▪ The size of the dissertation may be between 50 and 70 pages, which is not inclusive of scripts and other appendices The dissertation should be submitted both in print form and digital form (pdf / crystal reports).	120

Semester	II	Course Code	**24PSTD02D1**
Course Title	**Earth, Atmospheric, Ocean and Planetary Sciences**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20 %
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-1: (Remember) • K-2: (Understand) • K-3: (Apply)		
Course Objectives	The Course aims to • Provide important concepts of basic geosciences		

UNIT	Content	No. of Hours
I	Mineralogy and petrology – structural geology and geotectonic – – sediment logy and stratigraphy – marine geology and pale oceanography: Sources and methods of information – geochemistry: Elements and Earth– Extraction – Geochemical Environments – Applied Geology	9
II	Physical Geography: geomorphology: Process - Landforms – climatology: Insolation – Distribution of Temperature – Distribution of Atmospheric Pressure – Windbelts – Humidity – Cloud formation and precipitation – water balance Bio-geography: Trans-Himalayas – Himalayan Zone – Indian Desert – Semi-Arid Zone – Western Ghats – Deccan Plateau – Gangetic Plains – North Eastern Region - Coastal Region – Andaman Nicobar Islands Geography of India: Location of India – Area – Physical features of India	9
III	Geophysics: gravity - magnetic methods – electrical and electromagnetic methods – seismic methods – Radioactive methods	10
IV	Meteorology: Climatology – physical meteorology – atmospheric electricity – cloud physics – dynamic meteorology – numerical weather prediction – general circulation and climate modelling – synoptic meteorology – aviation meteorology – satellite meteorology.	10
V	Ocean science: Physical oceanography – chemical oceanography – geological oceanography – biological oceanography.	10

References	Text Books: 1. Dr. Surendra Kumar & RPH Editorial Board , Joint CSIR-UGC (NET) Earth, Atmospheric, Ocean and Planetary Sciences Exam Guide (Part B & C): Earth, Admospheric, Ocean and Planetary Sciences Guide, Paperback – 1 January 2021, Ramesh Publishing House, New Delhi.
	Reference Books: 1. Mahapatra. G.B., A Textbook of Geology, CBS publisher, 2019. 2. Huggett, Fundamentals of Geomorphology , Taylor and Francis, 2016 3. W.M. Telford, Exclusive with Professional Books (Hyd) Applied Geophysics South Asian Edition, 2010 4. Willis Isbister Milham, Meteorology, Andesite Press, 2015 **5.** Savindra Singh, Oceanography, Pravalika Publications, 2013
	E-Resources: 1. Carl Willhelm Correns, Introduction to Crystallography and Petrology 2nd Edition, **https://www.pdfdrive.com/introduction-to-mineralogy-crystallography-and-petrology-d169738500.html** 2. Richard C. Selley, Robin Cocks and Ian Plimer, Encyclopedia of Geology, Five Volume Set, Volume 1-5 (Encyclopedia of Geology Series), **https://www.pdfdrive.com/encyclopedia-of-geology-five-volume-set-volume-1-5-encyclopedia-of-geology-series-d184350405.html** 3. Alan H. Strahler, Introducing Physical Geography, 6th edition, https://www.pdfdrive.com/introducing-physical-geography-6th-edition-d188301758.html 4. William Lowrie, Fundamentals of Geophysics, 2nd Edition, **https://www.pdfdrive.com/fundamentals-of-geophysics-second-edition-e38471798.html** 5. Geology, Mining, Climatology, Meteorology, Sediment logy, Earth Science, Oceanography, https://www.pdfdrive.com/geology-mining-climatology-meteorology-sediment-logy-earth-science-oceanography-e40744251.html **6.** Robert H Stewart, Introduction to Physical Oceanography, https://www.pdfdrive.com/introduction-to-physical-oceanography-e33277726.html
Course Outcomes	On completion of the course, students should be able to CO1. Explain the concept of mineralogy, petrology. CO2. Understand the concept of Geography of earth CO3. Understand physical geography and geophysics CO4. Explain the concept of meteorology CO5. Explain the concept of oceanography.

Mapping of Cos with PSOs :

CO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	1	1
CO 4	3	3	3	2	2

Semester	II	Course Code	**24PSTD02D2**
Course Title	**Spatial Technologies for Watershed Management**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	40%
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate)		
Course Objectives	The Course aims to • introduce watershed management and characteristics • acquire knowledge on use of GIS and remote sensing in watershed management • acquire knowledge on watershed evaluation		

UNIT	Content	No. of Hours
I	Watershed–definition – Watershed delineation and codification – watershed approach – advantages – watershed as a unit of planning – causes and consequences for watershed deterioration – Watershed management – principles and components of watershed management – approaches to watershed development.	9
II	Characteristics of Watershed: Size – Shape - Physiographic – slope – climate – drainage – land use – vegetation – geology – soil – hydrology – hydrogeology – socio-economic Concentration time – Isochrones. Watershed management planning – watershed restoration	9
III	Remote Sensing – data sources – land use / land cover – DEM - slope – aspect – flow accumulation – flow direction – stream network –modeling sediment yield. Collection of Ground Control Points (GCP) – Ground truth verification/training sites for Digital Image Processing	10
IV	GIS – data sources for watershed management & data structures-Watershed delineation – Manual – Automatic - resource mapping Morphometric analysis: Linear aspect – Areal aspect – Relief aspect. Identification of erosion prone zones.	10
V	Monitoring & Evaluation: Depth of water table –cropping pattern – area under biomass – various Land use/ land cover –water body. Purpose – types of evaluation – factors affecting evaluation – understanding community participation -- PRA methods of evaluation.	10

References	Text Books: 1. N.D. Mani, Watershed Management: Principles, Parameters and Programmes, Dominant Publishers and Distributors, New Delhi, 2005
	Reference Books: 1. Paul A.DeBarry, PE,PH,APSS, "Watersheds Process, Assessment and Management", Wiley Student Edition, New Jersy, 2004 2. Srivastava, O.N. and Y.V. Rao, "Impact of Integrated Wasteland Development Programme (IWDP) - A Study in Uttar Pradesh, National Institute of Rural Development, Hyderabad, 2001. 3. Raj Vir Singh, "Watershed Planning and Management", Yash Publishing House, Bikaner, 2001. 4. E.M. Tideman, " Watershed Management guidelines for Indian Conditions", Omega Scientific Publisher, New Delhi, 2006 5. J.V.S.Murty, "Watershed Management", New Age International, New Delhi, 2007
	E-Resources: 1. Watershed Management by Dr. T.I. Eldho, Department of Civil Engineering, IIT Bombay. For more details on NPTEL visit http://nptel.ac.in 2. Amel Moustafa Azab, Integrating GIS, Remote Sensing, and Mathematical Modeling for Surface Water Quality Management, 2012, https://www.pdfdrive.com/integrating-gis-remote-sensing-and-mathematical-modelling-for-surface-water-quality-management-in-irrigated-watersheds-unesco-ihe-phd-thesis-e165584308.html 3. Land Stewardship in the 21st Century: The Contributions of Watershed Management, https://www.pdfdrive.net/land-stewardship-in-the-21st-century-the-contributions-of-watershed-management-e36318879.html
Course Outcomes	On completion of the course, students should be able to do CO1. Discuss the approaches and components of watershed management. CO2. Explain the watershed characteristics. CO3. Apply the tools of GIS in watershed management CO4. Apply remote sensing technology in watershed management CO5. Monitor and evaluate the watershed program using the tools of PRA and Geoinformatics.

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	2	0	2
CO 2	2	3	2	0	2
CO 3	2	3	2	0	2
CO 4	2	3	2	0	2
CO 5	2	3	2	0	2

Semester	II	Course Code	**24PSTD02D3**
Course Title	**Open Source Data and Software**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Major Elective		
Scope of the Course (may be more than one)	• Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • the open source software available for research and development.		

UNIT	Content	No. of Hours
I	Introduction to Open source: Importance – Advantages – Applications. Open source operating systems LINUX: Introduction – General Overview – Kernel Mode and user mode – Process – Advanced Concepts.	6
II	**Open Source Spatial Data:** Satellite Data- NOAA, Earth Explorer, Bhuvan, Sentinel, Google Earth, Toposheet – University of Texas **Vector Data:** Openstreet map, Geofabrik, Natural Earth Data, Open topography, GSHHG. **Open Source Attribute Data:** National Information Centre, Census of India, Statistical Year Book, India Stat, India Water Portal, Indian Water Resource Information System (IWARIS), and NRDMS **Spatial Data science:** NREL, Kaggle,	
III	**Open source Software:** GIS: Openjump – GRASS – QGIS – SagaGIS Image Processing: ILWIS, SciLab. GIS Database: PostGIS. Compilers: Python, R. Scripting Language: Java Scripting. Mark-up languages: HTML - WeODM Compare QGIS – ArcGIS –SagaGIS – OpenJump.	6

IV	**Mobile mapping:** Fundamental of mobile mapping, application of GPS in resources surveys and mapping. Mobile GIS apps: Weather apps, Wind speed/direction, Pollution apps, Location/navigation apps, Data collection apps, Geo data collect, Geo area Map, Geo Camera- ArcGIS Earth- ArcGIS Collector-ArcGIS Workforce.	6
V	**Web Mapping** with Open source tool kit – Introduction to Web mapping – Merits and demerits of web mapping – Different kinds of web mapping – Basic web-development language – Mapping Libraries and other utilities –Map Servers – Backend and Data base – Frontend libraries – Spatial Data Infrastructure (SDI) Platforms – Project on Web mapping: A Panchayat GIS will be created by different groups.	6
References	Text Books (with chapter number & page number, wherever needed): 1. Markus Neteler, Helena Mitasova, Open Source GIS: A GRASS GIS Approach, Edition, Springer 2007.	
	Reference Books: 1. Neteler, M and H.Mitasova, Open Source GIS. A GRASS GIS Approach, Kluwer Academic Publishers, Boston, USA/London, UK, 2008. 2. Qgis: https://www.packtpub.com/application-development/mastering-qgis 3. Machtelt Garrels Introduction to Lmux beginner Guide 4. Pride Fu, Jiulus S : WebGIS: Principle & Application, ESRI Press, 2011	
	E-Resources: 1. Linux Operating System: http://nptel.ac.in/courses/106106144/ 2. Javascript: http://nptel.ac.in/courses/106105084/25 3. SciLab: http://nptel.ac.in/courses/113101002/5 4. R programming: http://nptel.ac.in/courses/102101056/9	
Course Outcomes	On completion of the course, students should be able to do 1. Understand the concept and protocols in Open Source Software 2. Describe about various open source operating system. 3. Understand various Open Source Software. 4. Understand and create WebGIS. Know about GIS related mobile apps. 5. Understand Customisation of GIS	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	3	2	3	2	3
CO 2	3	1	3	2	3
CO 3	1	3	2	3	2
CO 4	1	2	3	1	3
CO 5	3	3	1	2	3

Semester	III	Course Code	**24PSTD02D4**
Course Title	**Spatial Technologies for Agriculture**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected	-
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and lifeskills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • introduce the technologies of Spatial Technologies • create an outline on Crop inventory • teach the concept of Soil genesis		

UNIT	Content	No. of Hours
I	Spatial Technologies: Definition - Meaning –Concept of Spatial Technologies - Contributing Technologies: Remote sensing – Digital Image Processing – GIS – GNSS.	8
II	Crop inventory and remote sensing: Introduction – leaf optical properties – identification of crops and crop inventorying – crop acreage estimation – vegetation indices – yield estimation.	10
III	Spatial Technologies for soil: Introduction – soil genesis and soil classification – soil taxonomy – soil reflectance properties – soil mapping using remote sensing – soil erosion estimation and sedimentation.	10
IV	Land Evaluation and management: Introduction – land use/ land cover classification – change dynamics – land capability assessments.	10
V	Damage assessment: Introduction – crop loss assessment by floods – flood hazard zone mapping – drought management – reflectance properties of stressed crops.	10

References	
	Text Books: 1. Francis J. Pierce, David Clay, GIS Applications in Agriculture, CRC Press, 2007
	Reference Books: 1. Dr. Graciela Metternicht, Dr. Alfred Zinck, Remote Sensing of Soil Salinization: Impact on Land Management, CRC Press, 2008

	2. Janis L. Boettinger, David W. Howell, Amanda C. Moore, Alfred E. Hartemink, Suzann Kienast-Brown, Digital Soil Mapping: Bridging Research, Environmental Application, and Operation, Springer Science & Business Media, 2010
	E-Resources: 1. Remote Sensing Handbook: Volume 2 - Land Resources Monitoring, Modeling, and Mapping, https://www.pdfdrive.com/remote-sensing-handbook-volume-2-land-resources-monitoring-modeling-and-mapping-with-remote-sensing-e157908108.html 2. Satellite Remote Sensing and GIS Applications in Agricultural Meteorology, https://www.pdfdrive.com/satellite-remote-sensing-and-gis-applications-in-agricultural-meteorology-e40010463.html 3. GIS Applications in Agriculture, Volume Four: Conservation Planning , https://www.pdfdrive.com/gis-applications-in-agriculture-volume-four-conservation-planning-e26616670.html
Course Outcomes	On completion of the course, students should be able to do CO1. Discuss the technologies of Spatial Technologies CO2. Explain the concept of crop inventory CO3. Apply remote sensing technology in soil CO4. Use Spatial Technologies in land evaluation and management CO5. Apply the concept in damage assessment

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	1	1	2
CO 2	3	2	1	1	3
CO 3	3	2	1	1	2
CO 4	3	3	1	1	3
CO 5	3	2	1	1	2

Semester	III	Course Code	24PSTD02D5
Course Title	**Spatial Technologies for Forestry**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected	-
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and lifeskills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • concept of Spatial Technologies in forestry		

UNIT	Content	No. of Hours
I	Forest: introduction – distribution of forest – types in India. Forestry: introduction – concept – role of Geoinformatics	7
II	Interaction of EMR with vegetation – spectral characteristics of vegetation – temporal characteristics of vegetation – vegetation indices – forest cover mapping.	9
III	Forest types mapping - forest density mapping –forest cover change detection – mapping of stressed vegetation – association between rock and forest types.	10
IV	Microwave remote sensing in forest studies – biomass estimation – growing stock estimation – formulation forest work plan.	12
V	Biodiversity studies – wildlife habitat analysis - biological invasion and monitoring of invasive species – forest management information system	10

References

Text Books:

1. Peter A. Burrough et al., Principles of Geographical Information System (3rd Edition), Oxford University Press Inc., New York, 2015.
2. Ian Heywood, Sarah Cornelivs and Steve Carver, An Introduction to Geographical Information System (3rd Edition), Pearson Education Pvt .Ltd., New Delhi, 2017.
3. Lillesand, Kiefer & Chipman, Remote Sensing and Image Interpretation (6th Edition), Wiley India Pvt.Ltd, New Delhi, 2017.

Reference Books:

1. David H. White, S. Mark Howden, Climate Change: Significance for Agriculture and Forestry,1994
2. Matti Maltamo, Erik Næsset, Jari Vauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht 2014, reprint edition, ISBN 978-94-017-8662-1

	E-Resources: 1. https://www.electronicshub.org/different-types-sensors/ 2. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M027029/ET/1517207018AERIALPHOTOGRAPHY(2.pdf 3. https://www.slideshare.net/virajain/lecture-1aerial-photogrammetry 4. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M028382/ET/1521702258Divyani_Digi_Photogrammetry (2.pdf 5. 8.https://earth.esa.int/documents/973910/1002056/CK3.pdf/4e5b4e5a-d898-43b8-9e5c-ba7494aa58c8
Course Outcomes	On completion of the course, students should be able to do 1. Explain the basics of forestry and role of Spatial Technologies in it 2. Discuss the concept of Remote sensing in forestry 3. Apply the tools of Spatial Technologies in forest mapping and assessment 4. Explain the use of micro wave remote sensing in forest studies 5. Analyze the use of Spatial Technologies in different biodiversity studies.

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	1	3	2
CO 2	3	3	3	1	3
CO 3	2	2	1	2	2
CO 4	3	3	2	1	3
CO 5	3	2	1	3	2

Semester	III	Course Code	24PSTD02D6
Course Title	**Spatial Technologies for Water Resource Management**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected	-
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and lifeskills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to 1. provide basic knowledge on hydrology, remote sensing in ground water exploration. 2. gives an idea about watershed. 3. explain the areas of applications of Spatial Technologies in surface water, glaciology, meteorology and oceanography.		

UNIT	Content	No. of Hours
I	Hydrology: Definition – its important – hydrological cycle – issues in water resource development – management and utilization. Spectral characteristics of water and relevance of remote sensing for hydrological investigation.	7
II	Remote Sensing in ground water exploration – factors affecting ground water occurrence. Types of aquifers – aquiclude – aquitard – aquifuge – location of aquifers. Drainage mapping – morphometric analysis. DEM in hydrological modeling.	9
III	Watershed: Definition – concept – role of Remote Sensing in conservation – planning – management. Mapping and monitoring of catchment and command areas – mapping of drought prone zones. Runoff estimation, groundwater flow – surface and ground water interaction – control and occurrence of ground water movement.	10
IV	Application of Spatial Technologies - I: Oceanographic studies: Definition – concept – importance of ocean – satellite and sensors for ocean studies – sea ice monitoring – estimation of wind velocity – direction – sea surface temperature – salinity – ocean colour – phytoplankton and seaweed mapping - potential fishing zones – suspended sediment – bathymetry mapping.	12
V	Application of Spatial Technologies - II: Meteorology: Rainfall mapping – potential and actual evapo-transpiration – atmospheric water content – cloud mapping.	10

	Glaciology: monitoring snow melt – snow formation – snow melt runoff estimation. Surface Fresh water: river diversion studies – site suitability for surface water storage – hydro-electric power plant – storage yield.	
References	**Text Books:** **1. J**ohn G. Lyon, GIS for Water Resource and Watershed Management, CRC Press, 2003	
	Reference Books: 1. John G. Lyon, Geographic Information Systems in Water Resources Engineering, CRC Press, 2009.	
	E-Resources: 1. Geographic Information Systems in Water Resources Engineering, https://www.pdfdrive.com/geographic-information-systems-in-water-resources-engineering-e190107317.html 2. Integrating GIS, Remote Sensing, and Mathematical Modelling for Surface Water Quality Management, https://www.pdfdrive.com/integrating-gis-remote-sensing-and-mathematical-modelling-for-surface-water-quality-management-in-irrigated-watersheds-unesco-ihe-phd-thesis-e165584308.html 3. GIS and Geocomputation for Water Resource Science and Engineering, https://www.pdfdrive.com/gis-and-geocomputation-for-water-resource-science-and-engineering-e158241847.html	
Course Outcomes	On completion of the course, students should be able to do 1. Explain the basics of Hydrology 2. Discuss the about remote sensing in ground water. 3. Explain the concept of watershed, mapping and monitoring 4. Apply Spatial Technologies in oceanography 5. Apply Spatial Technologies in Meteorology, Glaciology, Surface Fresh Water	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	3	3	2	1	2
CO 2	2	3	2	1	2
CO 3	1	1	3	2	3
CO 4	2	3	3	2	2
CO 5	2	2	1	3	3

Semester	III	Course Code	24GISP03D7
Course Title	**Spatial Technologies for Urban Planning and Utility Management**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Course	If revised, Percentage of Revision effected	-
Category	• Major Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and lifeskills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to 1. explore the use of Spatial Technologies in urban planning, utility management, demography, urban governance, urban ecology 2. provide knowledge on wastewater business, hospital utility, electricity distribution and solid waste management.		

UNIT	Content	No. of Hours
I	Urban planning and mapping: urban – regional planning – LU/LC mapping. Spatial data modeling for urban design – urban infra-structure – urban site selection – site suitability analysis for utilities and civic amenities. Urban sprawl – problems of urbanization	7
II	Mapping and Management of facilities: Geoinformatics applications in Automates Mapping (AM) – Facility Mapping (FM) – types of utility sectors – Spatial Technologies for pipeline planning and alignment – electricity and power supply – water and sewage – telecom – radio coverage prediction – signal strength mapping.	9
III	Demography and Urban governance: Population distribution map by age – gender – education – occupation – socio-economic grouping – health criteria index – crime rates and types. Urban governance: mapping administrative boundaries – city base map generation – property enumeration and property GIS – tax revenue rationalization – metropolitan information management system.	10
IV	Urban ecology applications: Air quality indexing and mapping – monitoring atmospheric haze – smoke – toxic gas movement and prediction of vulnerable zones – noise pollution. Natural resources inventory and management – vegetation – soil – surface water and ground water conservation – site suitability for ground water recharging – rain water harvesting – urban heat budgeting.	12
V	Wastewater Business: Integration of hydraulic/ hydrologic modeling. Generation of hospital utility database – generation of road network map – utility map for ambulance – blood bank and medical college. Electric distribution: data management –	10

	planning and analysis – workforce automation Solid waste management: landfills location selection – routing efficiency for solid waste collection.	
References	**Text Books:** 1. Manish Kumar, R. B. Singh, Anju Singh, Ram Pravesh, Syed Irtiza Majid, Akash Tiwari, Geographic Information Systems in Urban Planning and Management, Springer, 2023.	
	Reference Books: 1. Sulochana Shekhar, Deepak Kumar, Geoinformatics for Sustainable Urban Development, CRC Press, 2024. 2. M.S. Nathawat and A.C. Pandey, Geoinformatics For Decentralized Planning And Governance, 2008	
	E-Resources: 1. Michael J de Smith, Michael F Goodchild and Paul A Lougley, Geospatial Analysis (6thEdition),2020, https://spatial analysis online.com / HTML/I ndex.html 2. Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, 2016, https://www.pdfdrive.com/gis-fundamentals-a-first-text-on-geographic-information-systems-e188660361.html 3. Michael D. Kennedy, Michael F.Goodchild & Jack Dangermond, Introducing Geographic Information Systems with ArcGIS: A Workbook Approach	
Course Outcomes	On completion of the course, students should be able to do 1. Explain urban planning and mapping 2. Map and manage the urban facilities 3. Explain demography and urban governance 4. Apply Spatial Technologies in Urban Ecology 5. Apply Spatial Technologies in wastewater management, electric distribution, and solid waste management.	

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	1	3	1	3
CO 2	2	2	2	3	2
CO 3	2	3	3	2	2
CO 4	3	3	2	2	1
CO 5	2	2	1	3	3

Semester	II	Course Code	**24PSTDO2M1**
Course Title	**Spatial Modeling**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Modular course		
Scope of the Course	• Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • exposes the students to decision making and concepts of spatial decision support system		

UNIT	Content	No. of Hours
I	Introduction - Need for Spatial models- Conceptual model for solving spatial problems – Various types of Spatial Models - Descriptive and Process models - Creating Conceptual models - Site Suitability model.	6
II	Data models – Static models – Dynamic models - Cartographic models – Spatio – temporal models – Network models – Models based on purpose, methodology and logic – Rased Based Model – Vector based model.	5
III	Basic statistics and its GIS expression; Spatial dependency; Spatial interpolation (IDW, Kriging and others); Assessing interpolation results; Mapping spatial dependency; Sampling design – 3D models of relief.	6
IV	Linking numeric and geographic patterns; Normalizing maps; Viewing scatter plots; Clustering mapped data; Investigating map correlation; Developing prediction models; Assessing prediction results.	6
V	Dynamic map pedigree – Toward a humane GIS – GIS software's changing roles – Evolving the GIS mindset – Multimedia Mapping – Map display	7
References	Text Books : 1. Carlo Gaetan & Xavier Guyon (auth.), Spatial Statistics and Modeling, 2010, Springer	

	Reference Books: 1. 1 Longley P.A., M.F. Goodchild, D.J. Maguire and D.W. Rhind. 2005. 2. Geographic Information Systems and Science. Second Edition. John Wiley, Chichester, 2005. 3. Goodchild, M.F.2003. Geographic Information Science and Systems for Environmental Management. Annual Review of Environment and Resources. Vol.28: 493-519. 4. Burrough, P.A. and McDonnell, R.A. 1998. Principles of Geographical Information Systems. London: Oxford. 5. Goodchild, M F.1988. Modeling error in objects and fields. Accuracy of Spatial Databases Meeting; Montecito, CA; (USA); Dec.1988. Pp.107-113.1990.
	E-Resources: 1. Hamid Reza Pourghasemi & Candan Gokceoglu, Spatial Modeling in GIS and R for Earth and Environmental Sciences, https://www.pdfdrive.com/spatial-modeling-in-gis-and-r-for-earth-and-environmental-sciences-d183969339.html
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the descriptive and process spatial models. CO2. Learn about various ranking, rating and comparison methods involved in decision modeling. CO3. Gain knowledge on types of decision modeling. CO4. Apply the SDSS in specified areas. CO5. Understand the concept of multimedia mapping.

Mapping of Cos with PSOs:

CO/PO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	2
CO 2	1	2	2	1	2
CO 3	2	1	2	1	2
CO 4	1	1	2	1	2

Semester	II	Course Code	**24PSTD02M2**
Course Title	**Spatial Decision Support System**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	-
Category	• Modular course		
Scope of the Course	• Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • exposes the students to decision making and concepts of spatial decision support system		

UNIT	Content	No. of Hours
I	Introduction to Information and Decision Making - Concept and Characteristics of Spatial Decision Support Systems (SDSS) – Architecture of SDSS - Framework for Spatial Decision modeling - Spatial Decision Support System (SDSS) and GIS	6
II	Decision variables - Concept – Deterministic, Random - Decision Alternatives and Constraints - Efficiency and Effectiveness of Decision Making	6
III	Concept of Estimating Weights – Ranking Methods – Rating Methods – Pair-wise comparison methods – Trade off analysis methods – their comparisons – Decision Rules.	6
IV	Concept and types of Multi-attribute Decision modeling – Multi objective Decision Modeling – Sensitivity Analysis – Maps as Decision tools.	6
V	Land Suitability Analysis - Water Resources Management – Education and Health Care Resources location – Industry and Business– Site Selection.	6
References	Text Books: 1. Ramanathan Sugumaran and John Degroote, Spatial Decision Support Systems- Principles and Practices, CRC Press, Taylor and Francis Group, USA, 2011.	

	Reference Books: 1. Bonczek, R.H., C.W. Holsapple, and A.B. Whinston, 1981, Foundations of Decision Support Systems, Academic Press, New York. 2. House, W.C. (ed.), 1983. Decision Support Systems, Petrocelli, New York. 3. Jenson, J.R. 2000, Remote Sensing of the environment – An Earth Resource Perspective, Prentice Hall Inc. 4. Malczewski, J. 1999, GIS and Multicriteria Decision Analysis, John Willey and Sons, New York. 5. Raghu Ramakrishnan, 2002, Database Management Systems, Johannes Gehrke, McGraw- Hill.
	E-Resources: 1. Ramanathan Sugumaran and John Degroote Spatial Decision Support Systems: Principles and Practices, CRC press, http://www.gisresources.com/wp-content/uploads/2014/06/spatial-decision-support-system.pdf
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept, architecture and frame work of SDSS and CO2. Understand the concept of decision variables CO3. Learn about various ranking, rating and comparison methods involved in decision modeling CO4. Gain knowledge on types of decision modeling CO5. Apply the SDSS in specified areas

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	2
CO 2	1	2	2	1	2
CO 3	2	1	2	1	2
CO 4	1	1	2	1	2

Semester	II	Course Code	**24PSTD00M3**
Course Title	**LiDAR and its Applications**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	• Modular course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives	The Course aims to • explores the open source software available for research and development.		

UNIT	Content	No. of Hours
I	LASER & LiDAR Principles – Different LiDAR system – Applications – Advantages and Disadvantages – Space borne and airborne LiDAR missions – Typical parameters of a LiDAR system.	6
II	Principle of Laser Altimetry – Components of the system – GNSS, IMU, LASER, LiDAR data formats – Terrain Mapping Laser Configuration – Ocean bathymetry Laser Configuration - Limitations and Challenges of the system	6
III	GNSS and IMU data processing – Strip Adjustment – Geometric Correction – Data quality enhancement – Digital Surface Model – Filtering – Ground Point Filtering – Digital Elevation Model.	6
IV	Hydrology, Disaster Mitigation and Management – 3D city models – Telecommunication	6
V	Modeling – Urban planning – Coastal Zone Bathymetry Mapping – Feature extraction & Classification, vectorisation – Surface and land use classification. Orthophoto rectification using integrated LiDAR and digital photogrammetry techniques - Integration of LiDAR DEM with other hyper spectral data.	6
References	Text Books (with chapter number & page number, wherever needed): 1. Altimetry- Principles and Applications- Mathias Lemmens, CRC Press.	

	Reference Books: 1. Digital Photogrammetry - Yves Egels and Michel Kasser, CRC Press. 2. Laser Manual of Aerial Survey, Primary Data Acquisition- Roger Read and Ron Graham 3. Digital Terrain Modeling: Principles and Methodology- Zhilin Li Qing Zhu, Christopher Gold, CRC Press.
	E-Resources (URLs of e-books / YouTube videos / online learning resources, etc.) 1. Pinliang Dong & Qi Chen, LiDAR Remote Sensing and Applications, 2018, CRC Press, https://www.pdfdrive.com/lidar-remote-sensing-and-applications-d158479644.html 2. Light Detection and Ranging (LiDAR) Technology Evaluation, https://www.pdfdrive.com/light-detection-and-ranging-lidar-technology-evaluation-d26826416.html 3. Lidar 101: An Introduction to Lidar Technology, Data, and Applications, https://www.pdfdrive.com/lidar-101-an-introduction-to-lidar-technology-data-and-d17380303.html
Course Outcomes	On completion of the course, students should be able to do CO1. Understand the concept and protocols in Open Source Software CO2. Describe about various open source operating system CO3. Summarise functions of Geo apps CO4. Understand the web mapping and web servers CO5. Work on sample case studies using open source software

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	2	2	1	1
CO 2	2	2	2	1	1
CO 3	2	2	2	1	1
CO 4	3	3	3	2	2
CO 5	3	3	3	2	2

Semester	II	Course Code	**24PSTD00M4**
Course Title	**Drone Image Processing**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	Revised Course	If revised, Percentage of Revision effected	20 %
Category	• Modular course		
Scope of the Course (may be more than one)	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-4: (Analyze) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • Explain the concept of Drone image processing		

UNIT	Content	No. of Hours
I	UAV/Drone Image Processing for GIS data generation i.e Aerial Triangulation, Orthophoto, 3D Point Cloud, DSM, DTM, 3D Mesh Model and Contour. Comprehensive workflow to process UAV/drone images that will save time during image processing. The basic theory behind UAV/Drone image Processing and Hardware/Software Requirement.	6
II	UAV/Image pre processing step that involves Geotagging, Remove Geotagging, Point Shape File Creation, Rename the images using ExifTOOL and QGIS. UAV/Drone Image Processing Platforms such as Desktop, Cloud, Network Processing and Batch Processing.	6
III	Stereo Satellite Image Processing. Working with Ortho photo, Color correction, Seam line editing, 3D point Cloud classification, Conventional Ortho generation and Contour generation.	6
IV	Processing Oblique and Nadir Images for High Accurate 3D Model Generation. Volume Calculation and Earthworks for Civil or Mining Engineer. 360^{o} panorama generation for UAV/Drone Spherical Images	6
V	Processing RTK/PPK images and their image acquisition theory Export Aerial Triangulation Result as Stereo Setup for Stereo Compilation. Accuracy Assessment Method (Relative, Absolute and Survey Grade) for UAV/Drone data product.	6

References	Text Books: 1. Amy E. Frazier, Kunwar K. Singh, Fundamentals of Capturing and Processing Drone Imagery and Data, CRC Press, 2021, ISBN 9780367245726.
	Reference Books: 1. John R. Jensen, Drone Aerial Photography and Videography: Data Collection and Image Interpretation, 2018. 2. Felipe Gonzalez Toro and Antonios Tsourdos, Mdpi AG, UAV-Based Remote Sensing: Volume 2, 2018
	E-Resources: 1. Felipe Gonzalez Toro & Antonios Tsourdos, UAV or Drones for Remote Sensing Applications, https://www.pdfdrive.com/uav-or-drones-for-remote-sensing-applications-e176213164.html 2. Henri Eisenbeiss, UAV Photogrammetry, https://www.pdfdrive.com/uav-photogrammetry-e33411397.html 3. Pablo Zaroo-Tejada, High resolution hyperspectral and thermal remote sensing from UAV, https://www.pdfdrive.com/high-resolution-hyperspectral-and-thermal-remote-sensing-from-uav-e14457225.html
Course Outcomes	On completion of the course, students should be able to do 1. Understand data generation using Drone 2. Understand the pre processing steps and platforms for drone image processing 3. Explain the concept of stero satellite image processing. 4. Apply the UAV in 3D model, civil engineering etc., 5. Check and export the output.

Mapping of Cos with PSOs:

CO/PO	PSO				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	3	3	2
CO 2	2	3	3	1	2
CO 3	3	2	3	1	2
CO 4	2	3	3	1	2
CO 5	2	3	3	2	2

Semester	II	Course Code	**24PSTD00M5**
Course Title	**Web Technology for Spatial Technologies**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected	-
Category	• Modular course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Value-Added Courses imparting transferable and life skills		
Cognitive Levels addressed by the Course	• K-2: (Understand) • K-3: (Apply) • K-6: (Create)		
Course Objectives	The Course aims to • provides the basic knowledge about the Internet & Web Technology for Spatial Technologies.		

UNIT	Content	No. of Hours
I	**Basics of Web Technologies:** Overview of web technologies: HTML, CSS, JavaScript - Introduction to web development frameworks - Understanding the client-server architecture. HTML and CSS for Spatial Technologies: Introduction to HTML and its elements - Structuring web pages with HTML - Styling web pages with CSS.	6
II	**Introduction to JavaScript:** Basics of JavaScript programming - JavaScript syntax and control structures - Introduction to DOM (Document Object Model) manipulation. Interactive Web Elements with JavaScript: Using JavaScript for interactivity - Event handling and user interactions - Dynamic updates on web pages.	9
III	**Introduction to Web Mapping:** Concepts and principles of web mapping - Overview of popular web mapping platforms (Leaflet, OpenLayers). Creating Basic Web Maps: Basic map creation using Leaflet - Adding spatial data to web maps - Styling and customizing web maps.	9
IV	**Advanced Mapping Techniques:** Advanced map functionalities (popups, tooltips, overlays) - Geocoding and routing on web maps - Integrating spatial analysis tools in web mapping. Web GIS Applications: Components of a Web GIS application - Building a simple. WebGIS application - Case studies.	9
V	**Server-Side Technologies for Spatial Data:** Introduction to server-side scripting (Python Flask, Node.js) - Setting up a web server for spatial data - Basic CRUD operations with spatial data	10

	Cloud-Based Web GIS Solutions: Introduction to cloud computing for spatial technologies - Overview of cloud-based GIS platforms (ArcGIS Online, Google Earth Engine) - Deploying web GIS applications on the cloud.	
References	Text Books: 1. Laura Lemay et al., Mastering HTML, CSS & JavaScript Web Publishing, BPB Publications, New Delhi, 2019. 2. Mike McGrath, JavaScript: Create functions for the web (5th Edition), McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2016. 3. Programming Python, Edition 2 Mark Lutz, ORelilly publisher (Server Side Scripting 15th Chapter)	
	Reference Books: 1. Jon Raasch et al., Java Script and jQuery for Data Analysis and Visualization, Wiley India Pvt. Ltd., New Delhi, 2015. 2. Dane Cameron, HTML5, JavaScript and jQuery, Wiley India Pvt. Ltd., New Delhi, 2015.	
	E-Resources: 1. https://nptel.ac.in/courses/106/105/106105084/ 2. https://developers.arcgis.com/javascript/latest/ 3. https://www.djangoproject.com/start/overview/ 4. https://flask.palletsprojects.com/en/2.0.x/#	
Course Outcomes	On completion of the course, students should be able to do,	
	CO1	Understand the basics of websites and HTML, CSS, and Javascript
	CO2	Understand Geo Spatial Data and web mapping
	CO3	Understand Geo spatial Web services
	CO4	Understand advanced development in Spatial Technologies.
	CO5	Understand Cloud and Mobile Technologies

Mapping of Cos with PSOs:

CO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	3	3	2	3
CO 2	1	3	2	3	2
CO 3	2	3	3	2	1
CO 4	3	2	1	3	3
CO 5	2	1	3	2	3