P.G.Diploma in Spatial Technologies

SYLLABUS

(Revised Syllabus w.e.f the academic year 2021-22 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

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: Explose the students to various open software and data.

Eligibility: A pass in UG degree in Sciences, Engineering and Technology disciplines.

Scheme of Examination of the Programme

P.G.Diploma in Spatial Technologies

(Revised Syllabus w.e.f the Academic year 2021 – 2022 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	21PSTD0101	Introduction to Spatial Technologies	4	4	-	3	40	60	100
		21PSTD0102	Remote Sensing and Digital Image Processing	4	4	-	3	40	60	100
		21PSTD0103	Principles of Cartography	4	4	-	3	40	60	100
		21PSTD0104	Geographical Information System	4	4	-	3	40	60	100
		21PSTD0105	Global Navigation Satellite System	3	3	-	3	40	60	100
		21PSTD0106	PRACTICAL - I: Geographical Information System	2	-	4	3	60	40	100
		21PSTD0107	PRACTICAL -II: Remote Sensing & Digital Image Processing	2	-	4	3	60	40	100
	1st Semester Total			**23**	**19**	**8**	**-**			
II	Major Courses	21PSTD0208	IT for Spatial Technologies	3	3		3	40	60	100
		21PSTD0209	Spatial Technologies in Resource Management	4	4		3	40	60	100
		21PSTD0210	Spatial Technologies in Disaster Management	4	4		3	40	60	100
		21PSTD0211	Dissertation	4		8	3	75	125	200
	DC	21PSTD02DX	Elective – Discipline Centric	3	3		3	40	60	100
	MC	21PSTD02MX	Modular course	2	2	-		50	-	50
	VAC	21CSKD0201	Communication and Soft Skills	2	2			50	-	50
	VAC	21GTPP00H1	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	21PSTD0101	Introduction to Spatial Technologies	4
		21PSTD0102	Remote Sensing and DIP	4
		21PSTD0103	Principles of Cartography	4
		21PSTD0104	Geographical Information System	4
		21PSTD0105	Global Navigation Satellite System	3
		21PSTD0106	PRACTICAL - I: Geographical Information System	2
		21PSTD0107	PRACTICAL -II: Remote Sensing & Digital Image Processing	2
	1st Semester Total			**23**
II	Major Courses	21PSTD0208	IT for Spatial Technologies	3
		21PSTD0209	Spatial Technologies in Resource Management	4
		21PSTD0210	Spatial Technologies in Disaster Management	4
		21PSTD0211	Dissertation	4
	2nd Semester Total			**15**

Elective – Discipline Centric

Discipline Centric courses - 21PSTD02DX	
21PSTD02D1	Earth, Atmospheric, Ocean and Planetary Sciences
21PSTD02D2	Spatial Technologies for Watershed Management
21PSTD02D3	Open source data and software

Modular Course

Modular Course 21PSTD02MX	
21PSTD02M1	Spatial Modeling
21PSTD02M2	Spatial Decision Support System
21PSTD02M3	LiDAR and its Applications
21PSTD02M4	Drone Image Processing

OBE Template

Name of the Programme	**P.G.Diploma in Spatial Technologies**										
Year of Introduction	2002				Year of Revision				2021		
Semester-wise Courses and Credit distribution	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
No. of Courses	7	8									15
No. of Credits	23	24									47

Semester	I	Course Code	**21PSTD0101**
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 **(Minimum 20%)**	40%
Category	• Foundation course		
Scope of the Course (may be more than one)	• Basic Skill • Skill Development		
Cognitive Levels addressed by the Course	• K-2: (Understand)		
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 - Geographical Information System - Photogrammetry - Information & Communication Technologies- Global Positioning System- Digital Image Processing - Map as decision tool – Geoinformatics as a multidisciplinary discipline – Geoinformatics products – advantages of Geoinformatics – applications.	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. Geoinformatics data: Spatial: raster – vector, attribute data – metadata.	15
III	Basic principles of surveying – Classification and applications- Scales - Conventional signs - Survey instruments, survey methods - traversing, trilateration and triangulation - conventional, electronic	15

	(total station) – GNSS - DGPS	
IV	Aerial and Satellite based survey techniques (Photogrammetry, RADAR, LiDAR) - Survey by GPS – survey using UAV.	10
V	Application of Spatial Technologies: Rural Development, Geosciences, Agriculture, Forestry, Soil Studies, Meteorology, Military, Transport, Environmental studies, Banking and Health Civil Engineering – disaster and natural resource management – location based services – education 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.	
	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. 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	

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 aerial and photogrammetry techniques of surveying. CO5. Apply tools of Spatial Technologies in various applications.

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 **(Minimum 20%)**	40%
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 (Maximum: 5)	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	History and development - Electro Magnetic Spectrum - Components and types of remote sensing – Energy interaction with atmosphere and Earth features - Resolutions (Spectral, Spatial, Temporal & Radiometric) - 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	Historical development - definition – types – Sensors -Planning and execution- Geometry of vertical aerial photograph, scale of vertical aerial photograph, relief displacement. - Stereoscopic parallax - Aerial triangulation –Ortho photograph generation - Digital photogrammetry	10
III	Thermal Remote Sensing: Basic concepts - Thermal sensors & scanners - Thermal Inertia. Microwave Remote Sensing: Basic concepts - Microwave sensors and Radiometers - Geometric characters. RADAR – Radargrammetry (SLAR & SAR) – Missions : RISAT, RADARSAT, Sentinel 1A&1B, NISAR, ALOS PALSAR – SRTM. LiDAR – LiDAR system - components - operating principles—	10

	LiDAR data characteristics – advantages.	
IV	Hyper spectral Remote Sensing: basic concepts hyperspectral sensors, data formats and systems, AVIRIS, CASI, MODIS and Hyperion.	8
V	Types of satellites – environmental, resource survey satellites, weather and communication satellites, GPS satellites and Shuttle Mission - Major satellite systems: Sensors and data products of IRS, LANDSAT, SPOT, ERS, IKONOS, Quik Bird, ORBVIEW, WORLD VIEW and others. UAV and low altitude payloads in different spectral regions.	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/principlesremotesensing.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 8.https://earth.esa.int/documents/973910/1002056/CK3.pdf/4e5b4e5a-d898-	

	43b8-9e5c-ba7494aa58c8 9.http://www.geoinformatie.nl/courses/gima_rs/Day%203/GIMA%20ch4%20Microwave%20Remote%20Sensing.pdf 10.https://www.sciencedirect.com/topics/earth-and-planetary-sciences/side-looking-radar
Course Outcomes	On completion of the course, students should be able to CO1. Understand the basic concepts of remote sensing. CO2. Understand aerial photography, types, planning and execution. CO3. Apply different photogrammetric techniques. CO4. Understand the basics of LiDAR, RADAR, Microwave remote sensing and its principles. CO5. Understand various satellite and sensors.

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	**21PSTD0103**
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 **(Minimum 20%)**	35%
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 (Maximum: 5)	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	Introduction to cartography: Definition – nature, scope and its role of Cartography; Principles of Cartography; map and its components, Types of maps, Interpretation of topographic/ thematic maps.		10
II	Projection: Definition – concept – classification – uses and types of projection: Conical – Azimuthal - Cylindrical – map scale.		15
III	Data Collection, Creation of Database, Representation of data - Symbolization – 2D visualization (mapping techniques) – 3D visualization (Ortho TIN, DEM, DSM, DTM, Hill Shading, Hatching) – 4D visualization (creation of movies, animation) – Virtual reality map.		15
IV	Map designing and layout: Definition - Overall map designing – Internal components designing -Methods of printing maps		10
V	Digital Cartography: Adaptation of Computer in Cartography – Components of digital Cartography - advantages – disadvantages of digital cartography - Conventional mapping Vs Digital Mapping.		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 CO6. Understand the basic information about to earth, atmosphere and principles of acquiring earth related information CO7. Understand the meaning, scope and science & technologies involved in Geoinformatics. CO8. Understand and analyze the basics principles of surveying using conventional and modern tools and technologies CO9. Apply various methods of Geodata visualization for analysis. Apply tools of Geoinformatics 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	**21PSTD0104**
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 **(Minimum 20%)**	40 %
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) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	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 – sources of GIS data - spatial data models/ structure – representation of spatial data in GIS: Layer based – title based – object oriented based.	7
II	Data Input methods - Checking and correcting errors: Attribute data - spatial data, edge matching - rubber sheeting – data integration.	9
III	Measurement – Query - Reclass – Buffer - Overlay – MCE. Network modeling: Arc – Node – vertices – Analysis: travelling sales person problem – location-allocation modeling – route tracing – service area – closest facility.	10
IV	Surface modeling: Slope – Aspect – visibility analysis. Hydrological Analysis: Fill – flow direction – flow accumulation. Spatial interpolation - extrapolation.	12

V	Cartographic Output: Maps as output – Cartograms - Non-cartographic output – Spatial multimedia – Delivery mechanism: Hardcopy output – softcopy copy - 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. 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	**21PSTD0105**
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 **(Minimum 20%)**	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 (Maximum: 5)	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	9

	time at a point - differential correction - WAAS, LAAS	
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), SpringerWien, 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 different GNSS satellites and systems. 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	**21PSTD0106**
Course Title	**Practical I – 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 **(Minimum 20%)**	25 %
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-3: (Apply) • K-4: (Analyze) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	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	Surveying: Total stations – DGPS.	10
II	Introduction to commercial and open source GIS software. (AutoCAD, ArcGIS, QGIS etc) Map Appreciation - Map interpretation – spatial entities – data dictionary. Georeferencing - projections – Database creation. Spatial and attribute data entry, editing and joining them.	12
III	Working with tables and layer properties. Methods of data analysis I: Measurement - Buffer – overlay– spatial interpolation – reclass – TIN – DEM.	15
IV	Methods of data analysis II: Network – surface – hydrology - Geo statistical analysis. Map algebra – MCE.	15
V	Building models - Map Design and Layout	10

Course Outcomes	On completion of the course, students should be able to 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

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	**21 PSTD0107**
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 **(Minimum 20%)**	30%
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) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	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.	12
II	6. Streovision Test and Anatomy of pocket & Mirror Stereoscopes. 7. Interpretation of Aerial photographs 8. Decoding, Marking & Transfer of Principal Points, Base line drawing, Flight line marking, 3D Observation, Tracing details, Transfer the details to base map.	12
III	9. Reading and displaying satellite data from BIL, BSQ and BIP formats 10. Layer stacking and Generating True, False and Pseudo Colour Composite	12

	11. Georeferencing the base image, Image to Image, Map to Image 12. Extracting / Subset, Area of Interest (AOI) 13. Measuring distance and area. 14. Mosaic	
IV	15. Preprocessing - Geometric correction of satellite image 16. Enhancement using different filtering techniques, Image Fusion 17. Principal Component Analysis (PCA) 18. Band ratio, NDWI, NDSI, RVI, TNDVI, PRI, NDVI etc. 19. Classification (Supervised, Unsupervised, Hybrid, Fuzzy etc) 20. Accuracy Assessment 21. Change detection 22. Terrain Analysis	12
V	23. Layout Preparation 24. Hyper spectral Image Analysis 25. 3D visualization 26. SAR Image Processing 27. Exploration of various sites on UAV 28. Familiarization with hardware and software of UAV 29. Acquisition of satellite images: Theory in UAV mode 30. Processing of UAV images	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 – 2

First Year

Semester	II	Course Code	**21PSTD0208**
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 **(Minimum 20%)**	80 %
Category	• Core Course		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	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: Hardware, software and data:** Software: System, application, enterprise, free ware, open source - Coding: ASCII, UNICODE -DBMS, logical data model, physical and logical views, spatial databases available for natural resources and terrain-Data Science- Data Mining – Data Analytics - Big Data - Artificial Intelligence – Machine Learning - Drone Image Applications - Deep Learning.	9
II	**Internet:** Communication systems, wired and wireless communication, communication types - Major types of networks-LAN, WAN, MAN etc, Topologies-Internet, WWW, web server, client, web browser-TCP/IP Protocol Suite, IP Address - Applications of Internet. IoT- Applications Video Conferencing - Virtual reality - Cloud Computing.	12
III	**Python:** Introduction OOPS Concept – Application of OOPS – Introduction - Variables - Expressions - Statements - Operators - Functions - Conditionals and Recursion - Fruitful Functions.	12
IV	Iteration- Strings - Lists - Tuples - Dictionaries - Files and exceptions. Library : Geemap - Arcpy- Pandas - Geopandas - Geemap - RSGISLib - GDAL/OGR - Folium - ipyleaflet - Scikit -	9

	Matplotlib - NumPy - PyProj- PyTorch - Keras - TensorFlow - Theano – SciPy – LiDAR. Reading Satellite images.	
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 Gottrfrield, 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 CO 1. Understand about computer hardware and software CO 2. Understand about the Internet and net works CO 3. Create simple program in Python language. CO 4. Create program to manipulate strings and data structures and Understand packages in Python CO 5. 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	**21PSTD0209**
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 **(Minimum 20%)**	30%
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) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	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. 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 - sedimentation evaluation - watershed approach for natural resource management – runoff and hydrological modeling.	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 - Forest stock mapping - factors for degradation of forest - Forest change detection and monitoring -	10

	Forest fire mapping & damage assessment - LiDAR remote sensing for Forest studies.	
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 spotting – Sitting a new facility - customer loyalty studies - health information system - Solid and liquid waste management - Crime Analysis: mapping crime data - hot spot analysis.	10
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 (with chapter number & page number, wherever needed): 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., Geoinformatics 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 Geoinformatics in Land resource management CO2. Apply Geoinformatics in Water Resources Management CO3. Apply Geoinformatics in Agriculture and Forestry CO4. Apply Geoinformatics in Utility management CO5. Apply Geoinformatics 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	**21PSTD0210**
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 **(Minimum 20%)**	30%
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) • K-5: (Evaluate) • K-6: (Create)		
Course Objectives (Maximum: 5)	The Course aims to • apply various tools of Geoinformatics in disaster management.		

UNIT	Content	No. of Hours
I	Types of disaster – Natural: Earthquakes – Landslides - Volcanism - Tsunami-Cyclones – Floods - Drought - Forest Fire Man-Made Disasters: Nuclear Disasters - Chemical Disasters - Biological - Deforestation - Accidents - Disaster Management Concepts.	9
II	Vulnerability – Hazard – Risk Assessment - Natural Disaster Mapping, Management and mitigation using Geoinformatics Technology.	10
III	Disaster Management: Prevention - Preparedness and Mitigation - Damage assessment - Land use planning and regulation for sustainable development. Pre-disaster and post disaster planning for relief operations - Development of Disaster management plan.	10
IV	Disaster Response: Disaster Response Plan – Communication - Participation and Activation of Emergency Preparedness Plan - Logistics Management - Trauma and Stress Management - Rumour and Panic Management.	10
V	Emergency Support Functions and their coordination mechanism. Resource & Material Management. Management of Relief Camp.	9

	Rehabilitation, Reconstruction and Recovery - Information systems & decision making tools. Application of UAV in pre and post disaster planning.	
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 (URLs of e-books / YouTube videos / online learning resources, etc.) 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. Apply Geoinformatics in Disaster mitigation and management	

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	**21PSTD0211**
Course Title	**Dissertation**		
No. of Credits	4	No. of contact hours per Week	8
New Course / Revised Course	-	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Core Course • Industrial Placement		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	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

Elective – Discipline Centric

Semester	II	Course Code	**21PSTD02D1**
Course Title	**Earth, Atmospheric, Ocean and Planetary Sciences**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	New Coursse	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Major Elective		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	The Course aims to • Provide important concepts of basic geosciences		

UNIT	Content	No. of Hours
I	Mineralogy and petrology – structural geology and geotectonic – paleontology and its applications – sediment logy and stratigraphy – marine geology and pale oceanography – geochemistry – economic geology - Precambrian geology and crustal evolution – quaternary geology – applied geology.	9
II	Physical Geography: geomorphology – climatology – bio-geography – environmental geography – geography of India.	9
III	Geophysics: Signal Processing – field theory – numerical analysis and inversion – gravity and magnetic fields of the earth – palte tectonics and geodynamics – seismology elastic theory – gravity and magnetic methods – electrical and electromagnetic methods – seismic methods – well logging.	10
IV	Meteorology: Climatology – physical meteorology – atmospheric electricity – cloud physics – dynamic meteorology – numerical weather prediction – general circulation and climate modeling – 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 mineralogy, petrology. CO2. Understand physical geography and geophysics CO3. Explain the concept of meteorology CO4. 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	**21PSTD02D2**
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 **(Minimum 20%)**	80%
Category	• Major Elective		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	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 – Causes and consequences of watershed deterioration - Watershed delineation and codification – Advantages –- Watershed management – Approaches to watershed development – Components of watershed management	9
II	Geomorphology – Topography – Hydrography - Concentration time – Isochrones Morphometric analysis.	9
III	Watershed delineation – Watershed characterization and assessment – resource mapping.	10
IV	GNSS in: Collection of Ground Control Points (GCP) – Ground truth verification/training sites for Digital Image Processing – estimation of soil erosion - Management planning.	10
V	Monitoring & Evaluation: Need – Types of evaluation – Factors affecting evaluation – Understanding community participation – PRA methods of Evaluation. Analyzing the changes in: Depth of water table – Cropping pattern – Biomass estimation – Land use/ land cover.	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	**21PSTD02D3**
Course Title	**Open Source Data and Software**		
No. of Credits	3	No. of contact hours per Week	3
New Course / Revised Course	Revised	If revised, Percentage of Revision effected **(Minimum 20%)**	60%
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 **VectorData:** Openstreet map, Geofabrik, Natural Earth Data, Opentopography, 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.	6

	Scripting Language: Java Scripting. Mark-up languages: HTML - WeODM Compare QGIS – ArcGIS –SagaGIS – OpenJump.	
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 (URLs of e-books / YouTube videos / online learning resources, etc.) 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 CO1: Understand the concept and protocols in Open Source Software and Describe about various open source operating system. CO2: Understand various Open Source Software. CO3: Understand and create WebGIS. CO4. Know about GIS related mobile apps. CO5: 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

Modular Course

Semester	II	Course Code	**21PSTDO2M1**
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 **(Minimum 20%)**	20%
Category	• Modular course		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	The Course aims to • exposes the students to decision making and concepts of spatial decision support system		

UNIT	Content	No. of Hours
I	Development, Definition, Classification and Verification of spatial models. Spatial system theory. Temporal modeling and dynamic description of geoobjects. Spatial access methods.	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 concept, architecture and frame work of SM and decision variables 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

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	**21PSTD02M2**
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 **(Minimum 20%)**	20%
Category	• Modular course		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	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 Decision Making - Concept and Characteristics of Spatial Decision Support Systems (SDSS) – Architecture of SDSS GIS – Types of Spatial Decisions – Spatial – Decision Making Problems – Spatial Decision Making Process – Need for Decision support system - Spatial Decision Support System (SDSS) and GIS	10
II	Decision variables - Concept – Deterministic, Random - Decision Alternatives and Constraints - Efficiency and Effectiveness of Decision Making	10
III	Concept of Estimating Weights – Ranking Methods – Rating Methods – Pairwise comparison methods – Trade off analysis methods	10
IV	Concept and types of Multi-attribute Decision modeling – Multi objective Decision Modeling – Sensitivity Analysis. Models of SDSS: Boolean Overlay - Weighted Linear Combination – AHP – Ordered Weighted Approach – ANN – Cellular Automation – Fuzzy modeling SDSS software: ArcGIS Modelbuilder – ERDAS Imagine – Open SDSS – Open Source Software	9

V	SDSS Applications: Natural Resource Management – Environmental Management – Agriculture – Utility/ Communication/ Energy and Transportation – Business - Land Suitability Analysis – Education and Health Care Resources location – Water Resources Management.	9
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 CO5. Understand the concept, architecture and frame work of SDSS and decision variables CO6. Learn about various ranking, rating and comparison methods involved in decision modeling CO7. Gain knowledge on types of decision modeling CO8. 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	**21PSTD00M3**
Course Title	**LiDAR and its Applications**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 20%)**	-
Category	• Modular course		
Scope of the Course (may be more than one)	• 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 (Maximum: 5)	The Course aims to • explores the open source software available for research and development.		

UNIT	Content	No. of Hours
I	LASER, LiDAR –properties – working principle of LiDAR – Discrete and full-wave form LiDar – Types of LiDAR based on Carrier – Types based on pulse emitted – Discrete Vs Full – Waveform LiDAR - 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 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. Interpretation of LiDAR: Introduction to DEM – DTM – Canopy Height. Tree Delineation using Watershed Algorithm.	6

IV	Applications of LiDAR: Hydrology, Disaster Mitigation and Management – 3D city models – Telecommunication – Biodiversity – Forest Health Monitoring – Urban Planning – Wood Trade – Archeology – Automated Driving.	6
V	Other types of LiDAR System: Multi- Spectral – Atomospheric – Bathymetric LiDAR. Modeling – Coastal Zone Bathymetry Mapping – Feature extraction, vectorisation – Surface and land use classification. Orthophoto rectification using LiDAR – 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	**21PSTD00M4**
Course Title	**Drone Image Processing**		
No. of Credits	2	No. of contact hours per Week	2
New Course / Revised Course	New Course	If revised, Percentage of Revision effected **(Minimum 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 (with chapter number & page number, wherever needed): 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 (URLs of e-books / YouTube videos / online learning resources, etc.) 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 CO1: Understand data generation using Drone CO2: Understand the pre processing steps and platforms for drone image processing CO3: Explain the concept of stero satellite image processing. CO4: Apply the UAV in 3D model, civil engineering etc. CO5: 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