UNIVERSITY DEPARTMENTS - R2019

FACULTY OF CIVIL ENGINEERING

B.E. / B. TECH. (HONS)

B.E. GEOINFORMATICS

PROFESSIONAL ELECTIVE COURSES (PEC): VERTICALS

VERTICAL I (Surveying & Mapping)	VERTICAL II (Geospatial Data Analytics)	VERTICAL III (Image Processing and Analysis)	VERTICAL IV (GeoSpatial Applications)	VERTICAL V (Geodesy)	VERTICAL VI (Geo-Intelligence)
Terrestrial and Satellite Photogrammetry	GIS Customization and Scripting	Soft Computing Techniques	Environmental Geoinformatics	Advanced Geodesy	Digital Twins and BIM
GNSS Surveying	Open Source GIS	Thermal, Hyperspectral and Planetary Remote Sensing	Transportation Geomatics	Satellite Geodesy	Big Data Analytics for Geomatics
Terrestrial and Bathymetric Laser Scanning	Location Based Geospatial Services	Polarimetry and Interferometry	Geomatics for Hydrology and Water Resources	Physical Geodesy	IoT Applications in Geomatics
Unmanned Aerial System (UAS) for Large Scale mapping	Space Syntax	AI/DL for Geoinformatics	Satellite Meteorology	Geodetic Interferometry	BlockChain Technology for Spatial Data
Underground and Hydrographic Surveying	GIS based Utility and Asset Management	Pattern Recognition	Geomatics for Disaster and Risk Mitigation	Environmental Geodesy	Decision Support Systems for Geomatics
Cadastral Surveying	Spatial Statistics	Raster Data Modelling	Agriculture and Forest Management using Geomatics	Geodetic Control Survey and Adjustment	Location Intelligence and Surveillance
Engineering Survey and Mapping	GeoSpatial Modelling and Simulation	Sustainable Development Goals and Geomatics	Geomatics for ocean and Coastal Applications	Geodetic Astronomy	Geomatics for Smart Cities

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered from Semesters V to VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, more than one course is permitted from the same row, provided each course is enrolled in different semester.

The registration of courses for B.E./B.Tech (Hons) shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Hons) also. For more details on B.E./B.Tech (Hons) refer to the Regulations 2023, Clause 4.11.

UNIVERSITY DEPARTMENTS - R2019

FACULTY OF CIVIL ENGINEERING

B.E. / B. TECH. (HONS)

B.E. GEOINFORMATICS

PROFESSIONAL ELECTIVE COURSES (PEC)
VERTICAL– I: SURVEYING & MAPPING

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI5019	Terrestrial and Satellite Photogrammetry	PEC	3	0	0	3	3
2.	GI5020	GNSS Surveying	PEC	3	0	0	3	3
3.	GI5021	Terrestrial and Bathymetric Laser Scanning	PEC	3	0	0	3	3
4.	GI5022	Unmanned Aerial System (UAS) for Large Scale Mapping	PEC	3	0	0	3	3
5.	GI5023	Underground and Hydrographic Surveying	PEC	3	0	0	3	3
6.	GI5024	Cadastral Surveying	PEC	3	0	0	3	3
7.	GI5025	Engineering Survey and Mapping	PEC	3	0	0	3	3

VERTICAL– II: GEOSPATIAL DATA ANALYTICS

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI5026	GIS Customization and Scripting	PEC	2	0	2	3	3
2.	GI5027	Open Source GIS	PEC	3	0	0	3	3
3.	GI5028	Location Based Geospatial Services	PEC	3	0	0	3	3
4.	GI5029	Space Syntax	PEC	3	0	0	3	3
5.	GI5030	GIS based Utility and Asset Management	PEC	3	0	0	3	3
6.	GI5031	Spatial Statistics	PEC	3	0	0	3	3
7.	GI5032	Geo Spatial Modelling and Simulation	PEC	3	0	0	3	3

VERTICAL– III: IMAGE PROCESSING AND ANALYSIS

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI5602	Soft Computing Techniques	PEC	2	1	0	3	3
2.	GI5033	Thermal, Hyperspectral and Planetary Remote Sensing	PEC	3	0	0	3	3
3.	GI5034	Polarimetry and Interferometry	PEC	3	0	0	3	3
4.	GI5035	AI / DL for Geoinformatics	PEC	3	0	0	3	3
5.	GI5036	Pattern Recognition	PEC	3	0	0	3	3
6.	GI5037	Raster Data Modelling	PEC	3	0	0	3	3
7.	GI5038	Sustainable Development Goals and Geomatics	PEC	3	0	0	3	3

VERTICAL– IV: GEOSPATIAL APPLICATIONS

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	GI5006	Environmental Geoinformatics	PEC	3	0	0	3	3
2	GI5005	Transportation Geomatics	PEC	3	0	0	3	3
3	GI5016	Geomatics for Hydrology and Water Resources	PEC	3	0	0	3	3
4	GI5039	Satellite Meteorology	PEC	3	0	0	3	3
5	GI5017	Geomatics for Disaster and Risk Mitigation	PEC	3	0	0	3	3
6	GI5040	Agriculture and Forest Management using Geomatics	PEC	3	0	0	3	3
7	GI5018	Geomatics for Ocean and Coastal Applications	PEC	3	0	0	3	3

VERTICAL– V: GEODESY

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI5041	Advanced Geodesy	PEC	3	0	0	3	3
2.	GI5042	Satellite Geodesy	PEC	3	0	0	3	3
3.	GI5043	Physical Geodesy	PEC	3	0	0	3	3
4.	GI5044	Geodetic Interferometry	PEC	3	0	0	3	3
5.	GI5045	Environmental Geodesy	PEC	3	0	0	3	3
6.	GI5046	Geodetic Control Survey and Adjustment	PEC	3	0	0	3	3
7.	GI5047	Geodetic Astronomy	PEC	3	0	0	3	3

VERTICAL– VI: GEOINTELLIGENCE

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GI5048	Digital Twins and BIM	PEC	3	0	0	3	3
2.	GI5049	Big Data Analytics for Geomatics	PEC	3	0	0	3	3
3.	GI5050	IoT Applications in Geomatics	PEC	3	0	0	3	3
4.	GI5051	Blockchain Technology for Spatial Data	PEC	3	0	0	3	3
5.	GI5052	Decision Support Systems for Geomatics	PEC	3	0	0	3	3
6.	GI5053	Location Intelligence and Surveillance	PEC	3	0	0	3	3
7.	GI5054	Geomatics for Smart Cities	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVE COURSES (PEC)

VERTICAL I: SURVEYING AND MAPPING

GI5019 TERRESTRIAL AND SATELLITE PHOTOGRAMMETRY L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF TERRESTRIAL AND CLOSE-RANGE PHOTOGRAMMETRY 9

Terrestrial cameras - Metric and non-metric cameras - Photo theodolites - Stereometric cameras - Photogrammetric process, systems, products - Aspects - Image forming model - Coordinate systems - Transformations - Adjustment techniques - Geometric elements - Horizontal and vertical angles from terrestrial photographs - Camera azimuth.

UNIT II IMAGING SYSTEMS 9

Imaging concepts - Geometric fundamentals - Imaging systems - Targeting and illumination - Image preprocessing - Geometric image transformation - Digital processing of single images - Image matching and 3D object reconstruction.

UNIT III ANALYTICAL METHODS 9

Orientation methods - Bundle triangulation - Object reconstruction - Line photogrammetry - Multimedia photogrammetry - Panoramic photogrammetry - Analytical self-calibration - Statistics - Matrix equations for analytical self - Calibration - Initial approximations for least square adjustments - Solution approach for self-calibration adjustment - Control for terrestrial photogrammetry - Analytical determination of horizontal position of a point from photographic measurement - Graphical method.

UNIT IV PHOTOGRAMMETRIC MEASURING SYSTEM 9

Comparators - Single camera systems - Stereoscopic processing systems - Multi image measuring systems - Systems of surface measurement - Project planning - Camera calibration dynamic photogrammetry - Close range aerial imagery.

UNIT V APPLICATION OF TERRESTRIAL AND CLOSE RANGE PHOTOGRAMMETRY 9

Architecture and cultural heritage - Engineering surveying and civil engineering - Industrial applications - Forensic application - Medicine - Criminology - Structural studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Describe fundamental concepts in terrestrial and close-range photogrammetry.
CO2: Describe the imaging systems.
CO3: Use analytical methods in parameter estimation.
CO4: Use photogrammetric concepts in measurement.
CO5: Application of terrestrial and close-range photogrammetry in the problem domain.

TEXTBOOKS:

1. Paul. R Wolf., Bon A.DeWitt, Benjamin E. Wilkinson, “Elements of Photogrammetry with Application in GIS”, McGrawHill International Book Co., 4th Edition, 2014.
2. Luhmann, Thomas, Robson, Stuart, Kyle, Stephen and Boehm, Jan. “Close-Range Photogrammetry and 3D Imaging”, Berlin, Boston: De Gruyter, 2020. https://doi.org/10.1515/9783110607253.
3. Thomas Luhmann, Stuart Robson, Stephen Kyle, Ian Harley, “Close range photogrammetry Principles, techniques and applications”, Whittles Publishing, 2011. ISBN 978-184995-057-2 Print edition 978-1870325-50-9.
4. Alex Alvarez, Reg Downing , “Image Based Modeling : Advanced 3D Modeling from Panoramas”, 2005.
5. Wilfried Linder, “Digital Photogrammetry, A Practical Course” 4th edition, 2016.
6. Atkinson, “Development in Close Range Photogrammetry - I”, Development series, 1988.

REFERENCES:

1. Gollfried Konecny, “Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems”, CRC Press, 2nd Edition, 2014. ISBN: 9781420068566.
2. Karl Kraus, “Photogrammetry: Geometry from Images and Laser Scans”, Walter de Gruyter GmbH & Co. 2nd Edition, 2007.
3. 3.E.M.Mikhail, J.S.Bethel, J.C.McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2001.
4. E.M.Mikhail, J.S.Bethel, J.C.McGlone, “Introduction to Modern Photogrammetry”, Wiley Publisher, 2012. ISBN: 978-8126539987.
5. Karara, H.M., “Non topographic Photogrammetry”, 2nd Edition American Society for Photogrammetry and Remote Sensing, 1989.
6. American Society of Photogrammetry and Remote Sensing, 4th Edition, 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-
2	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-
3	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	3	-	3	3	3
AVg.	3	3	3	3	2	-	-	-	-	-	3	-	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5020 GNSS SURVEYING L T P C
3 0 0 3

UNIT I INTRODUCTION TO GNSS 9

Overview - History and evolution - GNSS satellite orbits and constellations - Working Principle - Components - Types, features, and specifications of GNSS receivers - Positioning and Navigation with GNSS - Reference Systems - Coordinate Systems - Time Systems - Orbit Determination - Ephemerides.

UNIT II GNSS SIGNAL AND OBSERVABLES 9

Signal Structure - Propagation Effects - Receiver Design: Types, Components, Processors - GNSS Observables: Code, Phase, Doppler and Biases - Data Combinations - Atmospheric Effects - Relativistic effects - Antenna Phase Center offset - Multipath - Data Transfer and File Formats - RINEX, NMEA.

UNIT III GNSS POSITIONING AND DATA PROCESSING 9

Point Positioning - Differential Positioning - Relative Positioning: Static, Kinematic, Pseudo Kinematic - Phase differences - Data Processing: Cycle slip Detection and Repair - Ambiguity Resolution - Adjustment and Filtering - Network Adjustment - Dilution of Precision - Coordinate Transformations - Height Transformations – SBAS and GBAS.

UNIT IV GLOBAL GNSS SYSTEMS 9

History - Segments - Configuration - Services - Signal Structure - New Developments of GPS, GLONASS, COMPASS and GALILEO systems - Comparison - Differential Systems: Space based,

ground based - Augmentation Systems: Space based, Ground based - Regional GNSS Systems: QZSS - Applications.

UNIT V IRNSS GNSS SYSTEM 9

Introduction - Comparison – Architecture – constellation - satellite design and characteristics - Ground control segment - Signal Characteristics L5, S, and C bands - Data Collection: IRNSS receiver types and specifications - Data Processing and Analysis - Differential correction techniques - Error analysis and quality control - Data Processing - Applications of IRNSS - Challenges and Limitations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the history, principles and components of GNSS systems.
CO2: Analyze GNSS data to derive accurate positioning information.
CO3: Apply data processing techniques for surveying and mapping applications.
CO4: Demonstrate a comprehensive understanding of various GNSS and Augmentation Systems.
CO5: Understand the architecture, data processing and applications of IRNSS GNSS System.

TEXT BOOKS:

1. Bernhard Hofmann-Wellenhof , Herbert Lichtenegger , Elmar Wasle, “GNSS – Global Navigation Satellite Systems, GPS, GLONASS, Galileo and more”, Springer Vienna, 978-3-211-73012-6, https://doi.org/10.1007/978-3-211-73017-1.

REFERENCES:

1. Elliott D. Kaplan, Christopher Hegarty, “Understanding GPS/GNSS: Principles and Applications”, Artech House; 3rd Edition (2017) ISBN-13: 978-1630810580.
2. Scott Madry, “Global Navigation Satellite Systems and Their Applications”, Springer New York, NY ISBN: 978-1-4939-2608-4, https://doi.org/10.1007/978-1-4939-2608-4.
3. Peter Teunissen and Oliver Montenbruck, “Handbook Of Global Navigation Satellite Systems” by Springer International Publishing, 2017, 978-3-3194-2926-7.
4. Basudeb Bhatta, “Global Navigation Satellite Systems New Technologies and Applications”, 2nd Edition CRC Press 2021, ISBN 9780367474089.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	2
2	3	3	2	2	3	-	-	-	-	-	-	-	1	-	2
3	3	3	3	2	2	-	-	-	-	-	1	-	2	2	2
4	2	1	1	-	-	-	1	-	-	-	1	2	1	2	1
5	2	2	2	1	1	2	1	-	-	-	1	2	2	2	1
AVg.	2	2	2	2	2	3	1	-	-	-	1	2	2	2	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5021 TERRESTRIAL AND BATHYMETRIC LASER SCANNING **L T P C**
3 0 0 3

UNIT I TERRESTRIAL LASER SCANNING **9**

Terrestrial Laser Scanner (TLS) - Measurement Techniques: Pulse and Phase based - Components of TLS - Scanning Mechanism in TLS - Scanning Geometry - Working Principle of TLS - Factors affecting 3D Point Cloud Quality - Commercially available Terrestrial Laser Scanners: Salient Features - Selection of Scanners - Static TLS - Dynamic TLS - Vehicle Mounted and Backpack Wearable Mobile Mapping Laser Scanner.

UNIT II TLS – PROJECT PLANNING AND DATA ACQUISITION **9**

TLS Project Planning - Eye Safety - Reconnaissance: Visibility - Number of Instrument Stations and positioning to ensure full coverage - Control Point Requirements - Indoor Mapping: Number of Instrument Stations and its position - Data Acquisition Procedures - Georeferencing - Processing Software - Data Quality, Modelling.

UNIT III TLS APPLICATIONS **9**

Overview of TLS Applications - Topographic Mapping - Asset Management Studies - Tunnel Deformation and Maintenance Studies - Mine: Volume Calculation Studies - Accident/Crime Scene Investigation - Cultural Heritage Preservation Studies - Digital 3D City Model development studies.

UNIT IV BATHYMETRIC LASER SCANNING **9**

Bathymetric Laser Scanners (BLS) - Types of Laser used in BLS - Working Principle of BLS Waveform Analysis - Secchi Depth - Factors affecting Depth of Penetration of BLS - Project Planning: Flying Height, Scanning Speed, Swath Width, and Point Spacing - Data Acquisition - Processing Software.

UNIT V BLS APPLICATIONS **9**

Overview of BLS Applications - Preparation of Nautical Charts - Maintenance Dredging in Ports and Harbors - Submerged archaeological sites in shallow water - Shallow Water Bathymetry studies - Coastal Engineering Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the working principle of Terrestrial Laser Scanner.
CO2: Summarize the Project Planning and Data Acquisition Procedures.
CO3: Understands the applications of TLS in various domains/industry.
CO4: Understands the working principle of BLS.
CO5: Understands the applications of BLS in various domains/industry.

TEXT BOOKS:

1. Yuriy Reshetyuk “Terrestrial laser scanning: Error sources, self-calibration and direct georeferencing”,VDM Verlag (July 9, 2009) Berlin Heidelberg - 2011, ISBN-13: 978-3639175509.
2. George Vosselman, Hans – Gerd Mass, “Airborne and Terrestial Laser Scanning”, Whittles Publishing, 2010. ISBN: 978-1904445-87-6.
3. “Airborne Laser Hydrography – II”, Blue Book II, William Philpot, editor,2019, Available from:https://ecommons.cornell.edu/handle/1813/66666.
4. Jie Shan and Charles K. Toth, “Topographic Laser Ranging and Scanning – Principles and Processing”, 2nd Edition, CRC Press, Taylor and Francis Group, 2018.
5. Pinliang Dong, Qi Chen, “LiDAR Remote Sensing and Applications”, 1st Edition, CRC Press 2018.

REFERENCES:

1. Bahadır Ergün (2011), Prof. Chau-Chang Wang (Ed.). "Terrestrial Laser Scanning Data Integration in Surveying Engineering, Laser Scanning, Theory and Applications",ISBN: 978-953-307-205-0,InTech,DOI:10.5772/14728. Available from:http://www.intechopen.com /books/laser-scanning-theory-and-applications/terrestrial-laser-scanning-data-integration-in-surveying-engineering.
2. Zhilin Li, Qing Zhu, Chris Gold, "Digital terrain modeling: principles and methodology", CRC Press, 2005.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	-	-	3	-	3	-	-	-	-	-	4	-	-
2	3	3	3	3	-	3	3	-	-	-	2	3	4	3	-
3	3	4	3	3	3	-	3	-	-	-	-	3	4	3	3
4	3	3	3	-	-	3	3	-	-	-	-	-	4	3	-
5	3	4	3	3	3	3	3	-	-	-	2	3	4	-	3
AVg.	3	3	3	3	3	3	3	-	-	-	2	3	4	3	3

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GI5022 UNMANNED AERIAL SYSTEM (UAS) FOR LARGE SCALE MAPPING L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Unmanned Aircraft Systems, History, Classification - Advantages - Aerodynamics and Airframe Configurations - Characteristics of Aircraft Types - Design Standards and Regulatory Aspects - Introduction to Design and Selection of the System for applications - Category of UAVs - Fixed wing - VTOL - Quadcopters – Nano, Mini, Micro – Small, Medium, Large – Launching and Landing methods -Hand - Catapult - Water surface - VTOL - civilian and military category classes.

UNIT II UAS HARDWARE AND CONTROL SYSTEMS 9

Components: Wings - Propellers - Sensors - Pitot tubes - Autopilot or manual operating system - IMU - UAS IP datalink - UAV tracking (antenna) - Mimo tracking antenna - Ground control systems - UAV gimbal - Propeller and accessories - Ground detecting sensors - Wing types and systems - Source of energy- Endurance – Range - Controls - PIO feedback - Modems - Memory system - Simulation - Ground test - Analysis – Troubleshooting, Anti-drone systems.

UNIT III PAYLOADS FOR UAS 9

Sensors: Payloads Dispensable Payloads - Non-Dispensable Payloads - Active Payloads - Passive Payloads –- Special sensors for UAV systems - Payloads: RGB, MSS, LiDAR, Microwave, Thermal, Hyperspectral, Magnetometer – Commercially available sensors: Specifications - Selection criteria of Payloads for various applications.

UNIT IV OPERATIONAL AND DATA PROCESSING SOFTWARE 9

Flight planning - Features of mission planning - Intuitive workflow - Polygon of AOI - Automatic 3D flight planning - Photogrammetry based flight simulation - Oblique and Ortho image coverage - Waypoints - Directional take-off - Real-time flight status – Preprocessing of data - Work flow of UAS photogrammetry - Camera model - Purpose of GCP - Point cloud and mesh – ray cloud DSM - Ortho– mosaic, DTM and other products – Commercial and Open source software.

UNIT V APPLICATIONS 9

Topographic mapping - Volume estimation from point cloud - Surveillance - Wildlife Monitoring – Disaster Management - Resource Applications: Forestry, Agriculture, Water, Archeology, Energy, Land, Glacier - Urban planning – Healthcare – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understanding the different types of UAS and their characteristics.
CO2: Synthesize the function of various components.
CO3: Know various payload available for mapping.
CO4: Plan and process UAS based mapping missions.
CO5: Plan and process UAS based mapping missions.

TEXT BOOKS:

1. Vahram Dilbaryan “Investigations about the use of UAV photogrammetry and Laser Scanning: Investigation about UAV Photogrammetry and Laser Scan for control of construction works by comparison with CAD model”, AV Akademikerverlag Publisher, 2017, ISBN: 978- 3639871098.
2. Lauren Newman , “Drones (21st Century Skills Innovation Library: Emerging Tech)”, Cherry Lake Publishing, 2017.
3. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010. ISBN: 978-0-470-05819-0.
4. Paul G Fahlstrom, Thomas J Gleason, “Introduction to UAV Systems”, 4th Edition, John Wiley & Sons, Ltd, 2012. ISBN: 9781119978664.

REFERENCES:

1. Dr. Armand J. Chaput, “Design of Unmanned Air Vehicle Systems”, Lockheed Martin Aeronautics Company, 2001.
2. Kirnon P. Valavanis, “Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy”, Springer, 2007.
3. Robert Nelson, “FLIGHT STABILITY AND AUTOMATIC CONTROL”, 2nd Edition, McGraw Hill Education, 2017, ISBN: 978-0070661103.
   https://www.pix4d.com/education-course-material**.**

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	3	2	-	-	-	-	2	-	2	1	1
2	3	1	2	2	3	1	-	-	-	-	2	-	2	1	2
3	3	1	2	2	3	2	-	-	-	-	2	-	3	2	2
4	3	2	3	2	3	1	-	-	-	-	2	-	3	3	3
5	3	2	2	2	2	3	-	-	-	-	2	-	3	3	3
AVg.	3	1	2	2	3	2	-	-	-	-	2	-	3	2	2

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GI5023 UNDERGROUND AND HYDROGRAPHIC SURVEYING L T P C
3 0 0 3

UNIT I UNDERGROUND SURVEYING 9

Introduction: Purpose, methods, advantages - Underground traversing and its constraints, Correlation of underground and surface surveys by different methods: traversing through shafts, assumed bearing, Weiss quadrilateral, Weiss triangle methods - Estimation of errors.

UNIT II ALIGNMENT AND STOPE SURVEYING 9

Alignment / Gradient control of vertical and inclined shafts, sinking and raising shafts - Gradient control in development openings - Holing surveys - Fixing center lines for shafts - Measuring subsidence - Determining the true and apparent dip and strike from bore hole data - Determining the deviation in the borehole drilling- Stope surveying - Purpose and advantages - Classification of stope surveying - Methods and instruments used - Documentation of underground structures, mining maps.

UNIT III HYDROGRAPHIC SURVEYING 9

Introduction - Shore line survey - Soundings - Datum - Instruments used - Horizontal and vertical controls - Methods of locating soundings - Plotting of soundings - Coast lining - Planning and data processing the tides - Prediction of tides - Tide gauges - Mean sea level as datum - River surveys - Measurement of current and discharge - Bathymetric measurements.

UNIT IV GROUND PENETRATING RADAR SURVEY 9

Electromagnetic principles of GPR - Electrical and magnetic properties of rocks - Soil and fluids - Types of GPR - Measurement configuration - Bands and polarizations - Manual and vehicle mounted GPR - Salient technical features of commercially available GPR - Ground penetrating radar surveys: Reflection survey - Multi source - Multi receiver - Data processing: Dewow - Time - Gain - Deconvolution - Migration - Topographic correction - Signal optimization, modulation, processing and filtration - Modeling and analysis - Processing software (commercially available & RGPR)- Other geophysical surveys for subsurface investigation.

UNIT V APPLICATIONS 9

Applications in ground water resources: Depth to water from the land surface - Archaeological science: Identification and mapping buried structures - Mapping of underground utilities like power cables - Pipelines and other buried utilities - Containment mapping. - Imaging shallow stratigraphy: Delineation of soil profiles to shallow depth - Geological mapping: Depth to bedrock, karst features, groundwater contact.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course the student is expected to be able to

CO1: Plan the underground and hydrographic survey for a given project also capable of extending consultancy service for real time Hydrographic and Mining operations.

CO2: Apply the knowledge of different methods of survey to investigate real underground and hydrographic condition

CO3: Apply the knowledge of survey to measure stope and traverse underground

CO4: Plan the underground and hydrographic investigation program for a given project and also capable of extending consultancy service for real time underground mapping and Foundation Engineering problems

CO5: Apply the knowledge of different methods of exploration to select appropriate methods of boring for investigating real field conditions.

REFERENCES:

1. George Wood Logan, “Elements of Hydrographic Surveying”, Legare Street Press, 2022, ISBN -13: 978-1015494541
2. Ghatak, S., “Mine Surveying and Levelling – Vol I, II & III“, Coal Field Publishers, Asansol, 2005.
3. Harry M. Jol, “GROUND PENETRATING RADAR: Theory and Applications”, 1st edition, Elsevier Science, 2008, ISBN: 9780444533487.
4. Raffaele Persico, “Introduction to ground penetrating radar: Inverse Scattering and Data Processing”, Y John Wiley & Sons, Inc., Hoboken, New Jersey, 2014.
5. Annan A. P, “GPR Methods for Hydrogeological Studies: in Hydrogeophysics”, edited by Y. Rubin and S. S. Hubbard, Springer, The Netherlands,2005, pp. 185-213.
6. Annan A. P, “Ground Penetrating RADAR: Near Surface Geophysics”, Dwain K. Butler, Society of Exploration Geophysicists, 2005, ISBN: 9781560801306
7. Dr. B. C. Punmia , Er. Ashok Kr. Jain , Dr. Arun Kumar Jain, “SURVEYING VOL. II”, 16th Edition, Laxmi Publications, 2019, ISBN: 9788170088837.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	3	2	2	-	-	-	-	-	2	3	1	2
2	3	3	3	3	2	2	-	-	-	-	-	2	3	2	3
3	3	2	3	3	3	2	-	-	-	-	-	2	2	2	3
4	3	3	2	3	3	2	-	-	-	-	-	2	2	3	2
5	3	2	3	2	3	3	-	-	-	-	-	2	3	3	3
AVg.	3	2	3	3	3	2	-	-	-	-	-	2	3	2	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5024 CADASTRAL SURVEYING L T P C

3 0 0 3

UNIT I CADASTRE- INTRODUCTION 9

History of cadastral survey - Types of survey - Tax - Real Property - Legal cadastre - Graphical and Numerical Cadastre, Legal Characteristics of Records - Torrens System.

UNIT II METHODS OF SURVEYING 9

Cadastral Survey Methods - Survey of villages - Instruments used for cadastral survey - Orthogonal, Polar survey methods - Boundary survey - Rectangulation - Town survey - Calculation of area - GPS and Total Station in Cadastral survey.

UNIT III MAINTENANCE AND MEASUREMENT 9

Cadastral survey maintenance - FMS: Manual and digital - Resurveys - Measurement of sub - Division – Measurement of obstructed lines - Survey of urban areas - Control requirement for Urban survey use of Satellite Imagery in boundary fixing - Maintenance of accounts.

UNIT IV LAND INFORMATION SYSTEM 9

land records in India - Digital conversions of records - NLRMP - DILRMP - Smart cities - Current systems - International and nationals - Digital solutions for land records - Examples - Indian initiatives - Tamil nilam.

UNIT V MODERN TECHNOLOGY 9

Current developments - UAV - UAS - Tools and techniques - Laser terrain mapping - Documentation - Data maintenance - Data bases - Block chain technology - Web technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the principles of the Cadastral system, records and taxation.
CO2: Apply various methods used for surveying, mapping and maintenance of cadastral records.
CO3: Know the procedure of maintenance and documentation of land records and the current national developments in this regard.
CO4: Update with modern surveying technology and geospatial solutions for creation, maintenance and documentation of land records.
CO5: Frame the methodology to create and maintain digital cadastre, LIS, etc.

TEXT BOOKS:

1. Peter F.Dale, John D. McLaughlin, “Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries”, Clarendon Press,1988.
2. George M.Cole &Donald A Wilson, “Land Tenure, Boundary Surveys, and Cadastral Systems”, CRC Press, 2016.
3. “Multipurpose Land Information Systems The Guidebook by The FederalGeodetic Control Committee”, US,1989.

REFERENCES:

1. “The (TAMIL NADU) survey and boundaries act - 1923”, Tamil Nadu Act No.VIII.
2. Pertti ONKALO, “Cadastral Survey Methodologies and Techniques in Developing Countries”, 2006.
3. “NLRMP - Guidelines, Technical Manuals and MIS”, 2009.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	2	1	2	1	3	3	1	2	3	2	3	3
2	1	3	2	2	1	2	3	3	1	2	3	3	3	3	3
3	2	3	3	3	3	2	3	3	3	3	3	2	3	3	3
4	3	2	2	3	3	3	2	2	2	3	3	3	3	2	2
5	3	3	3	2	3	3	3	2	3	2	3	2	2	3	3
AVg.	2	2	2	3	2	2	2	3	2	2	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5025 ENGINEERING SURVEY AND MAPPING L T P C
3 0 0 3

UNIT I ROUTE SURVEYING 9

Definition and objectives - Scope of route surveying using geomatics - Reconnaissance, Preliminary survey, Location survey and Construction survey by conventional methods and Geomatics techniques - Case studies of geomatics applications in various types of route surveying projects (e.g., highways, railways, pipelines) - Emerging trends and technologies in geomatics for route surveying.

UNIT II TOPOGRAPHIC SURVEYING 9

Definition, Scope, and Applications of topographic surveying - Surveying Instruments and Techniques - Topographic Data Acquisition - Advanced Topographic Surveying Techniques: Photogrammetry, LiDAR, Unmanned Aerial Vehicles, High-resolution Satellite imagery Analysis - Cost estimation and budgeting - Quality control - Real-world examples of topographic surveying project.

UNIT III ASTRONOMICAL SURVEYING 9

Astronomical terms and definitions - Celestial coordinate systems - Transformation between different coordinate systems - Nautical mile - Spherical excess - Astronomical triangle - Different time systems - Nautical Almanac - Star positions - Major constellations - Culmination, Prime Vertical Crossing and Elongation - Apparent altitude and corrections - Field observations and determination of an azimuth, time, longitude, latitude.

UNIT IV MAP COMPILATION AND ACCURACY 9

Types of maps - Elements of map design - Map layout - Map typography - Map symbolization - Map Production - Map design principles and guidelines - Symbolization principles and guidelines - Design and execution of a mapping project - Methods for assessing positional accuracy - Ground truth data collection and verification techniques - Statistical metrics for positional accuracy assessment - Assessing accuracy in vector and raster data.

UNIT V MAPPING SOFTWARE FOR SURVEYING 9

Introduction to Mapping Software for Surveying - Mapping software to collect, process, and visualize spatial data - Comparison of different mapping software options - Integration of artificial intelligence (AI) and machine learning in mapping software - Case studies of the use of mapping software in surveying - Current trends in mapping software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the principles and concepts of route surveying, including the importance of accurate route determination and alignment
CO2: Generate accurate and detailed topographic maps, including contour maps, planimetric map
CO3: Perform accurate calculations and analysis to determine Terrestrial coordinates.
CO4: Perform data integration and manipulation to ensure consistency and coherence in map compilation
CO5: Understand the principles and concepts of mapping software and its relevance in surveying applications.

TEXT BOOKS:

1. T. P. Kanetkar and S. V. Kulkarni, “Surveying and Levelling, Part 1 & 2”, Pune Vidyarthi Griha Prakashan, Pune, 2010, 24th edition. ISBN-10: 8185825114, ISBN-13: 978-8185825113.
2. Dr B. C. Punmia, Ashok K. Jain and Arun K Jain, “Surveying Vol. I & II”, Lakshmi Publications Pvt Ltd, New Delhi, 16th Edition, 2016. ISBN-10:9788170088530, ISBN-13:978-8170088530.

REFERENCES:

1. R. Subramanian, “Surveying and Levelling”, Oxford University Press, 2nd Edition, 2012. ISBN-10: 0198085427, ISBN-13 : 978-0198085423.
2. James M. Anderson and Edward M. Mikhail, “Surveying, Theory and Practice”, 7th Edition, McGraw Hill 2001. ISBN-10: 0070159149, ISBN-13: 978-0070159143.
3. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004.
4. S. K. Roy, “Fundamentals of Surveying”, 2nd Edition, Prentice Hall of India 2004. ISBN-10: 9788120341982, ISBN-13: 978-8120341982.
5. K. R. Arora, “Surveying Vol I & II”, Standard Book House, 2019. ISBN-13: 9788189401238

6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, 2nd Edition, 2011. ISBN-10: 9788173717406, ISBN-13: 978-8173717406.
7. Arthur H. Robinson et al, “Elements of Cartography”, 7th Edition, Wiley, 2002.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	2	-	-	2	-	-	3	3	3	3
2	3	3	2	3	2	3	-	-	2	-	-	2	3	3	3
3	3	2	3	3	3	2	-	-	2	-	-	2	3	3	3
4	3	2	2	3	3	2	-	-	2	-	-	2	3	3	3
5	3	3	2	2	3	3	-	-	2	-	-	2	3	3	3
AVg.	3	3	2	3	3	2	-	-	2	-	-	2	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL II: GEOSPATIAL DATA ANALYTICS

GI5026 GIS CUSTOMIZATION AND SCRIPTING L T P C
2 0 2 3

UNIT I INTRODUCTION 6+6

Need for customization in GIS - Introduction to customization environments and platforms - Introducing Python - Introducing model builder - Programming basics - Objects, classes, methods, functions, attributes and variables - Introduction to data types and arguments.

UNIT II PROGRAMMING IN GIS 6+6

Objects in GIS - Maps, tables, layers, symbols and features - Programming with objects - Concept of lists, loops, decision structures, strings, inheritance, polymorphism, encapsulation, and abstraction.

UNIT III GIS DATA ACCESS AND MANIPULATION 6+6

Reading attribute data - Accessing data fields - Reading through records - Retrieving records using attribute and spatial queries - Working with cursors - Working with raster data - Events and triggers - Reading and parsing text files - Writing geometries - Working with map documents.

UNIT IV TESTING AND TROUBLESHOOTING 6+6

Testing concepts - Unit testing, integration testing, recursive testing and performance testing - Troubleshooting and identifying problems - Diagnosis - Using the spyder debugger, printing messages from the geoprocessor - Code standardization and optimization technique.

UNIT V GIS DEVELOPMENT FRAMEWORKS 6+6

Introduction to desktop development frameworks (Python, .net, Java) - Web development frameworks (JS, Angular, React, Leaflets) - Mobile development frameworks (Android, IOS, Xamarin) - Database customization frameworks (PL/SQL, Post GIS/Postgres).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO1: Employ different programming languages commonly used in GIS customization and describe how to use these technologies to expand upon existing GIS software functionality.
CO2: Perform object-oriented programming tasks using various programming languages, such as Python.
CO3: Analyze procedures and interactions for workflows within GIS.
CO4: Program small-scale GIS-based models in Python, integrated within a GIS software.
CO5: Recognize and employ general software engineering concepts and good programming methods and practices.

TEXTBOOKS:

1. Paul Berry, "Head First Python", 2nd Edition, 2016.

REFERENCES:

1. Paul A. Zandbergen, "Python Scripting for ArcGIS Pro", 2020.
2. Joel Lawhead, "Learning Geospatial Analysis with Python: Understand GIS Fundamentals and Perform Remote Sensing Data Analysis using Python 3.7", 3rd Edition, 2019.
3. Chaowei Yang, "Introduction to GIS Programming and Fundamentals with Python and ArcGIS", 1st Edition, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	3	2	3	-	-	1	2	1	1	3	2	2	2
2	3	3	3	2	3	-	-	1	2	1	1	2	2	3	2
3	2	2	2	3	3	-	-	1	2	1	1	2	2	3	2
4	2	3	3	2	3	-	-	1	2	1	1	2	2	3	2
5	2	2	1	1	2	-	-	1	2	1	1	2	2	3	1
AVg.	2	2	3	2	3	-	-	1	2	1	1	2	2	3	2

1' = Low; '2' = Medium; '3' = High

GI5027 OPEN SOURCE GIS L T P C
3 0 0 3

UNIT I BASICS 9

Open source software and freeware - Open source licensing models - W3C, WWW and protocols - Software standards and open source GIS - OGC, GDAL and OSGeo, FOSS4G - Open source software for desktop GIS and Web mapping - Proprietary vs open source - OGC standards.

UNIT II DEVELOPMENT ENVIRONMENT 9

Linux, Windows and Mosix: History, Architecture and Salient features - PostgreSQL and database engines - C, C++ and java streams: Concepts, features - GNU - WAP and android stack - Scripts and macros.

UNIT III DATA MODELS FOR GIS 9

View graphics - Data exchanges - Portability and interoperability - Raster handling and image analysis - Vector data management - Raster and vector analysis - 2D/3D vectors with topology, 3D and 2D raster.

UNIT IV DATABASE MANAGEMENT AND USER INTERFACE 9

Files vs database - Distributed operations and architecture - ODBC - Open source database management tools - Database: Spatial and attribute queries, spatial functions and analysis – Map server and Geo server - Database server concepts - PostgreSQL.

UNIT V OPEN SOURCE SOFTWARE FOR WEB MAPPING 9

Open source software: GRASS, QGIS, OSSIM, and R environment - Web mapping architecture and components - Web mapping servers - Thin clients in Web mapping- WMS,WFS,WCS,WPS and restful web services - Open API.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO1: Understand the concepts and protocols used in Open source GIS.
CO2: Know the functionalities of Open source GIS software in Desktop and Web based environments.
CO3: Understand the GIS data models.
CO4: Understand the concepts of DBMS and user interface.
CO5: Acquire the knowledge of open-source software in web mapping.

TEXTBOOKS:

1. Mitchell Tyler, " Web mapping illustrated", O'Reilly Media Inc., 2005, ISBN : 9780596554866.
2. Helena M, "Open source GIS:A GRASS GIS approach",3rd edition, Springer NewYork, 2008.
3. Bill Kropla, "Beginning Map Server: Open Source GIS Development", A press , Springer Verlog, New york, 2005.

REFERENCES:

1. Peng, Z.R. and Tsou, M.H., " Internet GIS : Distributed Geographic Information Services for the Internet and Wireless Networks", John Wiley and Sons, New york, 2003.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	2	1		1	2	2		3	2	2	2
2	3	3	3	2	3	1		2	2	1	2	3	2	2	2
3	2	2	3	2	3	1	1	2	1	1	1	3	3	3	3
4	2	2	3	2	3	1	1	2	2	2	2	3	3	3	3
5	1	1	2	1	3	1	1	2	2	2	1	3	2	2	3
AVg.	2	2	2	2	3	1	1	2	2	2		3	2	2	3

1' = Low; '2' = Medium; '3' = High

GI5028 LOCATION BASED GEOSPATIAL SERVICES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction - Evolution of location based services (LBS)- Components- Spatial location: Coordinate systems, Datums, Map projections- Spatial database and GIS- LBS Standards- Interoperability- Application areas of location based services - Application taxonomy - LBS privacy - LBS markets and customer segments.

UNIT II PLATFORM AND ARCHITECTURE 9

Fundamentals of Positioning**-** Accuracy and Precision- Indoor and Outdoor platform and communication channel: Integrated and standalone, Network and Terminal-based positioning, GNSS, Cellular networks, WiFi, WLAN, Bluetooth, RFID - Data capture and collection - LBS middleware standards (Open GML,KML) - Mobile platform technologies for LBS- LCS Network Architecture.

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UNIT III DATA AND VISUALIZATION TOOLS 9

LBS Data - Crowdsourcing and open street maps , google earth, google maps, bing maps - Content distribution formats - GeoJSON, GeoRSS, KML - Generating KML's dynamically - Location determination: Indoor GPS, network based positioning techniques, short range positioning, hybrid positioning.

UNIT IV LBS APPLICATIONS 9

Vehicle Tracking: Tracking concepts, components of vehicle tracking, online and offline tracking - Alarms used in vehicle tracking, fleet management - Vehicle navigation: Navigation concepts for road, waterways and airways - Components of vehicle navigation, file formats used for navigation - Distress call management.

UNIT V COMMUNICATION & BUSINESS IN LBS 9

Location Intelligence- Web GIS- Communication in LBS: Mobile Mapping System- Maps - Issues - Multi model and context aware modes - Emerging sectors - Emerging products - Standard digitization - Legal and social issues.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the evolution and application of Location Based Services.
CO2: The concepts of Location Based Services and architecture.
CO3: Summarize the tools available for data and visualization of LBS .
CO4: Identify the various feasible LBS applications.
CO5: Identify the various feasible LBS applications.

TEXT BOOKS:

1. Allan Brimicombe, Chao Li, "Location-Based Services and Geo-Information Engineering", August 2009, ISBN: 978-0-470-85737-3.
2. Jochen Schiller & Agnes Voisard, " Location - Based Services", Morgan Kaufmann Publishers, 2004.
3. Richard Ferraro & Murat Aktihanoglu, "Location-Aware Applications", Manning Publications Company, 2011.
4. Syed A. Ahson& Mohammad Ilyas, "Location-Based Services Handbook: Applications, Technologies, and Security", CRC Press, 2010.

REFERENCES:

1. Next Generation Location Based Services for Mobile - Sidney Shek CSC , http://assets1.csc.com/lef/downloads/CSC_Grant_2010_Next_Generation_Location_Based_Services_for Mobile_Devices.pdf

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	3	1	-	-	-	-	-	-	3	2	1
2	3	2	2	1	3	1	-	-	-	-	-	-	3	2	2
3	3	2	2	2	3	1	-	-	-	-	-	-	3	3	3
4	2	2	1	2	1	2	-	-	-	-	-	-	2	3	3
5	3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
AVg.	3	2	2	2	3	2	-	-	-	-	-	-	3		2

1' = Low; '2' = Medium; '3' = High

GI5029 SPACE SYNTAX L T P C
3 0 0 3

UNIT I PUBLIC SPACE AND HUMAN BEHAVIOR 9

Types of space - Foucault's theory - Heterotopic sites - New urbanism, Spatial order, evolution of urban design - Space and human response - Theories of human behavior, the ambient environment - Temperature, sound, smell, illumination, shapers of space, location based visualization, maps and drawing.

UNIT II GEOMATICS PLANNING TOOLS 9

Visualization - 2D and 3D representation of space - High resolution data - Satellites, UAVs, ; Urban land cover classification, decision tree, support vector machines and other machine learning methods; Built up area estimation and urban typology - Population data, trip data, traffic data and network data - Pedestrian and traffic count analysis - Layout analysis - Creating urban land cover / typology map.

UNIT III GIS NETWORK ANALYSIS 9

Network data model - Topology considerations - Network database - Geocoding - Address matching - Time and distance based route analysis - Density maps - Service area analysis - OD matrix - Vehicle routing - Location allocation problems - Creating transportation network for an area.

UNIT IV SPACE SYNTAX METHOD 9

Space and society - Functions of cities - Theory of spatial combinatorics and natural movement - Centrality concept - Extrinsic spatial properties; Space syntax metrics: Convex space, isovist fields, and the axial line - Urban grid, justified graph, depth and total depth analysis: Connectivity, axial integration, global and local radii, syntactic step analysis, recent concepts.

UNIT V APPLICATIONS 9

Sustainable city debate - SDG and space syntax - Accessibility analysis of public facilities - Street network, urban planning, archeology, economy; Hand on qualifying the location suitability of a public utility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understanding the importance of planning of public spaces based on its effect on the human behavior for a justifiable decision on locating and designing public space in an urban area.

CO2: Develop knowledge on geospatial tools and technique for characterizing urban space based on its geometric pattern with remote sensing data.

CO3: Familiarization with the space concepts of urban spaces and topology based geospatial tools for organizing, analyzing and qualifying the urban spaces for and efficient refurbishment.

CO4: Understanding the space syntax concepts, theories and the metrics to characterize urban space based on their stake on human behavior so as to use them as inputs for planning.

CO5: Apply the knowledge in the concepts of space syntax and the tools to have a hands on experience with the available data sets about a city and to apply on other suitable applications.

REFERENCES:

1. B. F. Skinner, "Science and human behavior", Pearson Education, Inc, Library of Congress Catalog Card Number: 53-7045 , 2014.
2. MGH Bell, Y.Lida, "Transportation network analysis", John Willey and sons, ISBN: 0-471- 96493-X.
3. Yosef Sheffi, "Urban Transportation Networks: Equilibrium analysis with Mathematical Programming Methods", Prentice Hall, ISBN: 0-13-939729-9.
4. Akkelies van Nes , Claudia Yamu (2021), "Introduction to Space syntax in urban studies", Springer Link, 2021.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	2	1	1	1	-	-	-	-	-	-	3	2	2
2	3	2	1	1	1	1	-	-	-	-	-	-	3	2	3
3	2	1	1	1	3	1	-	-	-	-	-	-	3	2	2
4	2	1	2	1	2	1	-	-	-	-	-	-	3	2	2
5	2	2	2	1	2	2	-	-	-	-	-	-	3	3	3
AVg.	2	1	2	1	2	1	-	-	-	-	-	-	3	2	2

1' = Low; '2' = Medium; '3' = High

GI5030 GIS BASED UTILITY AND ASSET MANAGEMENT L T P C

3 0 0 3

UNIT I INTRODUCTION 9

History of AM/FM Systems - Moving from CAD to GIS - Introducing key components of Utility GIS - Unique utility GIS requirements - Introduction to various products available in the market towards utility GIS.

UNIT II DATA MODELS 9

Importance and uniqueness of data model for Utility GIS - Introduction to electric data model - Introduction to telco data model - Introduction to gas data model - Introduction to water data model - Introduction to multi utility data model.

UNIT III DATA COLLECTION METHODOLOGIES 9

Identify various data to be collected (Primary, Secondary and Tertiary data sources) - Introduction to mobile mapping data collection - Drone based survey - Door - To -Door survey (for consumer index) etc. - Introduction to quality control framework - Implementation of data governance within an organization.

UNIT IV BUSINESS PROCESS IMPLEMENTATION 9

Identifying business process - Integration with external systems (ERP, EAM, SCADA etc.) - Introduction to typical electric utility business process - Introduction to typical telco utility business process - Introduction to typical gas utility business process - Introduction to typical water utility business process.

UNIT V MODERN SYSTEM FOR SMART UTILITIES 9

Introduction to smart grid initiatives for electric utility - Fiber planning and 5G rollout for telcos , vegetation management using LiDAR/drone imagery via AI/ML systems - Advanced asset identification and management using AI/ML - Building of organizational dashboards using big data and analytics software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Gain a comprehensive understanding of Utility GIS systems, their history.

CO2: Develop proficiency in utilizing data models designed to effectively manage utility data.

CO3: Acquire practical skills in various data collection methodologies for utility GIS applications.

CO4: Apply knowledge of utility business processes useful to optimize utility GIS systems in an organization.

CO5: Gain insights into modern technologies and systems for smart utilities.

TEXT BOOKS:

1. Pat Hohl, Keith Mann, “Delivering Water and Power: GIS for Utilities”, 2021, ISBN-13: 978-1589486751, 2021.
2. Bill Meehan, “GIS for Enhanced Electric Utility Performance”, Artech House Power Engineering, 2013, ISBN-13: 978-1608075591.
3. Bill Meehan, “Modeling Electric Distribution with GIS”, 2013, ISBN-13: 978-1589482418.
4. Bill Meehan, “Empowering Electric and Gas Utilities with GIS”, 2007, ISBN-13: 978-1589480254.

REFERENCES:

1. https://www.ge.com/digital/applications/smallworld-gis-geospatial-asset-management
2. https://www.esri.com/en-us/arcgis/products/arcgis-utility-network/overview
3. https://www.hexagonsafetyinfrastructure.com/products/utilities-and-communications- products/advanced-utility-gis/intergraph-gtechnology

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	1	-	-	-	-	-	-	-	2	2	-	1
2	2	2	2	2	-	1	-	-	-	-	-	-	3	-	1
3	3	3	3	2	3	2	-	-	-	-	-	2	3	3	2
4	2	3	2	2	3	2	-	-	-	-	-	2	3	2	2
5	3	3	2	2	3	1	-	-	-	-	-	2	3	3	2
AVg.	2	3	2	2	3	2	-	-	-	-	-	2	3	3	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5031 **SPATIAL STATISTICS** **L T P C**
3 0 0 3

UNIT I INTRODUCTION 9

Introduction - Datatypes - Visualization - Spatial correlation review of non-spatial statistics - Spatial data - Overview of different types of spatial data - Exploratory spatial data analysis - Grid based Statistics - Metrics point sets - Distance statistics - Data clusters - Spatial autocorrelation - Spatial data visualization and exploration - Introduction to statistical tools needed for spatial analysis.

UNIT II STATISTICAL PARAMETERS AND MODELS 9

Mean and covariance functions - Stationary, isotropic - Matern covariance - Smoothness properties Positive definiteness - Random fields - Parametric models for the spatial correlations - Gaussian processes - Definition - Properties - Representations such as spectral and convolution - Geostatistical modeling: Approaches and models - Exploratory data analysis techniques in geostatistics - Sampling design, sample size and their implications for geostatistical analysis.

UNIT III ESTIMATION AND PREDICTION 9

Variograms and covariance functions - Fitting variogram functions - Variogram models, interpreting, statistical tests, variance decompositions - Maximum likelihood - Bayesian methods - Kriging Spatial Regression - Spatial smoothing - Data visualization - Spatial continuity analysis and modeling - Assessment of uncertainty models.

UNIT IV AREAL AND POINT PROCESS METHODS 9

Areal data: Neighborhoods, testing for spatial association - Global and local tests of association - Autoregressive models (CAR and SAR) inference - Estimation/inference; Grids and image analysis - Auto logistic models - Mapping using GIS; Point process data - Types of spatial patterns, spatial randomness - Spatial clustering and testing for clustering - Models and methods.

UNIT V SPATIAL STATISTICAL MODELS 9

Spatial autocorrelation - Spatial autoregressive models - Spatio temporal data, Spatio-temporal modelling - Markov models, non-separable models - Multivariate data - Bayesian methods for spatial data - Spatial regression and bayesian kriging - Software for geostatistical modeling - Geostatistical case studies for various applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Distinguish different types of spatial data (geostatistical, areal, point process) and understand how spatial autocorrelation plays a role in statistical modeling.
CO2: Apply the knowledge of investigating spatial autocorrelation in real time data.
CO3: Derive properties (covariance, smoothness, stationarity) of models for spatial data.
CO4: Apply the knowledge of spatial models and Bayesian statistics to handle Spatio temporal and Multivariate data.
CO5: Choose the appropriate spatial methods to use for different types of data using statistical software and tools.

TEXT BOOKS:

1. N. A. C. Cressie, “Statistics for Spatial Data”, John Wiley & Sons, 1993 ISBN:9780471002550.
2. Richard Webster, Margaret A. Oliver, “Geostatistics for Environmental Scientists”, John Wiley & Sons, 2007, ISBN:9780470028582.

REFERENCES:

1. Gaetan,C.and Guyon,X , “Spatial Statistics and Modeling”, Springer, 2010.
2. Gelfand, A.E., Diggle,P., Guttorp, P. and Fuentes,M., “Handbook of Spatial Statistics”, CRC Press, 2010.
3. Ricardo A. Olea., “Geostatistics for Engineers and Earth Scientists”, Springer, 1999.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	2	-	-	-	-	-	2	3	1	2
2	3	3	3	3	4	2	-	-	-	-	-	2	3	2	3
3	3	2	3	3	3	2	-	-	-	-	-	2	2	2	3
4	3	3	2	3	4	2	-	-	-	-	-	2	2	3	2
5	3	3	3	2	4	3	-	-	-	-	-	2	3	3	3
AVg.	3	3	3	3	3	2	-	-		-	-	2	3	2	3

1' = Low; '2' = Medium; '3' = High

GI5032 GEOSPATIAL MODELLING AND SIMULATION L T P C
3 0 0 3

UNIT I CONCEPTS OF MATHEMATICAL MODELS 9

Concepts - Types of models – Merits and Demerits - Examples - Modelling assumptions - Choice of equation - Phenomena and model geometry - Choice of variables and parameters - Data and knowledge acquisition - Model building - Calibration and validation - Results, visualization and inference - Development of model – Challenges.

UNIT II ATMOSPHERIC MODELING 9

Study on Atmosphere - Greenhouse effect - Aerosol - Natural and manmade - Ozone depletion - Acid rain - Classification of atmosphere - Modelling of atmosphere - Governing equations weather and climate modelling - Numerical weather prediction model - Global and regional climate models - Air quality model - Gaussian dispersion model.

UNIT III HYDROLOGICAL MODELLING 9

Hydrological cycle - Definition - Various components - Rainfall - Runoff model - Groundwater model - Different types; Lumped and distributed- Areal extent of the model - Boundary conditions - Compilation of geological & hydrological information - Model stresses - Model size & discretization - Finite difference & finite element - Interfacing GIS with groundwater model - Modelling the effect of climate change on water resources.

UNIT IV BIOLOGICAL / ECOLOGICAL SYSTEM MODELLING 9

Environmental modelling - Needs- Physical process - Integrating forest growth model with GIS - Ecological modelling, GIS & expert system - Regional fish species richness model - Introduction to quantitative methods - Landscape ecology.

UNIT V SIMULATION MODEL FOR FOREST MANAGEMENT 9

Types of fires - Empirical approaches to modelling wildland fire - Simulating forest fire regimes - Simulation of broadscale fire - Natural forest landscape disturbance - Forest fire - Timber harvesting - Forest management using decision support system - Developing forest management strategies based on fire regimes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Gain knowledge on concepts for building mathematical models.
CO2: Apply mathematical models in hydrology, Atmosphere; Biological / ecological domains.
CO3: Develop mathematical models for modelling hydrological phenomena.
CO4: Apply Modelling techniques for ecological systems.
CO5: Develop simulations for sufficient management of forests.

REFERENCES:

1. George F. Pinder, "Groundwater modelling using GIS", John Wiley & Sons, New York, 2002.
2. Michale N. Demers, "GIS modelling in Raster", John Wiley & Sons, inc, 2002.
3. Keith C. Clarke, Bradley O.Parks. Michale P.Crane, "GIS & Environmental modelling", Prentice Hall, Inc. New Jersey, 2002.
4. Meyer, Walter J., "Concepts of Mathematical Modeling ", 2004, ISBN 10: 0070417474 / ISBN 13: 9780070417472.
5. Edward A. Bender, "An Introduction to Mathematical Modeling", Dover Publication 2003, ISBN 10: 048641180X / 0-486- 41180-X, ISBN 13: 9780486411804.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	3	1	-	-	-	-	-	-	2	1	2
2	3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
3	3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
4	2	3	3	3	2	3	-	-	-	-	-	-	3	3	3
5	2	3	3	3	2	3	-	-	-	-	-	-	3	3	3
AVg.	2	3	3	3	2	3	-	-	-	-	-	-	3		

1' = Low; '2' = Medium; '3' = High

VERTICAL III - IMAGE PROCESSING AND ANALYSIS

GI5602 SOFT COMPUTING TECHNIQUES L T P C
3 0 0 3

UNIT I SOFT COMPUTING AND ARTIFICIAL NEURAL NETWORKS 9

Soft computing: Introduction - Soft computing vs. Hard computing - Soft computing techniques - Applications of soft computing - ANN: Structure and function of a single neuron: Biological neuron, artificial neuron, definition of ANN, taxonomy of neural net, difference between ANN and human brain, characteristics and applications of ANN, single layer network, perceptron training algorithm, linear separability, widrow & hebbian learning rule/delta rule, ADALINE, MADALINE and BPN.

UNIT II FUZZY SYSTEMS 9

Fuzzy Logic: Fuzzy set theory, fuzzy set versus crisp set, crisp and fuzzy relations - Introduction and features of membership functions, fuzzy rule base system: Fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making.

UNIT III NEURO FUZZY MODELING 9

Adaptive neuro - Fuzzy inference systems - Architecture - Hybrid learning algorithm - Learning methods that cross-fertilize ANFIS and RBFN - Coactive neuro fuzzy modeling - Framework neuron functions for adaptive networks - Neuro fuzzy spectrum.

UNIT IV GENETIC ALGORITHM 9

Genetic algorithm: Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, bitwise operator, generational cycle, convergence of GA, applications & advances in GA, differences & similarities between GA & other traditional method.

UNIT V APPLICATIONS OF SOFT COMPUTING IN GEOMATICS 9

Image registration - Object recognition - Automated feature extraction - Navigation - Integration of soft computing and GIS for flood forecasting and monitoring, landslide susceptibility, highway alignment, smart city planning, agriculture, solid waste disposal.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the concept of soft computing techniques and Artificial Neural Networks.

CO2: Gain knowledge about polarimetric processing concepts.

CO3: Understand the merits of hybrid computing techniques.

CO4: Solve problems using Genetic algorithms.

CO5: Use soft computing methods on multidisciplinary problems.

TEXT BOOKS:

1. Freeman J.A. and Skapura B.M., “Neural Networks, Algorithms Applications and Programming Techniques”, Pearson, 2002.
2. Jang J.S.R., Sun C.T and Mizutani E., “Neuro Fuzzy and Soft computing” , Prentice hall New Jersey, Pearson, 2015.

REFERENCES:

1. JacekZurada.M., “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1992.
2. Timothy J.Ross., “Fuzzy Logic Engineering Applications”, 4th Edition, McGraw Hill, NewYork, 2016.
3. Laurene Fauseett., “Fundamentals of Neural Networks”, Prentice Hall India, New Delhi, 1994.
4. George J.Klir and Bo Yuan., “Fuzzy Sets and Fuzzy Logic”, Prentice Hall Inc, New Jersey, 1995.
5. Nih.J. Ndssen., “Artificial Intelligence”, Harcourt Asia Ltd., Singapore, 1998.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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3	2	2	2	-	3	2	-	-	3	2	-	3	3	2	2
4	3	3	2	2	2	3		-	2	-	-	3	3	3	3
5	3	3	2	2	2	3	-	-	2	-	-	2	3	3	3
AVg.	3	3	2	1	3	2	-	-	2	1	-	2	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5033 THERMAL, HYPERSPECTRAL AND PLANETARY REMOTE SENSING L T P C
3 0 0 3

UNIT I THERMAL REMOTE SENSING 9

History - Thermal infrared radiation principles - Thermal radiation laws - Thermal properties of terrain - Data collection methods - Environmental consideration - Thermal sensors and characteristics - Thermal image characters - Image degradation sources & correction.

UNIT II THERMAL DATA ANALYSIS 9

Interpretation of thermal images, emissivity conservation, thermal inertia considerations, factors affecting analysis of thermal images - Application: Estimation of land surface temperature, geological studies, evapotranspiration, emissivity mapping, sea surface temperature mapping, ET distribution, urban heat island study.

UNIT III HYPERSPECTRAL REMOTE SENSING 9

Diffraction principles - Field spectrum - BDRF and spectral reflectance & imaging spectrometry – Sensors: Characteristics and applications - Virtual dimensionality - Viewing – Image cube, Spectral movie - Hughe‘s phenomenon - Data reduction, calibration and normalization – Red Edge.

UNIT IV HYPERSPECTRAL DATA ANALYSIS 9

Spectral library - Response functions - MNF transformation - Library matching, spectral angle mapper, BBMLC-spectral mixture analysis - End member extraction – Linear mixture model - Spectral unmixing - MIA analysis concepts - PCF, PCA, WPCA spectral transformation - Band detection, reduction and selection principles - Data compression - Applications: Vegetation, soil and mineral.

UNIT V PLANETARY REMOTE SENSING 9

Universe and solar system - Terrestrial planets - Planetary interior, atmosphere, planetary surface - Simple and complex craters - Planetary exploration and missions: Mars global surveyor, Mars express and MRO - Indian missions - Payloads - Moon mineralogy mapper, Thermal emission spectrometer, hySI - Age dating of craters - Spectral signature of minerals - Mineral identification.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the concepts of Thermal Remote Sensing.
CO2: Understand the thermal data analysis and applications.
CO3: Understand the Principles of Hyperspectral Remote sensing.
CO4: Workout Hyperspectral data analysis and Applications.
CO5: Acquire Knowledge at terrestrial planet and applicability of thermal and hyperspectral remote sensing.

TEXT BOOKS:

1. Richards., “Remote sensing digital Image Analysis-An Introduction”, Springer -Verlag, 5th edition 2013.
2. John R. Jenson., “Remote Sensing of the environment”, Pearson, 2011, 2nd edition.
3. Thomas M. LillesandRalph., W.Kiefer and Jonathan W.Chipman., “Remote Sensing and Image interpretation”, JohnWiley and Sons, Inc, New York,2015.
4. Bo Wu, Kaichang Di., Jürgen Oberst., Irina Karachevtseva., “Planetary exploration in Thermal and Hyperspectral data Analysis”, Planetary Remote Sensing and Mapping 1st Edition, CRC Press, 2018.

REFERENCES:

1. Janza,F.Z., Blue H.M.andJohnson., J.E., “Manual of Remote Sensing”, Vol.I, American Society of Photogrammetry, Virginia, USA,2002.
2. Verbyla., David., “Satellite Remote Sensing of Natural Resources”, CRCPress,1995.
3. Paul Curran P.J., “Principles of Remote Sensing”, Longman, RLBS,1988.
4. “Thermal Infrared Remote Sensing Sensors”, Methods, Applications Springer Publication 2013
5. Ruiliang Pu., “Hyperspectral Remote Sensing – Fundamentals & Practices”, CRC Press 2017
6. Deepak Kumar., “Remote Sensing Applications for Planetary Surfaces”, Lambert Academic Publishing, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	1	1	3	-	1	-	-	3	3	1	1
2	2	3	2	2	1	1	3	-	2	-	-	2	3	3	2
3	3	3	1	1	3	1	3	-	1	-	-	3	3	1	1
4	2	3	2	2	3	1	3	-	2	-	-	2	3	2	2
5	2	2	2	2	2	1	3	-	2		-	2	3	2	2
AVg.	2	3	2	2	2	1	3	-	2	-	-	2	3	2	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5034 POLARIMETRY AND INTERFEROMETRY L T P C

3 0 0 3

UNIT I BASICS OF SAR POLARIMETRY 9

Introduction - Electromagnetic waves, pane waves, coherence, polarization ellipse - Polarization types: Circular, elliptical and linear polarization - Amplitude and phase difference - Polarimetric channels: Single, dual, compact, alternative and quadrature polarized waves - Polarimetric representation: Stokes vector and degree of polarization, scattering matrix - Covariance, coherence, stokes and muller matrix - Polarimetry parameters: Total power, co-pol correlation coefficient, co-pol phase difference, degree of polarization and coefficient of variation - Merits and limitations of SAR polarimetry techniques for practical applications.

UNIT II PROCESSING OF SAR POLARIMETRY DATA 9

Polarization synthesis - Polarization Signature: Single, double ,multi-bounce scatterers and bragg scatterer - Coherent polarimetric decomposition methods: Pauli, krogager, cameron decompositions and touzi criterion - Incoherent polarimetric decomposition methods: Freeman, huynen-barnes, eigen vector - Eigen value decomposition - Polarimetric classifications: Unsupervised and supervised classifications, scope of machine and deep learning methods - Overview of data formats and software - Prospective technology and processing trends.

UNIT III BASICS OF SAR INTERFEROMETRY 9

Basics principle - Interference pattern: Point source, constructive and destructive interference - Interferogram - Interference fringe: Intensity and visibility of fringes - Localization of fringes - Complex SAR image - Interferometric data structure/Single Look Complex data - Classes of SAR interferometry - Single pass/across track, repeat pass/along track and differential SAR interferometry - INSAR viewing geometry - Sensitivities and errors**.**

UNIT IV PROCESSING OF SAR DATA FOR INTERFEROMETRY 9

Terrain altitude measurement using INSAR: Baseline estimation, interferogram generation, orbital flattening, phase unwrapping: Branch cuts, fringe detection and absolute phase determination, phase to height conversion, geocoding of DEM - Differential INSAR: - Multipass geometry - Multi-

interferogram techniques: PSINSAR , SBAS and SqueeSAR - 2D-displacement estimation - Precision assessment and validation: Atmospheric contribution, phase noise sources: Look angle and temporal decorrelation effect, volume scattering effect, data availability, software availability, limitations and future trends.

UNIT V MISSIONS AND APPLICATIONS 9

Missions: TerraSAR X, ERS 1and2, ENVISAT, RADARSAT, ALOS, RISAT, Sentinel 1 and GRACE satellite - Polarimetric Applications: Soil tillage, crop productivity - Snow mapping - Sea - Ice structure and type - Forest type mapping - Soil moisture mapping - Soil salinity estimation - Flood/Wetland mapping - Marine winds - Oil slick detection - Ship detection. Interferometric applications vegetation height estimation - Tectonic deformations: Pre, co-and post-seismic deformations - Ground subsidence: Oil and ground water extraction, Mine subsidence - Landslide detection - Reclaimed land monitoring - Glacier monitoring: Regular ice stream movement and tidal flexing of glaciers - Volcanic inflation and deflation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the basic concepts of Polarimetry and Interferometry.
CO2: Acquaint with the concepts of uncertainty and its impacts on artificial intelligence.
CO3: Acquire the knowledge about the fundamentals of SAR Interferometry.
CO4: Learn about the grammetric concepts of Interferometric techniques.
CO5: Familiarize about the applicability of SAR Polarimetry and Interferometry.

TEXT BOOKS:

1. Yoshio Yamaguchi., “Polarimetric SAR Imaging Theory and Applications”, CRC Press, 2023.
2. Michele Crosetto., Lorenzo Solari., “Satellite Interferometry Data Interpretation and Exploitation”, Elsevier, 2023.
3. John R.Schott., “Fundamentals of Polarimetric Remote Sensing”, SPIE press, 2010.
4. P.Hariharan., “Basics of SAR Interferometry”, Elsevier, 2007.

REFERENCES:

1. AlessandroFerretti., “Satellite InSAR data: Reservoir monitoring from Space”, EAGE Publications, 2014.
2. Alessandro Ferretti., Andrea Monti-Guarnieri., Claudio Prati., Fabio Rocca., “INSAR principles: Guidelines for SAR Interferometry processing and interpretation”, ESA Publications,2007.
3. Woodhouse lain. H., “Introduction to Microwave Remote Sensing”, Taylor & Francis, 1st edition, 2006.
4. V. B. H. (Gini) Ketelaar., “Satellite Radar Interferometry- Subsidence Monitoring Techniques”, Springer, 2009.
5. Jong-sen Lee., Eric Pottier., “Polarimetric Radar Imaging :From Basics to Applications”, Taylor & Francis Inc,2009.
6 Ramon F. Hanssen., “Radar Interferometry: Data Interpretation and Error Analysis: 2 (Remote Sensing and Digital Image Processing)”, Springer, 2001.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	3	3	2	-	-	-	-	2	-	-	-	3
2	3	3	3	3	3	2	2	-	3	3	3	3	3	3	3
3	3	2	2	-	-	-	2	-	3	-	2	3	3	3	3
4	3	3	3	3	3	3	3	-	3	3	3	3	3	3	3
5	2	3	3	3	3	3	3	3	3	3	3	2	3	3	3
AVg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5035	AI / DL FOR GEOINFORMATICS	L T P C
		3 0 0 3

UNIT I ARTIFICIAL INTELLIGENCE 9

Foundation of AI and history of AI intelligent agents: Agents and environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation - AI problems - Introduction to Machine and Deep learning - Methods - Difference.

UNIT II EXPLORATORY DATA ANALYSIS 9

Inferential statistics - Hypothesis testing - Spectral divergence - Spectral angle mapper - Spectral correlation analysis - Regression and classification - Supervised learning - Support vector machines - Random forest classifier - Gradient boosting random forest - Gaussian processor - Unsupervised learning - Clusters - k-means - Fuzzy concepts - Probabilistic C-Means - Training date sets - Measures of accuracy: RMS, correlation coefficient, ROC.

UNIT III DEEP LEARNING CONCEPTS AND METHODS 9

Cloud essentials - Github - Concepts - Convolution - Pooling - Activation functions - Tensors - Normalisation - Sampling - Training - Loss function - Optimizer - Inference - Ensemble techniques - Models with multiple sources - Patch based mode vs. fully convolutional mode - Introduction to CNNs - Back propagation algorithm, vanishing and exploding gradients overfitting evolution of CNN architectures: AlexNet, ZFNet, VGG Net, InceptionNets, ResNets, DenseNets.

UNIT IV LEARNING BASED CLASSIFIERS 9

Kernel concepts - Linear regression - Logistics regression - ANN - Feature extraction and selection- Variants of ANN - Backpropagation - Weight update - CNN - Supervised machine learning concepts - Recurrent neural network - Hybrid learning network - Prediction algorithms - Exercise: Building footprint extraction, vegetation classification - developing soil moisture prediction model.

UNIT V CNN METHODS AND APPLICATIONS 9

CNNs for detection: Background of object detection, R-CNN, fast R-CNN, faster R-CNN, YOLO, CNNs for segmentation: Automated pattern recognizition - Types of segmentation: Instance vs semantic segmentation, FCN, Seg- Net, U-Net, Mask-R CNN.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: To provide Knowledge about exploratory data analysis.
CO2: To understand the concept of Artificial Intelligence.
CO3: To understand about learning based classifiers.
CO4: To learn concepts and various methods of deep learning.
CO5: To learn about various applications of CNN.

TEXT BOOKS:

1. S. Russell and P. Norvig., “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2010.
2. T V Geetha, S Sendhilkumar., “Machine Learning Concepts, Techniques and Applications”, CRC Press, 2023. ISBN 9781032268286.
3. Ian J. Goodfellow., Yoshua Bengio., Aaron Courville., “Deep Learning”, MIT Press, 2017.
4. Francois Chollet., “Deep Learning with Python”, Manning Publications, 2021, 2nd edition.

REFERENCES:

1. Bratko., Prolog., “Programming for Artificial Intelligence”, Fourth edition, Addison Wesley Educational Publishers Inc., 2011.
2. M. Tim Jones., “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and Bartlett Publishers, Inc., First Edition, 2008.
3. Phil Kim., “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.

4. Ragav Venkatesan., Baoxin Li., “Convolutional Neural Networks in Visual Computing”, CRC Press, 2017.
5. Mohanty SP., Czakon J., Kaczmarek KA., Pyskir ATarasiewicz P., Kunwar S., Rohrbach J., Luo D., Prasad M., Fleer S., Göpfert JP., Tandon A., Mollard G., Rayaprolu N., Salathe M and Schilling M., “Deep Learning for Understanding Satellite Imagery An Experimental Survey”, 2020 Front. Artif. Intell. 3:534696. doi:10.3389/frai.2020.534696.

CO's-PO's & PSO's MAPPING

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3	3	3	2	2	3		-	-	-	-	-	3	3	3	2
4	3	3	3	2	3	2	-	-	2	2	-	3	3	3	2
5	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
AVg.	3	3	3	2	3	2	-	-	2	2	2	3	3	3	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5036 PATTERN RECOGNITION L T P C
3 0 0 3

UNIT I PATTERN CLASSIFIER 9

Overview of pattern recognition, Types of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayes theorem - Bayesian belief network, naive bayesian classifier, non-parametric density estimation, histograms, kernels, window estimators.

UNIT II CLUSTERING 9

Unsupervised learning - Clustering concept - Hierarchical clustering procedures - Partitional clustering - Clustering of large data sets - EM algorithm - Grid based clustering - Density based clustering.

UNIT III FEATURE EXTRACTION AND SELECTION 9

Boundary detectors and descriptors – Template and feature matching – Texture measures- Entropy minimization – GLCM - Karhunen loeve transformation - Feature selection: Filter, Wrapper and Embedded method - Binary feature selection - K-NN.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINES 9

State machines - Hidden markov models: Maximum likelihood for the HMM, the forward and backward algorithm, sum-product algorithm for the HMM, scaling factors, the viterbi algorithm, extensions of the hidden markov model - Support vector machines: Maximum margin classifiers, relevance vector machines.

UNIT V FUZZY AND ANN METHODS 9

Fuzzy classification: Fuzzy set theory, Fuzzy and crisp classification, fuzzy clustering, fuzzy pattern recognition - Introduction to neural networks: Elementary neural network for pattern recognition, hebb net, perceptron, ADALINE, back propagation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Perform various types of pattern recognition and its applications.
CO2: Carry out unsupervised classification suitable for pattern classification.
CO3: Perform feature selection algorithms and methods of implementing them in applications.
CO4: Carry out Hidden Markov Models and Support Vector Machines for classification.
CO5: Apply various advanced classification methods.

TEXT BOOKS:

1. Andrew Webb., "Statistical Pattern Recognition", Arnold publishers, London, Second edition, 2002.

REFERENCES:

1. C. M. Bishop., "Pattern Recognition and Machine Learning", Springer, Second Edition, 2011.
2. R. O. Duda., P. E. Hart., D. G. Stork., "Pattern Classification", John Wiley, 2001.
3. Narasimha Murthy., V. Susheela Devi., "Pattern Recognition", Springer 2011.
4. Menahem FriedmanAbraham Kandel., "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co. Ltd, 2020.
5. Robert J. Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., 1992.
6. S. Theodoridis., K. Koutroumbas., "Pattern Recognition", Fourth Edition, Academic Press, 2009.

CO's-PO's & PSO's MAPPING

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3	3	3	3	3	3	-	-	-	2	2	-	2	3	3	2
4	3	3	3	2	3	-	-	-	2	2	-	2	3	3	2
5	3	3	3	3	3	-	-	-	2	2	-	2	3	3	3
AVg.	3	3	3	2	3	-	-	-	2	2	-	2	3	3	2

1' = Low; '2' = Medium; '3' = High

GI5037 RASTER DATA MODELLING L T P C
3 0 0 3

UNIT I POINT BASED FUNCTION 9

Image Properties – Reading and writing – Display: Zoom, Pan – Histogram: Brightness, Contrast – Univariate and multivariate statistics –- Pyramids - Enhancements: Linear, Non-linear, scale space transformation- Arithmetic, Boolean and overlay operations.

UNIT II NEIGHBORHOOD AND PROXIMITY ANALYSIS 9

8-, 4-D- Neighborhood, adjancy, connectivity, distance, path - Texture: Types, criteria, statistical metrics, region growing, Buffers (point, line, area) – Co-occurrence matrix, cellular propagation and weighted propogation – Medial axis transformation.

UNIT III AREA DESCRIPTORS/ BOUNDARIES 9

Regions, zonal operators: Single layer and multi-layer operations, Statistical and geometric computation – Area, Shape numbers, Perimeter, Aspect ratio, Boundaries – ROI, subset creation - Point in polygon - Line in polygon - Overlay analysis.

UNIT IV MULTILAYER MODELING 9

Image ratio - Indices – Image Normalization: Mean, Standard deviation based - Image fusion- Similarity measures: Maximum likelihood classification: Feature vectors, Training statistics, supervised and unsupervised- MCDM: AHP, Delphi evidence based Methods.

UNIT V STATISTICAL METRICS 9

Mean - Mode - Standard deviation - Correlation - Regression – Variance, covariance, Co-occurrence - kappa statistics – ROC, AOC - Random, stratified and systematic sample selection – Data quality metrics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course, the student is expected to

CO1: Acquaint with the raster data structure and its relevance in from pint based, neighborhood based and region based geospatial data analysis.

CO2: Understand the various raster based data modeling applied on the earth observation data for resource management.

CO3: Evaluate theprocedures of spatial data handling using raster data model for solving resource management problems.

CO4: Acquire knowledge on the current development, issues methods and solutions in raster data analysis using earth observation data.

CO5: Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of geospatial data modeling.

TEXT BOOKS:

1. “Land Information Management: An Introduction with Special Reference to Cadastral Problems in Third World Countries”, by Peter F.Dale, John D. McLaughlin,1988.
2. “Land Tenure, Boundary Surveys, and Cadastral Systems” by George M.Cole &Donald A Wilson,2016.
3. “Multipurpose Land Information Systems The Guidebook” by The FederalGeodetic Control Committee, US,1989.

REFERENCES:

1. The (TAMIL NADU) survey and boundaries act, 1923, Tamil Nadu Act No.VIII.
2. “Cadastral Survey Methodologies and Techniques in Developing Countries”, Pertti ONKALO, 2006.
3. NLRMP - Guidelines, Technical Manuals and MIS,2009.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	2	1	2	1	3	3	1	2	3	2	3	3
2	1	3	2	2	1	2	3	3	1	2	3	3	3	3	3
3	2	3	3	3	3	2	3	3	3	3	3	2	3	3	3
4	3	2	2	3	3	3	2	2	2	3	3	3	3	2	2
5	3	3	3	2	3	3	3	2	3	2	3	2	2	3	3
AVg.	2	2	2	3	2	2	2	3	2	2	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5038 SUSTAINABLE DEVELOPMENT GOALS AND GEOMATICS LT P C
3 0 0 3

UNIT I SDG EVOLUTION 9

UNDP - Rio Earth summit 1992 - Agenda 21 - Millennium summit - MDGs - World summit on sustainable development - R + 20, rio - Open working group - Post - 2015 Development agenda - 2030 agenda - 2015 agreements and international policy shaping - SDG formulation

UNIT II 17 SDGs 9

SDGs - 17 goals - Targets and indicators global sustainable development report 2019 and 2023 - yearly SDG reports (2016 to 2022) - Capacity development - International scenario - Geospatial capacity in India - Niti Ayog - Cooperative federalism, sub groups and task force - key initiatives - Verticals - Reports - Model agreements - SDG scope in Tamil Nadu - TNAPCC 2

UNIT III SDG - WORLD EXPERIENCE 9

UNDP - Integrated solutions - SDG acceleration tool kits - Global initiative - Covid -19 experience; UN - GGIM - Genesis - Objectives - IAEG-SDGS - Regional committees - Working groups - Build the bridge phases - Collaboration, corroboration and collation.

UNIT IV GEOMATIC TOOLS FOR GIS 9

Geospatial technology - Earth observation - Historical and current sensors and technology -Open and costed data products - Geo portals - Application areas - SDG focus indicators - National datasets - Data portals - GIS - Data assimilation - Modeling capabilities - Statistical dis-aggregation

UNIT V SDG - GEOSPATIAL ROAD MAP 9

Data availability - Focus indicators - Geospatial Indian story maps - Geo-viable SDG indicators - Water availability - Primary productivity - Building index - Land capability maps - Health indices - Land temperature maps - Watershed characteristics - Climate products from satellites - Assessment of SDG matrix

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Appreciate the importance of sustainable development and the understand history of worlds unified effort to achieve through SDG s and the participation of the partner countries including India to achieve the same.

CO2: Understand the relevance of SDG s , the role of the geospatial technology as central idea to realize the SDG s and the status of this technology worldwide.

CO3: Acquire the knowledge about the standard geospatial focus indicators to achieve SDGs and evaluate the methodology to formulate them.

CO4: Acquire knowledge on the current development, issues, methods and solutions in application of geospatial technology in comprehending the SDGs for a better world future.

CO5: Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation efforts and capacity building of geospatial technology to achieve SDGs.

TEXT BOOKS:

1. “The sustainable Development Goals” by United Nations: Department of Public Information, 2018, ISBN - 978-9211013696.
2. Dilip Kumar., R.B. SinghRanjeet Kaur., “Spatial Information Technology for sustainable Development Goals (sustainable Development Goals series)”, ISBN-13, 978-3319580388, Springer, 1st edition, 2019.
3. Rajabifard., Abbas (Editor)., “Sustainable Development Goals Connectivity Dilemma”, ISBN9780429290626, Taylor & Francis, 2022 Open access http:// library.oapen.org/ handle/20.500.12657/24929.
4. SDGs Geospatial roadmap-UN GGIM, https://ggim.un.org/meetings/GGIMcommittee/ 11thSession/documents/The_Geospatial_SDGs_Roadmap_WGGI_IAEG_SDGs_20210804.pdf

REFERENCES:

1. UNDP, INEGI, “The SGD s Geospatial Roadmap”, 2019 – OPEN ACCESS.
2. UNDP, UNHABITAT, GLOBAL TASK FORCE, “Road map for localizing the SDG: implementation and monitoring at sub national level”.
3. WWW.NITIAYOG.IN
4. UNDP, “global consultation draft: strategies pathways”, 2020.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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5	1	3	3	3	3	3	3	3	2	3	2	3	3	3	3
AVg.	3	2	2	2	3	3	3	2	2	2	2	2	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

VERTICAL IV: GEOSPATIAL APPLICATIONS

GI5006 ENVIRONMENTAL GEOINFORMATICS L T P C

3 0 0 3

UNIT I WATER AND THE ENVIRONMENT 9

Sources and demands of water - Characteristics of water - Point and non-point sources of water pollution - Spectral responses of clear and contaminated water - Chlorophyll - Remote Sensing of Water quality assessment - Classification of water quality for various purposes, Sampling procedure, quality analysis, Database creation and quality modeling using GIS. Database Creation and designing water supply network, sewerage network using GIS. Runoff estimation - Flood prediction modeling - Aquifer vulnerability modeling.

UNIT II SOIL CONSERVATION AND MANAGEMENT 9

Formation of Soils - Classification - Landforms - Soil erosion - Factors influencing soil erosion, soil contamination - Distribution and accumulation of contaminants such as toxic metals, synthetic chemicals in soil – Mining pollution - Methods of conservation - Afforestation - EMR responses with contaminated soil - Modeling soil characteristics using satellite data - Soil degradation assessment using Remote Sensing and GIS - Land reclamation.

UNIT III SOLID WASTE MANAGEMENT 9

Definition - Sources - elements of integrated waste management and roles of stakeholders - Seven elements and seven step approach to integrated solid waste management planning, identification of storage and collection location - Analysis of collection route - Site selection: Transfer station, Disposal site - Waste allocation - leachate model - Case studies.

UNIT IV AIR POLLUTION 9

Structure and composition of atmosphere – Sources and classification of air pollutants, Air Quality Standards - Chemical and Physical Components - Sampling - Mapping of atmospheric pollution - Air pollution due to industrial activity - Plume behaviors - Dispersion model: Gaussian Plume model - Introduction to commonly used software-based models such as ADMS, AERMOD, CALINE,

CALPUFF, DEGADIS, HYROAD, INDUSTRIAL SOURCE COMPLEX, SCREEN, HYSPLIT, INDEX etc. - Remote Sensing to monitor atmosphere constituents - Case Studies.

UNIT V SENSORS AND DATA FOR ENVIRONMENTAL MONITORING 9

Sensors for environmental monitoring - sensors - LIDAR- LASER Remote Sensing - EMR - absorption spectrometers - Selection of ground truth sites-sea truth observation - Radar techniques for sensing ocean surface - Thermal measurements - Application of remote sensing for oil slicks mapping - Chlorophyll detection - Fisheries resources - Coastal marine studies - Determination of temperature and sea state.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the possible applications of remote sensing and GIS in water quality analysis and network design.

CO2: Understand the possible applications of remote sensing and for soil conservation.

CO3: Understand the possible applications of remote sensing and for solid waste management.

CO4: Understand the possible applications of remote sensing and for air pollution mapping and modeling.

CO5: Understand the possible applications of remote sensing and for climate change perspectives.

TEXT BOOKS:

1. Susan L. Ustin., "Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley& Sons Inc, 2004.
2. Eric Charles Barrett., Leonard Frank Curtis, " Introduction to Environmental Remote Sensing, Chapman and Hall", 2nd edition, 1982.
3. Andrew N. Rencz., " Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring", John Wiley & Sons Inc, 3rd Edition, 2004.
4. Baretl, E.C. and Culis I.F., "Introduction to Environmental Remote Sensing", 2nd edition, Chapman and Hall, New York, 2013.

REFERENCES:

1. Jr. Lintz, Joseph, David S. Simonett., " Remote sensing of environment Addision Wesley", 1976.
2. Martin Paegelow and María Teresa Camacho Olmedo., "Modelling Environmental Dynamics: Advances in Geomatic Solutions", Springer, 2008.
3. Jonathan Li and Xiaojun Yang., "Monitoring and Modeling of Global Changes: A Geomatics Perspective", Springer Remote Sensing/Photogrammetry, 2015.
4. Robert Scally., "GIS for Environmental Management", ESRI Press, 2006.
5. Andrew Skidmore., "Environmental Modelling with GIS and Remote Sensing", CRC Press, 2017.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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1	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
2	3	3	2	3	3	3	3	1	2	2	2	3	3	3	2
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4	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2
5	3	2	2	3	3	3	3	1	2	2	2	3	3	3	2
AVg.	3	3	3	3	3	3	3	1	2	2	3	3	3	3	2

1' = Low; '2' = Medium; '3' = High

GI5005 TRANSPORTATION GEOMATICS L T P C
3 0 0 3

UNIT I ENGINEERING SURVEYS AND GEOMETRIC DESIGN 9

Classification of roads and railways - Alignment surveys and investigations using conventional and remote sensing techniques (preliminary, reconnaissance and final location surveys) - Types of Highway pavements - Design principles of highway geometric elements.

UNIT II URBAN TRANSPORTATION SYSTEMS AND PLANNING 9

Urban transportation: policy alternatives - Transportation and the environment - Urban transport planning processes - Socio-demographic data and travel surveys - Transportation modelling - Traffic congestion - Plan evaluation and implementation - Planning and financing - Critiques of transportation modelling and forecasting.

UNIT III REMOTE SENSING APPLICATIONS IN TRANSPORTATION 9

Traffic analysis - Accident analysis - Site suitability analysis for transport infrastructure – Population distribution studies - Improving rural road network - Regional road network connectivity - Vehicle tracking - Incident identification and management.

UNIT IV GIS IN TRANSPORTATION ANALYSIS 9

Transportation analysis in GIS: Network flows - Shortest path algorithms: Distance and Cost-based - Transportation databases: creation and maintenance - Facility location: Catchment area analysis - Vehicle routing – Route alignment studies: Raster analysis - Highway maintenance - Case studies.

UNIT V INTEGRATED TRANSPORT MODELS 9

Land use transport interaction models - Transport environment interaction models - Intelligent Transportation Systems (ITS) - Development - Architecture - Integration with GIS, GPS, IOT – Traffic volume estimation and monitoring - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand various highway geometric elements and surveys carried out for highway alignment.
CO2: Understand the factors involved in urban transportation planning.
CO3: Apply remote sensing techniques for transportation problems.
CO4: Apply GIS for transportation analysis.
CO5: Gain knowledge on latest developments in transportation planning.

TEXT BOOKS:

1. Harvey J. Miller., Shih-Lung Shah, “Geographic Information Systems for Transportation – Principles and Applications”, Oxford University Press, 2001.
2. John Stillwell, Graham Clarke., “Applied GIS and Spatial Analysis”, John Wiley & Sons Ltd, 2004.

REFERENCES:

1. Papacostas, C.S, Prevedouros, P.D., “Transportation Engineering and Planning, Prentice- Hall India”, 2015.
2. L.R.Kadiyali., “Transportation Engineering”, Khanna Book publishing Co (P) Ltd, 2021.

3. Jotin Khisty C and B.Kent Lall, “Transportation Engineering-An Introduction”, Prentice Hall of India Private Limited, 2009.
4. Igor Ivan, Itzhak Benenson, Bin Jiang, Jiri Horak and James Haworth., “Geoinformatics for Intelligent Transportation System”, Springer International Publishing AG, 2015.
5. Barry Boots, Atsuyuki Okabe and Richard Thomas., “Modelling Geographical Systems – Statistical and computational applications”, Kluwer Academic Publishers, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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1	2	2	2	2	3	3	3	3	3	2		3	2		
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4	3	3	3	-	2		3	-	-	3	3	3	3	3	3
5	3	3	3	-	3	3	3	-	-	3	3	3	3	3	3
AVg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5016 GEOMATICS FOR HYDROLOGY AND WATER RESOURCES L T P C
3 0 0 3

UNIT I HYDROLOGIC COMPONENTS 9

Hydrologic cycle - Estimation of various components - Clouds: Types of Clouds - rainfall: Types of Rainfall - runoff - evaporation - transpiration - Evapo-transpiration -Interception - Depression storage - Spectral properties of water.

UNIT II SURFACE WATER MODELLING 9

Drainage basin - Delineation and codification of watershed - Morphometric analysis - Hydrological Modelling - Rainfall - runoff modelling - USDA-SCS-CN Method - Urban Hydrology - LiDAR Mapping for Urban area - Impact of Climate change on Hydrological modeling – Water quality mapping and monitoring - Correlation model for pollution detection.

UNIT III RISK AND DAMAGE ASSESSMENT 9

Mapping of snow-covered area - Snow melt runoff - Glacier runoff modelling - Flood forecasting - Flood Risk Zoning - Flood damage assessment - Flood Modelling - Early warning system for Flood mitigation - drought- Types - Assessment of droughts and mitigation – Desertification - Water harvesting methods, Assessments of intervention measures.

UNIT IV GROUNDWATER MODELLING 9

Origin - Classification and properties of aquifer - Ground water potential identification - Surface indicators - Aquifer parameters - Hydrologic budgeting - Different types of Ground water models - Mathematical modelling of groundwater system - Sea water intrusion - Interfacing GIS with groundwater model - Artificial recharge.

UNIT V IRRIGATION AND WATERSHED MANAGEMENT 9

Crop water requirements - Crop Stress: Biophysical Indicators – Irrigation performance assessment - Reservoir Sedimentation Studies - Capacity curve generation - modelling of reservoir siltation – Impact of climate and land use change on drainage basin - Erosion Estimation using Remote sensing - Prioritization of watersheds - watershed modelling for sustainable development.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the challenges faced by the scientific community in the management of water in the past as well as present situations in the face of ever-changing climate and socioeconomic conditions.

CO2: Develop knowledge on the previously used scientific methods and environment development with particular reference to the environment status and scope of geospatial technology to address the WRM issues.

CO3: Comprehend the current research trends and the remote sensing data sources, products and tools that are of value along with their limitations so as to find solutions to the issue of various phenomena and domain of WRM.

CO4: Analyze the complicated and multi-source and layered problems of water resources management with state of the art, tools and techniques for sustained livelihood.

CO5: Apply the knowledge in the conceptualization of extraction and implementation of the Geospatial based solutions sets and to interpret them with tools from ancillary sources for dependable policy making.

TEXT BOOKS:

1. Gert A. Schultz, Edwin T. Engman, "Remote Sensing in Hydrology and Water Management", Springer, 2011.
2. S. K. Gupta, "Modern Hydrology and Sustainable Water Development", John Wiley & Sons, 2010.
3. K. Ramamohan Reddy, B. Venkateswara Rao, C. Sarala, "Hydrology and Watershed Management with a Focal Theme on Ecosystem Resilience - Rural and Urban Water Requirements", 2014.

REFERENCES:

1. Schultz, G. A. and Engman, E. T., "Remote Sensing in Hydrology and Water Management", Springer, 2000.
2. David Keith Todd , "Groundwater Hydrology", John Wiley & Sons, New York, 2nd Edition, 2005.
3. H. M. Raghunath , "Hydrology- principles, Analysis, Design", New Age International, 2000.
4. L. Asawa, "Irrigation and Water Resources Engineering", New Age International, 2008.
5. Andrew Skidmore, "Environmental Modelling with GIS and Remote Sensing", 2017.
6. Dorota Swiatek, Stefan Ignar, "Modelling of Hydrological Processes in the Narew Catchment", Springer Science & Business Media, 2011.
7. Tim Davie, "Fundamentals Of Hydrology", 3rd edition, 2019.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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1	3	-	-	-	3	-	-	-	-	-	-	-	3		
2	3	3	3	-	3	-	-	-	-	-	-	-	3		
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4	3	3	3		2	-	-	-	-	-	-	-	3	2	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
AVg.	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

1' = Low; '2' = Medium; '3' = High

GI5039 **SATELLITE METEOROLOGY** **L T P C**
3 0 0 3

UNIT I ATMOSPHERIC CHARCTERISTICS 9

Meteorology: Definition and types - Origin and Composition of atmosphere - Structure of Standard atmosphere - Distribution of Temperature, Pressure and Density - Distribution of winds: Global wind circulation pattern, Local and Monsoon winds - Aerosols - Conventional measurement of Temperature, Humidity, Wind, pressure and precipitation - Modern meteorological instruments – Surface and Upper air observation network - Doppler weather radar.

UNIT II WEATHER AND CLIMATE SYSTEM 9

Cloud types and formation processes - Precipitation development - Bergeron and Findeison mechanism - Air masses and fronts: Warm, Cold, Stationary and Occluded fronts - Weather charts and symbols - Tropical Cyclones: Influencing factors, Formation, Structure, Life cycle, movement and climatology - Life cycle - Thunderstorms - ElNino -Southern Oscillation - Climatic scales and classification - genetic and empirical approaches.

UNIT III METEOROLOGICAL SATELLITES AND SENSING SYSTEM 9

Polar and Geostationary orbits - Payloads: imaging and non-imaging - Evolution of polar and geostationary satellites: TIROS, NIMBUS, GOES, Meteosat and Metop series - Indian meteorological missions - Current operational satellites: INSAT-3D and INSAT-3DR - Imaging channels: visible,IR, water vapour and shortwave IR - Meteorological image properties - Visual image interpretation.

UNIT IV ATMOSPHERIC SOUNDING 9

Atmopsheric absorption and emission - absorption bands of CO2, water vapour and ozone - Vertical sounding - Radiosonde - Radiative Transfer Modelling- transmittance and weighting function - IR and Microwave sounders - vertical profile retrieval for temperature - aerosol retrieval - Ozone sounding:in-situ measurement, satellite techniques - BUV, occultation, Limb scattering and emission.

UNIT V APPLICATIONS 9

Weather forecasting: Tools and methods - Low pressure system monitoring - DVORAK Cyclone intensity estimation - Cyclone Warning System - Flood and storm surge warning system - Global warming and sea level change - Agrometeorology - Urban meteorology - aviation meteorology - WildFires and Volcanic Ash.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: To gain knowledge about the characteristics of earth atmosphere, meteorological parameters and its conventional observation.

CO2: To understand the various weather and climate processes and phenomena.

CO3: To familiarize about the characteristics and applications of past and current operational meteorological platforms and sensors.

CO4: To acquire knowledge about the principle of atmospheric sounding and vertical profile retrieval methods.

CO5: To analyze and investigate the critical weather and climatic issues and to develop the solutions.

TEXT BOOKS:

1. Chandrasekar.A., “Basics of atmospheric science”, PHI Learning Pvt Ltd, 2010.
2. Stojce Dimov IIcev., “ Global Satellite Meteorological Observation (GSMO) Applications”, Springer, 2018
3. S.R.Kalsi., “Use of Satellite Image in Tropical Cyclone Intensity Analysis and Forecasting”, India Meteorological Department, New Delhi, Meteorological Monograph, Cyclone warning Division No.1/2002.
4. Kidder and VonderHarr., “Satellite Meteorology: An introduction”, Academic Press, 1995.
5. Cracknell., “The Advanced Very High Resolution Radiometer (AVHRR)”, Taylor and Francis Int. Ltd., 1997.

REFERENCES:

1. Asnani, G.C., “Tropical Meteorology”, Vol.I and II, 3rd Edition, 2016.
2. Doviak and Zrnic., “Doppler Radar and Weather Observations”, Dover Publications Inc, 2006.
3. Su-Yin Tan., “Meteorological Satellite Systems”, International Space University, Springer, 2014.
4. Kelkar R.R., “Satellite Meteorology”, B S Publications, 2007.
5. P.J. Robinson., “Contemporary Climatology”, Ann Henderson-Sellers, 2nd edition, 1999.
6. Adarsh Deepak., “Remote Sensing of Atmospheres and Oceans”, Academic Press , 2012.
7. Adarsh Deepak., “Inversion methods in Atmospheric Remote Sensing”, Academic Press Inc, 2012.
8. Kelkar R.R., “Satellite Meteorology”, B S Publications, 2007.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
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5	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
AVg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5017 GEOMATICS FOR DISASTER AND RISK MITIGATION L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Disaster: Definition and Classification – Hydrological, meterological, geological and man-made disasters, characteristics crisis and consequences –Multi hazard disaster risk management – National database for emergency management, relief and rescue operations –Role of earth observation in DRR – International collaboration, satellite communications –Best practices in DRR, etc – Role of Government administration, International disaster assistance.

UNIT II HYDROLOGICAL DISASTERS 9

Hydrological Data Acquisition and Analysis: Rainfall data collection and analysis, Streamflow and river gauge data, Digital elevation models and terrain analysis – Hydrological modeling techniques – Flood hazard mapping and risk assessment– Floodplain delineation and modeling – Real-time flood monitoring, mitigation and early warning systems – Case studies.

UNIT III METEOROLOGICAL DISASTERS 9

Meteorological Data Acquisition and Analysis: Weather station data collection and analysis, Radar data processing and interpretation, Satellite-based meteorological data products, Numerical weather prediction models and data assimilation techniques - Cyclone forecasting, lightening, storm surge modeling, - Analysis & detection - Spatial Modeling and Simulation- Multi-hazard and risk assessment and mitigation in meteorology.

UNIT IV GEOLOGICAL DISASTERS 9

Landslide and earthquake inventory and susceptibility mapping : Data collection, compilation and methods - Statistical and geospatial models - Terrain stability analysis using geospatial data - Landslide and earthquake susceptibility and hazard maps - Early warning systems - Case studies - Geospatial Modeling for Geological Disaster Analysis - Geospatial Techniques for Geological Mitigation and Management.

UNIT V DROUGHTS AND FOREST FIRES 9

Drought indices and indicators for geospatial analysis–Remote sensing data for drought severity and extent mapping – Integration of meteorological and hydrological data for drought monitoring – Geospatial data for forest fire risk assessment – Vegetation mapping and fuel load estimation – Fire behavior modeling and fire danger mapping – Risk Assessment , mitigation and Mapping – Early Warning Systems– Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Gain knowledge on various types of disasters and infrastructural facilities available for managing disasters.

CO2: Plan long term disaster mitigation measures.

CO3: Evaluate the safety of the various social structures.

CO4: Use remote sensing data products for disaster management.

CO5: Apply GIS concepts in disaster management.

TEXT BOOKS:

1. Brian Tomaszewski, "Geographic Information Systems in Disaster Management", Routledge Taylor & Francis Group, 2021.
2. Sisi Zlatanova, Alfred Stein, and Elfriede M. Fendel, "Geoinformatics for Disaster Management" Springer, 2005.

REFERENCES:

1. F.G.Bell., “Geological Hazards: Their assessment, avoidance and mitigation”, SPON, 2007.
2. “Mitigating Natural Disasters, Phenomena, Effects and Options, A Manual for policy makers and planners”, United Nations, 1991.
3. Gupta, Anil.K, Sreeja S, Nair, Bemmerlein-Lux, Florian, Chatterji, Sandhya., “Disaster Management and Risk reduction: Role of Environmental Knowledge", Narosa Publishing House, 2013.
4. Kapur Anu, “Vulnerable India: A Geographical study of Disasters”, IIAS and sage Publishers, 2010.

CO's-PO's & PSO's MAPPING

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AVg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1' = Low; '2' = Medium; '3' = High

GI5040 AGRICULTURE AND FOREST MANAGEMENT USING GEOMATICS L T P C
3 0 0 3

UNIT I CROP INVENTORY AND REMOTE SENSING 9

Introduction - Leaf optical properties - Identification of crops and crop inventorying - crop acreage estimation - Vegetation indices - Yield estimation - Crop production forecasting through digital analysis - Microwave and hyper spectral sensing for crop inventory - Crop monitoring and condition assessment
- Case studies.

UNIT II REMOTE SENSING FOR SOIL 9

Introduction - Soil survey, types of soil surveys - Soil genesis and soil classification - Soil taxonomy - Soil reflectance properties - Soil mapping using remote sensing - Problem soils - Saline, alkali soil characteristics - Mapping of saline alkaline soils-soil erosion and sedimentation - Assessment of soil erosion - Estimation of reservoir capacity.

UNIT III LAND EVALUATION AND MANAGEMENT 9

Introduction - Land use/Land cover definition - Land use/ Land cover classification - Concepts and approaches of land evaluation - Change dynamics - Land capability assessments - Decision support system for land use planning - Optimum land use planning for sustainable agriculture.

UNIT IV DAMAGE ASSESSMENT 9

Introduction - Damage by pests and diseases - Crop loss assessment by floods - Flood hazard zone mapping- Remote sensing capabilities and contributions for drought management - Land degradation due to waterlogging and salinity - Cropstress - Reflectance properties of stressed crops - Identification of crop stress - Agricultural insurance in India - CCIS, ECIS, FIIS and NAIS.

UNIT V FOREST MANAGEMENT 9

Introduction - forest taxonomy - Inventory of forests-forest type and density mapping - Biomass assessment - Timber volume estimation - Factors for forest degradation - Mapping degraded forests deforestation and afforestation - Forest fire mapping and damage assessment - species mapping - sustainable development of forests.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Characterize the crops using Remote Sensing tools.
CO2: The concepts of soil mapping through remote sensing.
CO3: The evaluation of land capability for better land use planning.
CO4: Acquire Knowledge in damage assessment using remote sensing.
CO5: Understand the forest management using remote sensing.

TEXT BOOKS:

1. "Applications of Remote Sensing in Agriculture", Elsevier Science, 2013.
2. Mutlu Ozdogan, Yang Yang., "Remote Sensing of Agricultural crops & Vegetation", Excelic press, 2020.
3. Steve E. Franklin., "Remote Sensing for Sustainable Forest Management", CRC Press, 2001.
4. Srinivas,M.G., "Remote Sensing Applications", Narosa Publishing House, 2001.
5. Andrew Rencz., "Manual of Remote Sensing. Vol.3. Edn.3. Remote Sensing for the Earth Sciences, American Society for photogrammetry and Remote Sensing", John Wiley& Sons, 1999.

REFERENCES:

1. Jensen,J.R., "Remote Sensing of the Environment -An Earth Resource Perspective". Pearson Education India; 2nd edition , 2013.
2. Mahesh Gaur, C.B. Pandey & R.K. Goyal., "Remote Sensing in Natural Resources Monitoring and Management", Scientific Publishers, 2016.
3. Agarwal,C.S. and P.K.Garg, "Remote Sensing in Natural Resources Monitoring and Management", WheelerPublishing, 2000.
4. Narayan,L.R.A., "Remote Sensing and its Applications", Universities Press (India) Ltd., , 2001.
5. A.K.Singh &U.K. Chopra., "Geoinformatics Applications in Agriculture", New India Publishing Company, 2007.
6. Peter James Eredics., "Mapping Forestry", ESRI Press, 2010.
7. Nicholas Baghdadi, Clement Mallet, Mehrez Zribi., "QGIS & applications in Agriculture and forest", John wiley &Sons, 2018.
8. Ravi Shankar Dwivedi., "Remote Sensing of Soils", Springer, 017.
9. G.P.Obi Reddy, S.K.Singh., "Geospatial Technologies in Land Resource Mapping, Monitoring and Management", Springer International Publishing, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	2	2	-	1	1	-	3	3	2	1
2	3	2	3	2	3	2	2	-	1	1	-	2	3	2	3
3	2	2	2	3	2	2	3	1	1	1	-	2	3	2	1
4	2	2	3	3	3	2	3	2	3	2	-	3	3	2	3
5	2	2	3	2	2	2	2	-	2	1	-	2	3	2	2
AVg.	2	2	3	2	2	2	2	2	2	1	-	2	3	2	2

1' = Low; '2' = Medium; '3' = High

GI5018 GEOMATICS FOR OCEAN AND COASTAL APPLICATIONS L T P C
3 0 0 3

UNIT I FUNDAMENTAL OCEANOGRAPHY AND COASTAL PROCESSES 9

Origin and formation of large water bodies - Ocean basins - Oceanic Zones - Ocean Circulations: Global thermohaline, wind driven circulations and currents - Regional Upwelling and eddy development - Waves: structure, characteristics and wave generated currents - Current meters - Tides - Coastal erosional and accretional landforms.

UNIT II SEA WATER CHARACTERISTICS AND MEASUREMENT 9

Heat, Light and sound transmission characteristics - Seawater chemistry - Ocean Biology - Marine food web - Sea water sampling and measurement - NISKIN water sampler and DSRT - CTD profiler CTD rosette - Bathythermograph - XBT - Sediment samplers: Dredge,GRAB and deep sea coring devices.

UNIT III COASTAL HYDRODYNAMICS AND SENSING SYSTEMS 9

Sea water intrusion - Pollution dispersion - Coastal protection structures - Platforms and sensing systems - Payloads - Past and current operational satellites: NOAA, SeaSTAR, Adeos, ERS, Topex/Poseidon, QikSCAT and sentinel 3 - Indian missions: Oceansat1 and 2, SARAL and SCATSAT.

UNIT IV REMOTE SENSING RETRIEVAL AND MAPPING 9

Ocean color remote sensing - Bio-optical algorithm and SeaDAS processing - Sea surface temperature estimation - Sea surface topography mapping: RADAR altimetry and data processing - Sea level Anomaly - Scatterometry:Sea surface wind retrieval and mapping - Bathymetry - Bathymetric LiDAR.

UNIT V COASTAL MANAGEMENT APPLICATIONS 9

Coastal zone management: Critical issues, LU/LC and wetland mapping - Coastal Regulation Zones - Potential Fishing Zone Mapping - Shoreline Change Analysis - Sea Level Rise Monitoring - Cyclone tracking and damage assessment - Tsunami early warning system and damage assessment - Use of SAR images - Ship detection - Oil spill studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the basic concepts of Ocean and Coastal processes.
CO2: Gain knowledge on physical, chemical and biological characteristics of sea water.
CO3: Familiarize about coastal hydro dynamism and operational sensing systems.
CO4: Acquire knowledge on retrieval through remote sensing methods.
CO5: Analyze the applicability of retrievals for solving critical issues and develop strategic management plan.

TEXT BOOKS:

1. Ian.S.Robinson., “Discovering the Ocean from Space: The unique applications of satellite oceanoghraphy”, Springer &Praxis Publishing, 2010.
2. Seelye Martin., “An Introduction to Ocean Remote Sensing”, Cambridge University Press, 2nd edition, 2014.
3. Ian.S.Robinson., “Measuring the Oceans from Space-The principles and methods of satellite Oceanoghraphy”, Springer &Praxis Publishing, 2004.

REFERENCES:

1. Robert Stewart., "Introduction to Physical Oceanography", University Press of Florida, 2009.
2. Motoyoshi Okeda and Frederic W.Dobson., "Oceanographic applications of Remote Sensing", CRC Press, 1995
3. Vasilis D. Valavanis., "Geographical Information System in oceanography & Fisheries", Taylor & Francis London &NewYork, 1st edition 2007.
4. David Halpem., "Satellites, Oceanography and Society", Elsevier Science, 2012.
5. Alasdair J.Edward, "Remote Sensing Handbook for Tropical Coastal Management", UNESCO publishing, 2000.
6. Karsten Mangor, Nils K. Drønen, Kasper H. Kærgaard, Sten E. Kristensen., "Shoreline Management Guidelines", Publisher: Horsholm, DHI Water & Environment, Denmark, 4th edition, 2017
7. L.S.Robinson. "Satellite Oceanography: An introduction for Oceanographers and Remote-Sensing Scientists", John Wiley and Praxis Publishing, 1995.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	-	3	-	-	-	-	-	-	3	3
2	3	2	2	3	2	-	-	3	3	3	2	2	-	-	2
3	2		3	2	3	3	3	3	2	3	3	3	3	3	3
4	3	3	2	3	3	2	3	2	3	3	3	2	3	3	-
5		3	3	3	3	3	3	3	3		3	3	3	3	3
AVg.	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1' = Low; '2' = Medium; '3' = High

VERTICAL V: GEODESY

GI5041 ADVANCED GEODESY L T P C
3 0 0 3

UNIT I GEODETIC NETWORK DESIGN 9

Definition and significance of geodetic control networks - Types of geodetic networks - Components of a geodetic network: stations, observations, constraints - Factors influencing network design: accuracy requirements, terrain, accessibility - Determining optimal control point configurations - Evaluating network reliability and precision.

UNIT II GEODETIC NETWORK ANALYSIS 9

Geodetic network adjustment techniques - Determining the coordinates and heights of unknown points based on measured angles, distances, and other observations - Adjustment models and observation weighting - Solution methods for network adjustment - Software tools for network adjustment - Simulation methods for network design evaluation.

UNIT III GEODETIC HEIGHT 9

Geopotential number - Height systems: orthometric, ellipsoidal, normal, and dynamic height and their correction - Ellipsoidal height and its determination with a single and reciprocal observation of vertical angle - Geoid determination methods - Geopotential models and their role in geoid modelling

- Geoid height determination techniques - Geodetic levelling networks and benchmarks - National and international height reference systems - Applications of geodetic height measurement.

UNIT IV GEODETIC GEOPHYSICS 9

Integration of geodetic observations with geophysical models to study Earth's dynamic processes - Monitoring tectonic plate movements - Crustal deformation - Sea level variations - Geophysical phenomena like earthquakes and volcanic activity - Theory of least squares and variance - Covariance matrices, to detect and analyze small-scale deformations.

UNIT V GEODETIC APPLICATIONS AND GEOSPATIAL ANALYSIS 9

Geodesy for geodynamics, geohazards, geospatial infrastructure, navigation, and mapping - Analysis and processing of geodetic imagery, point clouds, and digital elevation models for geospatial applications - Geospatial analysis techniques, geodatabase management, and integration with Geographic Information Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Create an optimal and reliable network of geodetic control points that enables accurate positioning and measurements on the Earth's surface.

CO2: Gain proficiency in working with different geodetic reference systems, including their definitions, transformations, and compatibility.

CO3: Understand the principles, methods, and applications of geodetic height measurement.

CO4: Investigate various phenomena related to the Earth's shape, gravity field, tectonic movements, and other geophysical processes.

CO5: Utilize geodetic data and geospatial techniques to solve real-world problems.

TEXT BOOKS:

1. Weikko A. Heiskanen and Helmet Moritz.,"Physical Geodesy", W.H.Freeman and Company, 1967.
2. Michele Caputo., "The gravity field of the Earth", International Geophysics Series- Vol-10, Academic Press, 1967.

REFERENCES:

1. Petr Vanicek and Edward J. Krakiwsky., "Geodesy: The concepts", North-Holland Publications Co., 1991.
2. James R.Smith., "Introduction to Geodesy", John wiley & Sons Inc, 1997
3. Tom Herring., "Geodesy", Elsevier, 2009, ISBN: 0444534601.
4. Schwarze, V.S., "Geodesy: The challenge of the 3rd millennium", Springer verlag, 2002
5. Charles D. Ghilani., "Adjustment Computations: Spatial Data Analysis", 6th Edition, 2017., ISBN-10: 9781119385981.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	2	1	1	2	2	1	3	3	3	2
2	3	3	3	2	3	2	2	1	3	2	1	3	3	3	3
3	3	3	2	2	3	2	2	1	2	1	1	3	3	3	3
4	3	3	2	3	2	2	1	1	3	2	1	3	3	3	3
5	3	2	3	3	2	1	1	1	2	2	1	3	3	3	3
AVg.	3	3	3	3	3	2	1	1	2	2	1	3	3	3	3

1- low, 2 - medium, 3 - high,

GI5042 **SATELLITE GEODESY** **L T P C**

3 0 0 3

UNIT I INTRODUCTION 9

Introduction - Classification - Concepts - Historical Development - Reference Coordinate Systems – Time - Keplerian laws of satellite motion- Perturbed Satellite Motion - Orbit Determination - Satellite Orbits and Constellations - Applications.

UNIT II SATELLITE GEODETIC TECHNIQUES 9

Observables and Basic Concepts - Determination of Directions - Ranges and Range Differences (Doppler method) - Interferometric Measurements - Satellites Used in Geodesy - Navigation Payload - PRARE - Planned Satellites and Missions - Electronic Ranging SECOR - Electronic observation techniques - Doppler Effect - Positioning concept - Development of TRANSIT satellites.

UNIT III LASER RANGING AND VLBI 9

Introduction - Satellites with Laser Reflectors - Laser Ranging Systems - Components - Corrections, Data Processing and Accuracy - Applications of Satellite Laser Ranging - Lunar Laser Ranging - Space borne Laser.

UNIT IV SATELLITE ALTIMETRY AND GRAVIMETRY 9

Principle - satellites and missions - Measurements - Data Processing and Accuracy - Corrections - determination of mean sea surface - Applications: Geoid and gravity field determination, Geophysical interpretation, Oceanography and Glaciology - Gravity Field Missions - Concept - Satellite-to-satellite tracking (SST) - High-low mode, CHAMP, Low-low mode, GRACE - Satellite gravity gradiometry - Concept - GOCE mission.

UNIT V GNSS SYSTEM 9

Introduction - Components - Signal Structure - observables - code and carrier phase observation - Ambiguity resolution - Multi path and other observational errors - Cycle slip detection - Positioning: Static - Rapid static and pseudo kinematic; kinematic positioning -. Real time network (VRS) services - Geodetic control surveys- Applications of GNSS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Explain the fundamental concepts and principles of satellite geodesy, including satellite orbits, orbital perturbations, and geodetic reference systems.

CO2: Demonstrate a comprehensive understanding of principles used to determine directions and ranges with geodetic satellites.

CO3: Perform geodetic measurements using satellite laser ranging (SLR).

CO4: Utilize satellite geodesy techniques for precise positioning, gravity field determination, and deformation monitoring.

CO5: Use GNSS based observation for establishment of control networks and utilize it in various applications.

TEXT BOOKS:

1. Seeber G., “Satellite Geodesy”, Walter De Gruyter, Berlin, 2nd edition, 2008.

REFERENCES:

1. Alfred Leick., “GPS satellite surveying, Dover Earth Science”, John Wiley & Sons Inc., 4th Edition, 2015.
2. Guocheng Xu., “GPS Theory, Algorithms and Applications”, Springer – Verlag, 2004.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2
2	3	3	2	2	3	-	-	-	-	-	-	-	3	2	1
3	3	2	2	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	2	1	2	-	-	-	-	-	-	-	3	3	2
5	3	3	2	2	3	-	-	-	-	-	-	-	3	3	2
AVg.	3	3	2	2	3	-	-	-	-	-	-	-	3	2	2

1' = Low; '2' = Medium; '3' = High

GI5043 PHYSICAL GEODESY L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Need to study gravity- historical review- research areas – applications - Potential theory: some vector calculus - attraction and potential - potential of a solid body- Laplace equation – exterior potential field - Poisson equation – interior potential field- spherical harmonics- boundary value problems - Measurement techniques in physical geodesy.

UNIT II GRAVITY FIELD OF THE EARTH 9

Gravitation- gravity- attraction of point mass- attraction of a point mass- rigid body- gravity and shape of the Earth- level surfaces and plumb lines- natural coordinates- Normal gravity: Superposition principle- ellipsoid as an approximation of the Earth- the level ellipsoid- series expansion of the normal gravity field - Earth's gravity field and its modelling Gravity anomalies and geoid determination.

UNIT III GRAVIMETRY 9

Functional of the gravity field - terrestrial gravimetry – absolute and relative- airborne gravimetry - spaceborne gravimetry – gradiometry - torsion balance - gravity networks. Gravity field modelling: The linear model of physical geodesy- disturbing potential and gravity- anomalous potential and gravity - gravity anomalies and their interpretation - gravity reductions- Geoid modelling: The Stokes integral- Koch's formula- Vening - Meinesz formula- Molodensky's approach- practical aspects.

UNIT IV GRAVITY FIELD AND HEIGHT SYSTEMS 9

Statistics of the gravity field: The power spectrum - Kaula's rule of thumb - covariance functions - Height systems: Height measurements - physical and geometric heights and their relationship - height systems around the world- Geoid as a vertical reference frame.

UNIT V TEMPORAL VARIATIONS OF THE GRAVITY FIELD 9

Geophysical effects on gravity - loading theory – tides - hydrological loading - atmospheric loading - ocean loading - ice-mass loading - glacial isostatic adjustment - Earth's rotation and polar motion - Geodetic observations of rotation and polar motion.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the fundamental principles and concepts underlying physical geodesy.
CO2: Familiarize various geodetic measurement techniques used in physical geodesy.
CO3: Develop skills to analyze and interpret geodetic data, including gravity measurements.
CO4: A**c**quire knowledge of earth's gravity field parameters computations.
CO5: Understand the factors affecting the gravity field and their influence.

TEXT BOOKS:

1. Bernhard Hofmann-Wellenhof, Helmut Moritz, and Wolfgang Freeden, “Physical Geodesy”, 2019.
2. Hofmann-Wellenhof- B and Moritz- H, “Physical Geodesy”. Springer Vienna. Doi: 10.1007/978-3-211-33545-1, 2006.
3. Thomas H. Meyer, “Introduction to Geometrical and Physical Geodesy: Foundations of Geomatics”, ESRI press. 2010.
4. Wolfgang Torge and Jürgen Müller, “Geodesy”,De Gruyter, 2012.
5. Martin Vermeer, “Physical Geodesy”Aalto University Publication Series, 2020.

REFERENCES:

1. Torge- W. “Geodesy”. 3rd edition. Walter de Gruyter. Berlin, 2012.

2. Vanícek- P and Krakiwsky- E. “Geodesy: The Concepts”. 2nd edition. Elsevier Science. 2015.

3. Zhiping Lu, Yunying Qu, Shubo Qiao, ”Geodesy: Introduction to Geodetic Datum and Geodetic Systems”, Springer Berlin, Heidelberg, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	3	2	1	1	2	2	1	3	3	3	2
2	3	3	3	3	3	2	2	1	3	2	1	3	3	3	2
3	3	3	2	2	3	1	2	1	2	1	1	3	3	3	3
4	3	3	2	3	2	2	2	1	3	2	1	3	3	3	3
5	3	2	3	3	2	1	1	1	2	2	1	3	3	3	3
AVg.	3	3	3	3	3	2	2	1	2	2	1	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5044 GEODETIC INTERFEROMETRY L T P C
3 0 0 3

UNIT I INTRODUCTION 9

History - Overview - Basics of interferometry - Interferometric base line - Differential interferometry - Phase unwrapping - Correlation.

UNIT II GEODETIC INTERFEROMETRY TECHNIQUES 9

ScanSAR interferometry - Solutions for baseline and source position vectors - Phase Referencing - Position - Frequency - Precession and Nutation - Measurement of Polar Motion and UTI.

UNIT III GEODETIC MEASUREMENTS 9

Geodetic Measurements - Proper Motion and Parallax Measurements - Solar Gravitational Deflection - Imaging Astronomical Masers - Least-Mean-Squares Analysis - Second-order effects in phase referencing.

UNIT IV VLBI IN GEODETIC INTERFEROMETRY 9

Introduction - VLBI elements - Techniques - Space segment - Propagation media - Ground segment - Interferometer and interferometric principle - Carrier of interferometer baseline- Determination of observables - Precision and analysis of group delays.

UNIT V DATA ANALYSIS 9

Automated geodetic VLBI - Antenna and receiving systems - Data acquisition systems - Monitoring and control systems - Observations - Data reduction and analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Apprehend the fundamentals of interferometry.
CO2: Identify various interferometric techniques.
CO3: Understand different geodetic measurements for Geodetic observations.
CO4: Comprehend the components and working principle of VLBI.
CO5: Summarize the methods for VLBI data analysis and reduction.

REFERENCES:

1. Alef.W Felli, M., and Spencer, R.E., Eds., Kluwer, Dordrecht., (1989), "Introduction to Phase-Reference Mapping in Very Long Baseline Interferometry: Techniques and Applications", pp. 261–274.
2. Backer, D.C., and Sramek, R.A., 1999, "Proper Motion of the Compact, Nonthermal Radio Source in the Galactic Center, Sagittarius A", Astrophys. J., 524, 805–815.
3. Bailer-Jones, C.A.L., 2015, "Estimating Distances from Parallaxes", Publ. Astron. Soc. Pacific, 127, 994– 1009.
4. Bartel, N., Bietenholz, M.F., Lebach, D.E., Ransom, R.R., Ratner, M.I., and Shapiro, I.I., 2015, "VLBI for Gravity Probe B: The Guide Star", IM Pegasi, Class. Quantum Grav., 32, 224021 (21pp).
5. Bartel, N., Ratner, M.I., Shapiro, I.I., Cappallo, R.J., Rogers, A.E.E., and Whitney, A.R., 1985, "Pulsar Astrometry via VLBI", Astron. J., 90, 318–325.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	2	-	1	-		-	-	2	2	1	1
2	3	2	2	2	1	-		-	2	-	-	2	3	2	2
3	3	3	2	2	3	-	1	-		-	-	2	3	2	2
4	3	3	2	2	3	-		-	2	-	-	2	2	2	2
5	3	3	1	2	2	-	1	-		-	-	2	3	2	3
AVg.	3	3	2	2	2	-	1	-	2	-	-	2	3	2	2

1' = Low; '2' = Medium; '3' = High

GI5045 ENVIRONMENTAL GEODESY L T P C
3 0 0 3

UNIT I THE EARTH SYSTEM 9

Systems approach to studying Earth, climate and weather systems, mass distribution, transport and exchange in the Earth system, impact of physical processes on the geometry and gravity of the Earth, loading theory and the sea level equation.

UNIT II OBSERVATION TECHNIQUES IN GEODESY 9

Geometric techniques - Total Stations, strain meters, tide gauges, Global Navigation Satellite Systems, satellite laser ranging, very long baseline interferometry, satellite altimetry (radar and laser), interferometric SAR; Gravimetric techniques - Absolute gravimetry, relative gravimetry, satellite gravimetry - CHAMP, GRACE and GOCE.

UNIT III TIDES AND HYDROLOGICAL OBSERVATIONS 9

Gravitational interaction of the Sun, Moon and the Earth, ocean tides, atmospheric tides, solid Earth tides, Doodson numbers, Water storage change, soil moisture, river runoff and lake levels, groundwater variability.

UNIT IV OCEANOGRAPHIC AND CRYOSPHERIC OBSERVABLES 9

Sea surface topography and the mean sea level, ocean currents, ocean mass redistribution, ocean bathymetry, sea ice thickness observations, ice mass balance, glacier thickness and drift.

UNIT V ATMOSPHERIC AND SOLID EARTH OBSERVABLES 9

Total precipitable water, ionospheric total electron content, atmospheric circulation and mass redistribution, elastic, viscoelastic and episodic deformation and gravity responses to geodynamic processes like plate tectonics, earthquakes and volcanic activity - Tsunami early warning, atmospheric /ionospheric seismology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Summarize the concept of the earth system and processes influencing the system.
CO2: Explore various geodetic techniques for observation of the earth system.
CO3: Identify the observations used for measurement of tides and hydrological parameters.
CO4: Identify the observations used for measurement of Ocean and Cryospheric parameters.
CO5: Identify the observations used for measurement of Atmospheric and Solid earth parameters.

REFERENCES:

1. Lambeck, K., (1989). Geophysical Geodesy. Oxford University Press.
2. Lambeck, K. (1980)., " The Earth's variable rotation: Geophysical causes and consequences", Cambridge University Press.
3. Christopherson, Geosystems 8th edition, Pearson Prentice Hall,2010.
4. Stammer, D. and Cazenave, A., Satellite Altimetry over oceans and land surfaces (2017).

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	1	2	1	1	-	-	1	-	-	-	2	1	1
2	3	1	2	3	3	1	1	-	1			-	3	3	2
3	3	2	1	3	2	-	2		1	-	-	-	2	2	2
4	2	2	2	3	2	-	2	-	1	-	-	-	2	2	2
5	2	2	2	3	2	1	1	-	1	-	-	-	2	2	2
AVg.	2	2	2	3	2	1	2	-	1	-	-	-	2	2	2

1' = Low; '2' = Medium; '3' = High

GI5046 GEODETIC CONTROL SURVEY AND ADJUSTMENT L T P C
3 0 0 3

UNIT I HORIZONTAL CONTROL SURVEYING 9

Definition - Uses and establishment of horizontal control - Methods: Triangulation, traversing and trilateration - Classification and accuracy - Instruments: Theodolite, total Station and GNSS - Pre-analysis procedure - Survey tolerances - Selection of survey instrument - Horizontal control point selection and distribution - Field procedure for triangulation, traversing and trilateration: Horizontal angle measurements methods - Baseline measurement - Elimination of blunder and systematic errors - Computation of weight of observation for length and angle.

UNIT II ADJUSTMENT OF HORIZONTAL CONTROL 9

Introduction - Simple adjustment methods - Error propagation and linearization - Least squares adjustment method for triangulation, traversing and trilateration - Least squares adjustment of indirect Observations - Least squares adjustment of observations only - Geodetic network design principles - Network adjustment and analysis for horizontal control - Adjustment software and tools.

UNIT III VERTICAL CONTROL SURVEYING 9

Definition - Uses and establishment of vertical control - Methods: Spirit levelling, Reciprocal levelling, trigonometric levelling, GNSS Surveying and precise Levelling - Classification and accuracy - Instruments: Dumpy level, tilting level, auto level, digital level, total Station and GNSS - Field procedures for measurement and data collection - Elimination of blunder and systematic errors - Computation of weight of observation - Geoid modeling.

UNIT IV ADJUSTMENT OF VERTICAL CONTROL 9

Introduction - Simple adjustment methods - Error propagation and linearization - Least squares adjustment method for level net and trigonometrical leveling - Least squares adjustment of indirect observations - Least squares adjustment of observations only - Geoid modeling and its applications - Network adjustment and analysis for vertical control - Network densification techniques - Adjustment software and tools.

UNIT V COORDINATE COMPUTATION 9

Plane and spherical coordinate system - Computation of plane coordinate for horizontal control point of triangulation, traversing and trilateration stations - Computation of spherical coordinate for horizontal control point of triangulation, traversing and trilateration stations - Computation of bearing and length from plane coordinates - Computation of forward azimuth, backward azimuth, and length from spherical - Coordinates - Report writing and documentation standards - Presentation and visualization of survey results

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the concepts and principles of geodetic control surveying
CO2: Apply appropriate surveying methods and techniques for establishing geodetic control points
CO3: Analyze and interpret geodetic control survey data.
CO4: Perform adjustments of survey measurements using various adjustment techniques.
CO5: Utilize geodetic software tools for data processing and adjustment

TEXT BOOKS:

1. Mikhail, E.M. and Gracie G., “Analysis and adjustment of Survey measurements”, Van Nostrand Reinhold, New York, 2007., ISBN-10 : 0442253699.
2. Charles D. Ghilani., “Adjustment Computations: Spatial Data Analysis” 6th Edition, 2017, ISBN-10: 9781119385981.

REFERENCES:

1. Subramanian. R., “Surveying and Levelling”, Oxford University Press, Second Edition, 2012. ISBN-10: 0198085427, ISBN-13 : 978-0198085423
2. James M., Anderson and Edward Mikhail., “Surveying, Theory and Practice”, Seventh Edition, McGraw Hill 2001. ISBN-10: 0070159149, ISBN-13: 978-0070159143
3. Bannister and S. Raymond., “Surveying”, Seventh Edition, Longman 2004. ISBN-10: 0582302498, ISBN-13: 978-0582302495
4. S. K. Roy., “Fundamentals of Surveying”, Second Edition, Prentice, Hall of India 2004. ISBN-10: 9788120341982, ISBN-13: 978-8120341982
5. K. R. Arora., “Surveying Vol I & II”, Standard Book House, 2019. ISBN-13: 9788189401238
6. C. Venkatramaiah, “Textbook of Surveying”, Universities Press, Second Edition, 2011. ISBN-10: 9788173717406, ISBN-13: 978-8173717406

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	3	2	1	1	2	2	1	3	3	3	3
2	3	3	3	3	3	2	1	1	2	2	1	2	2	3	3
3	3	3	3	2	3	2	2	1	2	1	1	3	3	3	3
4	3	2	2	3	2	2	1	1	3	1	1	3	3	3	3
5	2	3	3	3	3	2	1	1	3	2	1	3	3	3	3
AVg.	3	3	3	3	3	2	1	1	2	2	1	3	3		3

1' = Low; '2' = Medium; '3' = High

GI5047 GEODETIC ASTRONOMY L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Definition and application of geodetic astronomy - Spherical trigonometry - Spherical excess- Celestial sphere - Definition of terms in astronomy - Solution of astronomical triangle celestial coordinate systems

UNIT II CELESTIAL COORDINATE SYSTEM 9

Celestial coordinate system: Horizon system - Hour angle system - Right ascension system - Ecliptic system and their inter-transformations - Derivation and problems: Variation in celestial coordinates: precession - Nutation and polar motion - Reduction of star position

UNIT III TIME SYSTEMS 9

Sidereal time - Universal time - Relation between sidereal time and universal time - Irregularities of rotational time systems - Proper motion time systems: solar - Sidereal - Ephemerides - Atomic - Time dissemination - The astronomical basis of time keeping and time recording - Rotational time systems: UT0- UT1- UT2 and UTC- Polar motion CIO - Earth rotation - Leap second

UNIT IV DETERMINATION OF POSITION AND ASTRONOMIC AZIMUTH 9

Determination of astronomic azimuth - Latitude and longitude - Azimuth by star hour angle and star altitudes - Latitude by meridian zenith distance and polaris at any hour angle - Longitude by meridian transit distance

UNIT V STAR CATALOGUES AND APPLICATION OF GEODETIC ASTRONOMY 9

Historical and types of star catalogues - Ephemerides - Time span - Observer location - Target body- almanacs - Star almanacs for land surveyors - Astrometry: Precise positions - Angular proper motions and parallaxes of celestial sources - Application of Geodetic Astronomy: Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Develop a comprehensive understanding of geodetic astronomy principles and techniques.

CO2: Gain proficiency in converting between different celestial coordinate systems using appropriate mathematical methods.

CO3: Understand different time systems and their relationship to astronomical observations.

CO4: Acquire knowledge and skills in determining astronomic azimuths, latitudes, and longitudes using star observations.

CO5: Apply the concepts and methods of geodetic astronomy for precise positioning and geodetic applications.

REFERENCES:

1. Torge, W., (2001) Geodesy, 3rd edition, Walter de Gruyter.
2. Vanícek. P and Krakiwsky. E., (1986). Geodesy: The Concepts 2nd edn, Elsevier.
3. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 2nd edition 2008.
4. Kaula, W.M. (2000). Theory of Satellite Geodesy: Applications of Satellites to Geodesy. Dover Publications.
5. Montenbruck, O. and Gill, E (2000). Satellite Orbits. Springer – Verlag, Berlin, 2003.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	3	-	-	-	-	-	-	-	3	2	1
2	3	3	3	2	1	-	-	-	-	-	-	-	3	3	2
3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	2
4	3	2	2	2	1	-	-	-	-	-	-	-	3	2	2
5	2	3	2	1	2	-	-	-	-	-	-	2	3	2	1
AVg.	3	3	2	2	1	-	-	-	-	-	-	2	3		2

1' = Low; '2' = Medium; '3' = High

VERTICAL VI: GEOINTELLIGENCE

GI5048 DIGITAL TWINS AND BIM L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction to technologies - Computational tools in science and technology - From computational techniques to digital twins - Different tools in digital twins - Applications, opportunities, and challenges influencing digital twins - DT modelling and simulation - Review of various DT models (static versus dynamic) - Digital twins platform ecosystem and the business context/advantages of digital twins - Risks and challenges.

UNIT II DESIGNING AND DEPLOYING DIGITAL TWINS 9

Digital twins terminologies & essentials - Working of digital twins - Digital thread - Digital shadow - Digital twins building blocks - Digital twins technology drivers & enablers - Types of digital twins, based on product, process, based on functionality, based on maturity - Characteristics of a good digital twins platform - Use of artificial intelligence (AI) in developing and deploying digital twins.

UNIT III SIMULATION AND MODELLING 9

Simulation techniques with digital twins - Simulation techniques for digital twins: Agent-based modelling, systems dynamics, discrete event simulation - Modelling digital twins using augmented reality (AR), virtual reality (VR), and other strategies for complex problems - Applying digital twins to model based design - Implementing digital twins - Application of digital twins to real-life problems.

UNIT IV INTRODUCTION TO BIM 9

Building components and systems (architectural, MEP, structural) - Building drawings, specifications - Building design process - Definition of BIM - History of BIM - BIM on the architecture and engineering disciplines - BIM as a part of the e-building design process - BIM vs 3D CAD - Evolution and development of BIM & object-based parametric modeling - BIM platforms.

UNIT V BIM MODELING AND APPLICATIONS 9

Mass and concept modeling - Detailed modeling - Creating, importing and modifying families of objects and elements - Architecture, MEP and structural applications - Creating plans, sections, details, schedules, cover page - Circulation (stairs, pathways, etc.) - Documentation - Applications of BIM in cost estimating, energy modeling, conflicts/interference checking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Describe the digital technologies for industrial visualization such as digital twins, extended reality, and artificial intelligence.

CO2: Understand the potential of digital twins in the context of design of complex systems.

CO3: Model the architecture, identify the functions and understand the necessary steps of data gathering and data preparation to develop a digital twins application.

CO4: Design basic building components and employ parametric modeling in 3D design.

CO5: Understand applications of BIM, such as cost estimation, architectural renderings, interference checking, and modeling of energy consumption.

REFERENCES:

1. Elaine Durtsche, "Digital Twin Technology: Twins Digital Technology and Industries", 2022. ASIN : B09PM9KVTD
2. Garber, Richard, "BIM Design: Realizing the Creative Potential of Building Information Modeling", AD Smart 02. Chichester, U.K.: Wiley, 2004.
3. Kim, Marcus, Lance Kirby, and Eddy Krygiel, "Mastering Autodesk Revit 2017 for architecture". 1st edition INpolis, IN: John Wiley & Sons, 2016.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	4	3	4	2	-	-	-	-	1	4	3	4	2
2	3	3	4	3	3	3	-	-	-	-	2	4	3	3	3
3	3	3	4	3	3	2	-	-	-	-	3	3	2	4	3
4	3	3	4	3	4	3	-	-	-	-	3	4	2	3	2
5	3	3	4	2	3	3	-	-	-	-	3	3	3	3	3
AVg.	3	3	4	3	3	2	-	-	-	-	3	3	3	3	3

1' = Low; '2' = Medium; '3' = High

GI5049 BIG DATA ANALYTICS FOR GEOMATICS L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Concept of geospatial big data - Spatial database - Sources - Satellites, UAV mounted cameras , Distributed sensors, GPS enabled devices - Volunteer Geographic Information platforms - Address linked public records - Crowdsourced geospatial data - Challenges and opportunities - Geospatial data analysis tasks - Geospatial big data storage and processing solutions - Distributed data management platforms.

UNIT II GEOSPATIAL BIG DATA ANALYTICS 9

Scalable geospatial data pipeline - Automated downloading - High performance computing - Processing Cross-Domain data fusion - Knowledge extraction - Geovisualization and geovisual analytics - Interactive analysis - Proactive Location intelligence, geospatial OLAP, CEP engine - Batch analysis - Analysis extension, big data statistics, data mining - Theme analysis - Geospatial big data integration and management.

UNIT III BIG GEO-AI 9

Big geospatial AI - Multimodal spatio-temporal datasets - Temporal dynamics of big data - Geospatial knowledge construction - Remote sensing scene understanding - Semantics - Classification and regression methods - Machine and deep learning methods - SVM, RF, GBRT, gaussian processor, CNN, RNN, feed-forward neural networks - Hybrid models - Model development and selection - Cloud-Based machine and deep learning frameworks - Automated training database generation - Automated mapping and feature extraction.

UNIT IV CLOUD SERVICES FOR GEOSPATIAL BIG DATA 9

Geospatial big data storage and processing solutions - Geospatial big data visualization methods and tools - GIS cloud - Application and technology model - Geodata and the cloud - Advantages of GIS hosted on a cloud - ETL processes - Geospatial big data mining - Hadoop and MapReduce frameworks - Spark and stream data processing - Cloud-based databases and web editing - Amazon EC2, Esri's cloud-based GIS SaaS, Google Earth Engine (GEE), GEE with QGIS, Microsoft Planetary Computer (MPC), Big Query, Vertex AI, Cloud SQL, Dataproc, Web editing: Opportunities and challenges - Cloud computing for geospatial big data analytics - Geospatial cloud partners.

UNIT V CASE STUDIES 9

3D Visualization of digital twins cities - Geospatial spectral solutions - Urban flood mapping and damage assessment - Geo-statistical modeling for landslides - Agriculture - City dynamics from crowdsources dataset - Cryosphere - Land use and land cover - Forest - Climate change.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the various data sources and database management platforms of the big geospatial data.

CO2: Learn and explore the scalable solutions available for processing and analyzing geospatial big data.

CO3: Understand the role of AI in geospatial big data analytics.

CO4: Attain knowledge of various state-of-the-art open-source and commercial cloud computing platforms available to handle big geospatial data.

CO5: Appreciate the opportunities of geospatial big data analytics by exploring case studies of various application areas to better understand the potential real-world impact of this field.

TEXT BOOKS:

1. Durbha, S.S., Sanyal, J., Yang, L., S Chaudhari, S., Bhangale, U., Bharambe, U., & Kurte, K., "Advances in Scalable and Intelligent Geospatial Analytics: Challenges and Applications (1st edition), 2023. CRC Press. https://doi.org/10.1201/9781003270928.

REFERENCES:

1. Yu, J., Sarwat, M. 2021., "Big Geospatial Data Processing Made Easy: A Working Guide to GeoSpark. In: Werner, M., Chiang, YY. (eds) Handbook of Big Geospatial Data", Springer, Cham. https://doi.org/10.1007/978-3-030-55462-0_2
2. Moya, D., Giarola, S., Hawkes, A. 2021, "Geospatial Big Data analytics to model the long-term sustainable transition of residential heating worldwide", IEEE International Conference on Big Data (Big Data), Orlando, FL, USA, 4035-4046. https://doi.org/10.1109/Big Data 52589.2021.9671339.
3. Sassite,F., Addou, M., Barramou, F. 2020, "A smart data approach for Spatial Big Data analytics", IEEE International conference of Moroccan Geomatics (Morgeo), Casablanca, Morocco, 1-6. https://doi.org/10.1109/Morgeo49228.2020.9121920.
4. Lenka, R. K., Barik, R. K., Gupta, N., Ali, S. M., Rath, A., Dubey, H. 2016, "Comparative analysis of Spatial Hadoop and GeoSpark for geospatial big data analytics", 2nd International Conference on Contemporary Computing and Informatics (IC3I), Greater Noida, India, 484-488. https://doi.org/10.1109/IC3I.2016.7918013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	3	-	-	-	3	-	-	3	3	1	1
2	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2
3	3	3	3	3	3	-	-	-	3	-	-	3	3	3	3
4	3	1	1	2	3	-	-	-	3	-	-	3	3	2	1
5	2	3	1	1	2	-	-	-	3	-	-	3	3	3	1
AVg.	3	2	2	2	3	-	-	-	3	-	-	3	3	2	2

1' = Low; '2' = Medium; '3' = High

GI5050 IOT APPLICATIONS IN GEOMATICS L T P C

3 0 0 3

UNIT I FUNDAMENTALS OF IoT 9

Web of Things versus Internet of Things - Evolution of Internet of Things - Elements of an IoT system - Physical, networking, middleware, service, and application layer - Trends and implications - Enabling technologies - IoT Architectures - Simplified IoT Architecture and Core IoT Functional Stack - Functional blocks of an IoT ecosystem - IoT protocols - Interoperability - Design and development - Data analytics and supporting services - Ethics, privacy and security.

UNIT II IoT FOR INTELLIGENT TRANSPORTATION 9

GIS - T - Map view, navigational view, behavioral view - Intelligent transport system - Sensor system, monitoring system, display system - GIS and GPS integration - Web mapping - Big data cloud computing - Vehicle road coordination, intelligent parking - Intelligent transportation planning - Deep learning under 5G network - Traffic volume - STTF prediction - CASE for traffic signals control - Intelligent logistics - Intelligent supply chain system.

UNIT III INTELLIGENT AGRICULTURE 9

Geospatial big data - Remote sensing, GIS, GPS - RFID- Web server - IoT sensors - AI Block chain technology - Agricultural IoTs for precision agriculture - Smart monitoring - Intelligent irrigation systems - Agrochemicals applications - Disease management - Smart harvesting - Supply chain management - Smart agricultural practices - Soil erosion rate sensor - Soil health - Soil moisture - Research challenges - Future research directions for agricultural IoTs.

UNIT IV IoT FOR ENVIRONMENT & HEALTHCARE APPLICATIONS 9

Sustainable environmental - Weather monitoring - Endangered species protection - Smart energy management - Electricity supply chains - Air quality monitoring - Smart waste management - Fleet management - Smart water quality monitoring - IoT based intelligent building - Intelligent building architecture - Digital twin - Healthcare planning and policy - Disease mapping - IoT based in-hospital healthcare system - ZigBee mesh protocol - Integrated smart watches - Risk management system based on IoT, BIM, and GIS.

UNIT V IoT FOR DISASTER APPLICATIONS 9

Disaster management cycle - Mitigation - Preparedness - Response - Recovery - IoT-based early warning systems - Natural disasters - Earthquake, landslides, volcanic eruption, floods, stream erosion, cyclones, tsunami, fire - Man-made disasters - Nuclear, chemical, mine, biological disasters - BRINCO- BRCK- flood beacon - Community based flood early warning system - Tsunami early warning system - Floating sensor network - Lighting detection - ALARMS - Shake Alert - IOT based cost efficient emergency recovery - Victim localization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Learn the fundamentals of IoT Architecture, Protocols, Interoperability, Privacy, and Security.
CO2: Understand the potential of IoT in developing intelligent urban transportation and logistics.
CO3: Explore the opportunities of the IoT in smart agriculture applications.
CO4: Explore the scope of IoT in sustainable environment and healthcare applications.
CO5: Understand the potential use of IoT in preparedness, response, recovery, and mitigation phases of disaster management for natural and man-made disasters.

REFERENCES:

1. Sadeghi-Niaraki, A., 2023., "Internet of Thing (IoT) review of review: Bibliometric overview since its foundation", Future Generation Computer Systems 143, 361-377. https://doi.org/10.1016/j.future.2023.01.016.
2. Dhanaraju, M., Chenniappan, P., Ramalingam, K., Pazhanivelan, S., Kaliaperumal, R., 2022, "Smart Farming: Internet of Things (IoT) - Based Sustainable Agriculture", Agriculture 12, 1745. https://doi.org/10.3390/agriculture12101745.
3. Sharma, K., Anand, D., Sabharwal, M., Tiwari, P.K., Cheikhrouhou, O., Frikha, T., 2021, "A Disaster Management Framework Using Internet of Things - Based Interconnected Devices.", Mathematical Problems in Engineering ,2021, 1-21. https://doi.org/10.1155/2021/9916440.
4. Granell, C., Kamilaris, A., Kotsev, A., Ostermann, F.O., Trilles, S., 2020, "Internet of Things.", In: Guo, H., Goodchild, M.F., Annoni, A. (eds), Manual of Digital Earth. Springer, Singapore. https://doi.org/10.1007/978-981-32-9915-3_11
5. Hassan, R., Qamar, F., Hasan, M.K., Aman, A.H.M.; Ahmed, A.S., 2020, "Internet of Things and Its Applications: A Comprehensive Survey." Symmetry 12, 1674. https://doi.org/10.3390/sym12101674.
6. Manju Khari, Raghvendra Kumar, Valentina E. Balas, Vijender Kumar Solanki., 2018, "Internet of Things and Big Data Analytics for Smart Generation",Germany: Springer International Publishing. ISBN:9783030042035, 3030042030
7. Hwaiyu Geng ,2016, "Internet of Things and Data Analytics Handbook", Wiley, ISBN: 978-1-119-17364-9

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	2	1	3	-	-	-	3	-	-	3	3	1	2
2	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2
3	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2
4	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2
5	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2
AVg.	3	3	3	2	3	-	-	-	3	-	-	3	3	3	2

1' = Low; '2' = Medium; '3' = High

GI5051 BLOCKCHAIN TECHNOLOGY FOR SPATIAL DATA L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Blockchain in a digital world - Crypto asset or digital asset, self-sovereign identity - Smart contract - Decentralized business model - Device-to-device communication in a blockchain - The double - Spend problem - Byzantine generals computing problems - Public key cryptography - Hashing – Digital signatures, Distributed networks, Encryption/ decryption methods, distributed ledger technology.

UNIT II SECURITY STANDARDS 9

Blockchain Protocol, currency, network security - Different types of network attack: Wormhole attack, Byzantine attack, Network-based attack, etc. - Secure Network Architecture: Network segmentation and firewall configuration Secure communication protocols (TLS/SSL) - Cryptographic Security Measures - Access Control and Identity Management.

UNIT III BLOCKCHAIN ARCHITECTURE 9

Blockchain structure: Basic operations, gas, minor's role in a blockchain - Ethereum blockchain: Smart contracts, Ethereum structure, Ethereum operations - Incentive model in a blockchain - Tiers of blockchain technology: Blockchain versions - Types of blockchain: Public blockchain, private blockchain, semi-private blockchain, sidechains.

UNIT IV ALGORITHMS & TECHNIQUES 9

Proof of stake **-** Proof of work - Delegated proof of stake **-** Proof elapsed time, deposit - Based consensus - Proof of importance **-** Federated consensus or Federated byzantine consensus **-** Practical byzantine fault **-** Tolerance. Blockchain use case: Supply chain management **-** Public key cryptography **-** Public key and private key combinations in blockchain security **-** Hashing, transaction integrity **-** Securing blockchain.

UNIT V BLOCKCHAIN IN GEOSPATIAL APPLICATIONS 9

Blockchain evolving into geo blockchain - Preserving geospatial data privacy and integrity - GIS & blockchain - Geospatial use cases: Public - Good data, IoT - Autonomous devices & apps – Token systems and Traceability -Land ownership and administration - FOAM: Open protocol for decentralized geospatial data markets – Surveying and mapping solutions: IEC standards -Supply Chain Management: Transparency and traceability of goods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Explain the basic concepts of blockchain
CO2: Apply the knowledge of blockchain structure and operations for designing & implementation.
CO3: Illustrate the essential components of a blockchain platform.
CO4: Use the working of an immutable distributed ledger and trust model that defines blockchain.
CO5: Able to apply block chain technologies to handle geospatial data for various applications.

TEXT BOOKS:

1. Elad Elrom, "The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects", 2019. ISBN-13: 978-1484248461, ISBN-10: 1484248465.
2. Kirankalyan Kulkarni, "Essentials of Bitcoin and Blockchain", 2019, Packt Publishing.
3. Tiana Laurence, "Blockchain for Dummies", 2nd Edition, 2019, John Wiley & Sons.

REFERENCES:

1. Alan T. Norman, "Blockchain Technology Explained: The Ultimate Beginner's Guide About Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts", Create Space Independent Publishing Platform, 2017.
2. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly Publisher Media; 1st Edition, 2015.
3. Andreas Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly Publisher Media, 2017.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	2	-	-	-	-	-	4	3	2	2
2	3	3	3	3	2	2	-	-	-	-	-	3	3	2	3
3	3	3	3	3	3	2	-	-	-	-	-	2	2	3	3
4	3	3	2	3	3	2	-	-	-	-	-	3	2	3	2
5	3	3	3	2	3	3	-	-	-	-	-	2	3	3	3
AVg.	3	2	3	3	3	2	-	-	-	-	-	3	3		3

1' = Low; '2' = Medium; '3' = High

GI5052 DECISION SUPPORT SYSTEMS FOR GEOMATICS L T P C
3 0 0 3

UNIT I STRUCTURE OF EXPERT SYSTEMS 9

Definition - Features, needs, components - Characteristics - Players - Structure and phases of building ES - Human vs Artificial expertise, conventional programming vs expert system - types - Rule based, frame based & hybrid - Activities - Design, planning, monitoring, controlling - Expert system - examples in geomatics.

UNIT II RULE BASED EXPERT SYSTEMS 9

Levels and sources of knowledge - Knowledge Engineering - Process - Knowledge acquisition methods - RGA analysis - Machine learning - Validation, representation schemes, rule, semantic network, frames and logic - Inference techniques - Types of reasoning deductive, inductive, adductive, analogical and non-monotonic - Rule based expert system - Evolution - Architecture - Evolution - Architecture - Conflict resolution - Types of inference: Forward and backward chaining - Search techniques - Case studies: MYCIN, PROSPECTOR - R environment - Examples in geomatics.

UNIT III INEXACT REASONING 9

Bayesian theory, examples - Certainty theory: Overview, uncertain evidence, rule inferencing - Certainty factors - Fuzzy sets - Representation, hedges inference & fuzzy logic - Classification of RS data using Fuzzy logic.

UNIT IV OPERATION RESEARCH 9

Origin - Nature and significance - Models and modeling - Applications and scope - Linear programming - Problem formulation - Structure and assumptions - Standard form - Graphical solution - Solution by simplex method - Sensitivity analysis - Duality - Formulations of dual problem - Geoinformatics problems & solutions - Use of AHP.

UNIT V NETWORK MODELS 9

Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT network - Critical path scheduling - Types of inventories - The classical EOQ model - Deterministic inventory problems - Price breaks - Stochastic inventory problems - Selective inventory control techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the structure of the Expert system and its difference with conventional programming.
CO2: Acquaint with Rule based expert system for geomatic problems.
CO3: Solve inexact real-world problems to get the solution.
CO4: Perform operation research and geomatic tools to design a Hybrid model to solve real world problems.
CO5: Plan, control and monitor the activities of the project properly for effective implementation.

TEXT BOOKS:

1. Peter Jackson, “Introduction to Expert systems”, Pearson Education, 1999.
2. Turban E, “Expert Systems and Applied Artificial Intelligence”, Macmillan, 2004.

REFERENCES:

1. Donald A Waterman, “A Guide to Expert Systems”, Pearson Education, 2001.
2. Durkin J, “Expert Systems Design and Development”, Prentice Hall, 1994.
3. Dan W Patterson, “Introduction to Artificial Intelligence and Expert systems”, Prentice Hall, 2009.
4. Ermine J I, “Expert Systems: Theory and Practice”, Prentice, 2004.
5. Ramez Elmasri and Shamkant Navathe, “Fundamentals of Database Systems”, Addison Wesley Company, 7th edition, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	1		-	1	-	-	-	-	-	3	3	2	-	-
2	1	3	1	-	3	2	-	-	-	2		3	-	2	1
3	2	3	2	2	2	2	1	-	-	3	2	2	-	2	3
4	3	3	3	3	2	3	2	-	-	3	3	3	2	3	3
5	2	2	3	3	2	3	-	-	-	2	3	3	-	3	2
AVg.	2	3	3	3	2	3	2	-	-	3	3	3	2	3	2

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5053 LOCATION INTELLIGENCE AND SURVEILLANCE L T P C
3 0 0 3

UNIT I MAPS AND SPATIAL REASONING 9

Key concepts - Underlying spatial sciences - Scientific method and spatial reasoning - Methods and issues relating to representing the physical world in digital and print maps - Cartography and graphic elements: Discussion of map design principles, symbology, and cartographic technique - Use of graphics to communicate, stylize and problem-solving.

UNIT II GEOSPATIAL DATA COLLECTION 9

Overview of technologies and uses of GNSS and GPS - Geospatial data collection workflows and primary data collection; accuracy and precision - Spatial data quality - Evaluating and maintaining spatial data quality - Spatial data sources for spatial analysis - New world of data, research methods.

UNIT III LOCATION INTELLIGENCE 9

Location Intelligence (LI): Layering location-specific data on a dashboard for unique insights. – LI model: spatial analyzes, cartographic visualizations, and mapping – Location scoring, analysis and creating of service areas– Statistics-based decision-making, and customer mapping-Managing accuracy and uncertainty in GIS.

UNIT IV SURVEILLANCE 9

Purpose of surveillance - Common forms of surveillance - Surveillance cameras: Specifications, process - Inside surveillance: Mobile phone tracking, GPS trackers, computers, networks, and miniaturization - Outside surveillance: Remote sensing, surveillance cameras, facial recognition, a profusion of internet - Connected devices, Geodemographics.

UNIT V 3D MAPPING & SURVEILLANCE 9

UAV-based surveying – Mobile mapping systems - 3D modelling - Applications - Smart 3D surveillance - Real-time change detection: LiDAR, video and thermal imaging, geofencing - Enterprise-level video surveillance solutions for various applications, public safety, mining, energy infrastructure, transportation and property tax and building violation mapping - Significance in physical security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Explain modern geographic analysis and visualization tools can be used across a variety of disciplines.
CO2: Demonstrate the understanding of data representation methods by creating meaningful maps.
CO3: Apply modern mapping and GIS technologies to problem-solving within diverse fields of study.
CO4: Utilize various tools of surveillance based on their purpose and forms.
CO5: Apply the knowledge of remote sensing technology for 3D mapping and surveillance.

REFERENCES:

1. VanOort P A J (Pepijn), “Spatial Data Quality: From Description to Application”, Doctoral dissertation, Netherlands Geodetic Commission, Delft, 2005, (Selected chapters).
2. Zeiler, Michael and Jonathan Murphy, “Modeling Our World: The Esri Guide to Geodatabase Concepts”, Redlands, CA, Esri Press, 2010.
3. https://www.esri.com/arcgis-blog/products/mapping/mapping/introducing-smart-mapping/
4. https://dl.acm.org/doi/abs/10.1145/1459359.1459409
5. https://link.springer.com/article/10.1007/s12518-013-0120-x

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	4	2		3	2	-	-	-	-	-	3	3	1	2
2	3	3	3		3	2	-	-	-	-	-	2	3	2	3
3	3	4	4		3	2	-	-	-	-	-	3	2	4	3
4	3	3	2		3	2	-	-	-	-	-	3	2	4	2
5	3	4	4		3	3	-	-	-	-	-	3	3	3	3
AVg.	3	4	3	3	3	2	-	-	-	-	-	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High

GI5054 GEOMATICS FOR SMART CITIES L T P C

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UNIT I GEOSPATIAL DATA ACQUISITION 9

Key concepts and characteristics of smart cities - Remote sensing techniques for urban mapping - Unmanned aerial vehicles (UAVs) and their role in data collection - LiDAR technology for 3D urban modeling - 3D spatial-temporal modeling - Integration of global position system (GPS), remote sensing and GIS.

UNIT II DATA ANALYSIS AND VISUALIZATION 9

Introduction to geospatial analysis techniques - Spatial data modeling and analysis for urban planning - Data visualization methods for smart city applications - Spatial decision support systems (SDSS) for urban planning - Spatial data analysis and mining techniques - multi-criteria decision analysis (MCDA) in smart city decision-making - Integration of geospatial data with other urban datasets.

UNIT III INFRASTRUCTURE MANAGEMENT 9

Geomatics for transportation planning and management - Asset management using geospatial technologies - Monitoring and maintenance of urban infrastructure - Geospatial analysis of energy consumption patterns - Renewable energy site selection using geospatial tools - Geospatial analysis of water resources in urban areas - Water supply and distribution optimization for smart cities.

UNIT IV URBAN MOBILITY AND PUBLIC SAFETY 9

Global navigation satellite system (GNSS) and location - Based service techniques - Geospatial analysis for transportation planning and optimization - Intelligent transportation systems (ITS) - Emergency response planning using geospatial tools - Crime mapping and analysis for urban security - Disaster management and resilience using geomatics.

UNIT V ENVIRONMENT AND HEALTH APPLICATIONS 9

Geospatial analysis of environmental indicators in smart cities - Green space planning and urban ecology using geomatics - Climate change adaptation and mitigation strategies - Geospatial analysis for public health planning - Disease surveillance and spatial epidemiology - Geomatics applications in healthcare accessibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- On completion of the course the student is expected to be able to

CO1: Understand the role of geomatics in smart city planning and management.
CO2: Apply geospatial data acquisition techniques in the context of smart cities.
CO3: Analyze and interpret geospatial data for urban planning and decision-making.
CO4: Evaluate the impact of geomatics technologies on smart city development.
CO5: Demonstrate practical skills in using geospatial tools and software for smart city applications.

REFERENCES:

1. Houbing Song, Ravi Srinivasan, Tamim Sookoor and Sabina Jeschke, “Smart Cities: Foundations, Principles, and Applications”, Wiley Publishers, 2017.
2. Poonam Sharma, “Geospatial Technology and Smart Cities: ICT, Geoscience Modeling, GIS and Remote Sensing”, Springer Nature, Switzerland AG, 2021.
3. Dr. P Partheeban and Dr. B Anuradha, “Applications of Geospatial Technologies for Smart City Traffic and Transportation Planning”, Veda Publications, Chennai, 2022.
4. T M Vinod Kumar, “Geographic Information System for Smart Cities”, COPAL Publishing Group, India, 2014.
5. Carrillo, Francisco Javier, et al., “Knowledge and the City: Concepts, Applications and Trends of Knowledge-based Urban Development”, Routledge, 2014.

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CO	PO												PSO		
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2	3	3	3	3	3	3	3	2	3	3	3	3	3	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	2	2	3	-	-	2	-	2	-	3	3	3	3
AVg.	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

1’ = Low; ‘2’ = Medium; ‘3’ = High