Program Outcome of this course

Sl. No.	Description	POs
1	Qualitative improvement in Civil Engineering education	PO1
2	Usage of Geospatial technologies in problem solving	PO2
3	Sustainable development of cities and communities	PO3
4	Understand Environment and develop climate smart action plans	PO4
5	Natural Resource management and disaster resilience	PO5
6	Critical Analysis of problems and Innovations in developmental planning.	PO6
7	Design and development of Geoinformatics- based solutions.	PO7
8	Subject specific skill development	PO8
9	Socio-economic development through efficient project management	PO9
10	Providing inputs for transparent administration through e-governance	PO10
11	Innovation and creativity through research and development	PO11
12	Entrepreneurship	PO12

Semester- I (BSC)

Introduction to Geospatial Science & Statistics			
Course Code	**22CGI11**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
To introduce and familiarize the students with the basic concepts EMR, survey, programming skills and statistical analysis which serve as a prerequisite for understanding Geoinformatics.

Module-1

Basic Concepts: Electromagnetic Radiation (EMR), propagation of EM waves from one medium to another, attenuation, quantum nature of EMR, thermal radiation, Sources of EMR for remote sensing, Fundamentals of radiometry, Introductory physics of sensors, Introduction to geographic information system (GIS), Basics of Survey and Cartography.

Teaching-Learning Process	Structured lectures on the physical, mathematical and theoretical basis of geospatial technologies prepared from standard books written by eminent authors through audio-visual technologies. Understand the concepts EMR, GIS and survey and cartography.

Module-2

Basic Statistics and Probability Theory: Central tendency and dispersion, Skewness, Kurtosis: Mean mode, median, standard deviation, variance, and covariance. Introduction to probability theory, kinds of probability, probability models.

Teaching-Learning Process	Structured lectures on general statistics prepared from standard books written by eminentauthors through audio-visual technologies. To understand basic concepts of statistics and probability theory.

Module-3

Sampling and Testing of Hypothesis: Introduction, sampling, sample mean, sampling from normal distribution, stratification and sampling, simple hypothesis testing, composite hypothesis, tests of hypotheses – sampling from normal distribution, chi-square tests, tests of hypotheses and confidence intervals.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Acquire skills on sampling and testing hypothesis.

Module-4

Simple Regression and Correlation: Estimation using regression line, correlation analysis, making inferences, limitations and errors. **Time Series and Forecasting:** Introduction, variation in time series, trend analysis, cyclical variation, seasonal variation, irregular variation, time series analysis in forecasting.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home). To acquire skills on Simple regression and correlation.

Module-5

Introduction to Spatial data analysis in R: Basic data types and data structures in R Looping, functions, Linear, Multi regression, Analysis of Covariance, Time series analysis in R, Visualising Spatial Data using R, working with vector data and raster data in R.

Teaching-Learning Process	Structured lectures on R statistical programming prepared from open source literature and manuals/guides written by eminent authors.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fundamentals of Remote Sensing; George Joseph
2. An Introduction to Spatial Data Analysis and Visualisation in R Guy Lansley and James Cheshire
3. Applied Spatial Data Analysis with R Roger S. Bivand, Edzer J. Pebesma Virgilio Gómez-Rubio
4. Statistics for Management Richard I.Levin, David S. Rubin, Sanjay Rastogi, Masood Hussain Siddiqui
5. An Introduction to R Spatial Analysis and Mapping Chris Brunsdon and Lex Comber

Web links and Video Lectures (e-Resources):

- https://github.com/topics/r-programming-projects
- https://www.coursera.org/learn/r-programming

Skill Development Activities Suggested

- To develop the skills on R statistical programming.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Basic physical concepts remote sensing and survey	I, II
CO2	Basic Statistics, Probability Theory	I,II
CO3	Stratification and Sampling, Testing of Hypothesis	III,IV
CO4	Simple Regression and Correlation, Time Series and Forecasting	IV,V
CO5	Introduction to Spatial data analysis in R	II,III,IV

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	x									
CO2		x								
CO3								x		
CO4						x				
CO5						x	x	x		

Semester – I (IPCC)

REMOTE SENSING AND PHOTOGRAMMETRY			
Course Code	**22CGI12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03.00

Course objectives:

i) To understand the basic concepts of remote sensing, systems & techniques of data acquisition.

ii) To acquire skills in image processing techniques and interpretation of remotely sensed data.

iii) To impart skills for extraction of information from aerial/satellite stereo-data.

MODULE-1

Introduction: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology, interdisciplinary nature and relation with other disciplines, Types of remote sensing with respect to wavelength regions; spectral reflectance of land covers; radiative transfer equation; energy interaction in the atmosphere. Geometry of aerial photograph: scale, relief displacement, scale of tilted photograph; digital aerial cameras, Principles of stereoscopic vision, types of stereoscopes, stereoscopic viewing, stereoscopic parallax.

Sensors & Platforms: Types of sensors- passive sensors and active sensors; imaging systems, photographic sensors, characteristics of optical sensors; Sensor resolutions, Multispectral and hyperspectral scanners, Imaging spectrometer; space borne imaging sensors, microwave sensors; thermal sensors. Types of platforms and their characteristics.

Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies. Understanding the concept of Remote Sensing techniques, its platforms and sensors.

MODULE-2

Image Interpretation and Digital Image Processing: Basics of image interpretation, elements of interpretation, Generations of Thematic maps. Importance of ground truth, reference data, use of smart phone, geo-tagging. Data formats, image rectification, radiometric correction, atmospheric correction.

Advanced Remote Sensing Technologies: Microwave remote sensing, Synthetic Aperture Radar; Hyper spectral Imaging Spectrometer; Thermal Imaging System; Advanced Laser Terrain Mapping.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Understanding the techniques of image interpretation, image pre-processing and advance remote sensing techniques.

MODULE-3

Analytical and Digital Photogrammetry: Image coordinate system and Object space coordinate system; Minor Control Points (MCPs), collinearity equations of vertical and tilted photograph, Epipolar geometry co-planarity equations, Relationship between image and object space. Basic photogrammetric operation in digital environment, Inner Orientation, Exterior Orientation procedures in digital photogrammetry. **Flight Planning and Block Control:** Flight planning, choice of photo scale, photographic end lap and side lap, purpose of photography, ground coverage, weather conditions, season of the year, flight map, specifications, General requirements of ground control points; planning Block Control Points (BCP), pre-pointing and post pointing.	
Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home). Acquiring knowledge on photogrammetric processing and production standard.
MODULE-4	
Aero Triangulation (AT): Definition, Classification of AT, GPS supported AT, geometric relationship between a camera and GPS antenna with respect to its position and attitude, synchronization of GPS coordinates with camera exposures, and INS parameters in bundle block adjustments for each exposure stations. **Concept of Block/Bundle/Strip Adjustments:** definition of block, types of block adjustments, development of block adjustment; bundle block adjustment, accuracy of block adjustment, space resection, space intersection,. Artificial Intelligence (AI) in Bundle adjustment**.**	
Teaching-Learning Process	Tutorial methods for the laggards, seminar methods for the groups, demonstration method where the faculty member / instructor himself performs a set of operations using the instruments and software tools. Evaluating the methods of production and issues on designing specifications.
MODULE 5	
Soft copy Photogrammetry: Digital photogrammetric system, Configuration of Digital photogrammetric work station, photogrammetric scanners, softcopy photogrammetry, 3D visualization in digital environment (stereo-viewing), Quad buffer, characteristics of digital image data, image enhancement, image matching, feature extraction by 2D and 3D mode, Advantages of digital photogrammetry. Digital surface modelling by DTM/DEM, Interpolation techniques, GRID and TIN, break lines, profiles, mass points / random points, DTM generation process, differential rectification, mosaic, Seamless data generation.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations using the instruments and software tools. Analysing the latest technology and the integration of spatial science with computer technology.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Generating the spectral reflectance of land covers using a spectroradiometer or a Hyperspectral satellite RS Data.
2	Interpretation of false colour composites made of VNIR, thermal and microwave sensor data.
3	Calculation of scale of a satellite image using a SOI toposheet
4	Identification of Land Use Land Cover types at Level-II (1:50,000 scale) using interpretation keys.
5	Ground truth collection and geotagging of sample sites using any hand-held GPS or a Mobile App.
6	Image rectification and image registration using ERDAS Imagine software or any Open Source Software.
7	Mirror stereoscope- computation of base line and orientation of aerial photographs and 3-D photo interpretation.
8	To find the height of a point using Parallax bar.
9	Selection of Block Control Points and post pointing (field work)
10	Chalking of details
11	**Generate a LULC Map and estimate the areas of each cover type using a box grid.**
12	**Estimate the height of a tree or a building using a stereo pair of photographs and parallax bar.**

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

1. Two Tests each of 20 Marks

2. Two assignments each of 10 Marks/One Skill Development Activity of 20 marks
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
4. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

- Fundamentals of Remote Sensing by George Joseph 1st edition 2003
- Remote Sensing and Image Interpretation by by Lillesand Kiefer Chipman 6th edition 2014
- Remote Sensing and GIS by Basudeb Bhatta 2nd edition 2011
- Elements of Photogrammetry by Paul R Wolf Indian edition 2014.
- Introduction to Modern Photogrammetry by E M Mikhail, James S Bethel and J C McGlone 2001.

Students are encouraged to visit SWAYAM web site where there are several Massive Open Online Courses (MOOC), **http://swayam.gov.in**

Students are encouraged to take the benefits of SWAYAM PRABHA- the direct to home (DTH) 34 channels telecasting educational programmes on 24x7 basis using GSAT-15 satellite. The channels are up-linked from BISAG-N, Gandhinagar.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- To learn skill in image interpretation techniques in practical class.
- To get familiarized with filed instruments.
- To get knowledge about photogrammetry software.
- To learn Mirror Stereoscope for height of tree or building.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Introduction to RS and Photogrammetry, Sensors and Platforms	I, II
CO2	Image Interpretation, Digital Image Processing, Advanced Remote Sensing Technologies.	II, III
CO3	Analytical and Digital Photogrammetry, Flight Planning and Block Control	II, III
CO4	Aero Triangulation, Concept of Block/Bundle/Strip Adjustments	III, IV
CO5	Soft copy Photogrammetry	V, VI

Mapping of COS and POs

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

Semester – I (PCC)

GIS & SPATIAL DATA ANALYTICS			
Course Code	**22CGI13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours of teaching +10-12 sessions of SDA	Total Marks	100
Credits	04	Exam Hours	03.00

Course Learning objectives:
To understand the basic principles of GIS, creation of GIS database, understanding the formats of raster and vector data, measurement techniques, modelling, and spatial data analytics.

Module-1

Introduction to GIS: Definitions, Components of GIS, interdisciplinary relations, Discrete geographic objects, Continuous geographic features, Vector and Raster Data structures. Spatial Data types, Non-spatial / Attribute Data types, Tessellations to represent geographic objects, Basic Data Models –raster and vector, Spaghetti model and Topological model, Advanced data models, raster and vector data formats.

Teaching-Learning Process	Structured lectures on the fundamentals of GIS and spatial data analytics prepared from standard books written by eminent authors through audio-visual technologies. Students will acquire knowledge of terminology and elements of data analytics.

Module-2

Data Sources and Data Entry: Primary and secondary methods of acquisition of spatial and non-spatial data: surveying, remote sensing, Photogrammetry, Global Navigation Satellite System (GNSS), Database creation, Data capturing, map scanning and digitizing, data exchange standards, topology building, editing and cleaning, linking of spatial and non-spatial data.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Students will acquire conceptual knowledge on the subject.

Module-3

Data Processing and Data quality: Hardware and software needed**,** data editing, data conversion, scale changes, coordinate thinning, georeferencing, sliver removal, edge matching, interactive editing, rubber sheeting. components of geographic data quality, Sources of error in geographic data, error management; quality assurance & quality control (QA/QC), components and types of GIS standards, international GIS standards, interoperability of GIS.	
Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home). Students will learn the sources of error and quantifying it.
Module-4	
Spatial Data Analysis and Visualization: Spatial Measurements, Queries, Vector Data Analysis, Raster Data Analysis, Network Analysis, Terrain analysis, spatial analysis of 3-Dimentional data, Data integration and map overlay. GIS and Maps**,** Visualization process and strategies, mapping qualitative and quantitative data., map / information dissemination.	
Teaching-Learning Process	Tutorial methods for the laggards, seminar methods for the groups, demonstration method where the faculty member / instructor himself performs a set of operations using the instruments and software tools for spatial data analysis and visualization.
Module-5	
Advanced Spatial Data Modelling: Trend surface analysis, Spatial interpolation, fuzzy analysis, GIS analytical models: Digital Terrain Models, Hydrologic modelling, Spatial Multi Criteria Analysis and engineering GIS applications, recent advances in GIS & Spatial Data Analytics (SDA), Career opportunities in GIS and SDA.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations using the instruments and software tools (COTS and Open Sources).

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

6. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
7. The question paper will have ten full questions carrying equal marks.
8. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
9. Each full question will have a sub-question covering all the topics under a module.
10. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Concepts and Techniques of Geographic Information Systems, CP Lo Albert K W Yeung, 2005 Prantice Hall of India.
2. Principles of GIS for Land Resources Assessment by P.A.Burrough, Oxford: Science publications, 1986.\
3. An Introduction to Geographical Information Systems by Ian Heywood, S Cornelius, Second edition
4. Introduction to GIS by Kang-tsung Change, Third edition

Web links and Video Lectures (e-Resources):

- Students are encouraged to visit SWAYAM web site where there are several Massive Open Online Courses (MOOC), **http://swayam.gov.in**
- SWAYAM PRABHA web site

Skill Development Activities Suggested

- Visualization maps using different software
- Integrated the ancillary data with satellite images using softwares.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Basic concepts of GIS and understanding raster and vector formats.	I, II
CO2	Concepts spatial and non-spatial Data Sources and Data Entry.	II,III
CO3	Acquiring spatial data processing techniques and quality /assurance	III,IV
CO4	Acquiring knowledge Spatial Data Analysis and Visualization	IV,V
CO5	Knowledge about advanced Spatial Data Modelling for output product	V,VI

Mapping of COS and POs

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

Semester- I (PCC)

CARTOGRAPHY, GEODESY AND GLOBAL NAVIGATION SATELLITE SYSTEMS			
Course Code	**22CGI14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hours of teaching +10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03.00

Course Learning objectives:
Upon completion of this subject students should have gained the knowledge of Cartography, Geodesy, and Global Positioning System and also they become familiar with the basic principles and their applications in Geoinformatics Projects.

Module-1	
Introduction to Cartography and Map: Cartographic concepts, science and art in cartography, essential cartographic process. Types of map, map scale, map composition, conventional signs; plan and profile, representation of relief, Map Numbering Systems, Map Legend, Symbols & Border Information, Layout of Maps, Base map and Thematic map. **Digital Cartography:** Digital cartography, cartographic generalization, hyper maps; web cartography.	
Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain cartographic process, how a map is prepared through digitisation

Module-2	
Introduction to Geodesy: Definitions, classification, shape and size of the earth, applications. Earth, Geoid and Reference Ellipsoid; Everest Spheroid, WGS 84, Vertical datum, Mean Sea Level, level surfaces, plumb line and deflection of the vertical, coordinate system in geodesy; Datum transformation. **Projections:** Classification of map projections, Scale factor, LCC, Polyconic and UTM.	
Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain physical and geometric geodesy, co-ordinate system, illustrate important map projections.

Module-3	
Satellite Geodesy: Introduction, Fundamentals of celestial mechanics, Normal orbits, Equation of motion and laws and elements of Kepler, geometry of elliptic orbit, perturbed satellite motion, Doppler surveying, Advantages of satellite geodesy.	
Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home), explain 2-body motion in orbit, Kepler's elements and concept of Doppler's survey.

Module-4	
Introduction to satellite-based Positioning systems: Concept of GNSS, GLONASS, GALILEO, GAGAN, India's NavIC. Components of GPS, principle of ranging, types of receivers; GPS satellite signals, Precise Point Positioning (PPP); satellite geometry and accuracy measure, signal propagation error, International GPS Geodynamic Services (IGS)	
Teaching-Learning Process	Tutorial methods for the laggards, seminar methods for the groups, demonstration method where the faculty member / instructor himself performs a set of operations using the instruments, explain the characteristics of GPS, its signal propagation, range measurement and geometry of satellites in the orbit.

Module-5

Differential GPS – DGPS, concepts and principles, differential corrections, local area DGPS, wide area DGPS, LAAS, WAAS; Measurement with GPS – rapid static method, semi kinematic method, Real time kinematic method. GPS pseudolites. **Planning and Field Observations:** Ground control points, field observations, criteria for selecting reference station, post processing, Receiver Independent Exchange Format (RINEX). Geo-referencing of satellite imagery / photograph. **Applications:** Continuously Operating Reference Station (CORS) system, applications of Location Based Services, Geo-fencing.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations using the instruments and software tools, develop observation procedure with Differential GPS, create field planning and carry out data processing.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

5. Three Unit Tests each of **20 Marks**
6. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

5. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
6. The question paper will have ten full questions carrying equal marks.
7. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
8. Each full question will have a sub-question covering all the topics under a module.
9. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Satellite Geodesy: Gunter Seebar,
2. GPS satellite surveying: Alfred leick
3. Essentials of GPS, N K Agrawal
4. Fundamentals of Cartography by R P Misra, 2nd edition

Web links and Video Lectures (e-Resources):

- https://1lib.in/

Skill Development Activities Suggested

- Map reading
- Field observation using DGPS

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the concept of cartography and production of map on various scales using latest digital technology.	I,II
CO2	Understand the analytical and equipotential surface of Earth, its gravity field and projection system.	II,III
CO3	Acquire knowledge about satellite orbits, perturbation and application of force factor.	III,IV
CO4	Understand the concept of constellation in Global Navigation Satellite System and its usage in position determination.	II,III
CO5	Acquire knowledge about the usage of Differential GPS, create field planning and carry out data processing.	IV,V

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	x									
CO2		x								
CO3							x			
CO4		x								
CO5								x		

Semester- I (PCC)

GEOSPATIAL DATABASE MANAGEMENT SYSTEMS AND PROGRAMMING SKILLS			
Course Code	**22CGI15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hours of teaching +10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03.00

Course Learning objectives:

i) To understand the basic concepts of Database management system, creation of GIS database.
ii) To understanding the advanced concepts of Hadoop, MongoDB, Hive.
iii) To acquire programming skills in python using different libraries.

Module-1

Databases and Users: Introduction, characteristics of database approach, intended uses of a DBMS, implications of database approach.

Database System Concepts and Architecture: Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems.

Data Modelling: Conceptual data models for database design, ER model- concepts, schema constructs and simple applications.

Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain the basic Database system concepts with their models.

Module-2

Relational Data Model: Concepts and constraints, update operations on relations, relational algebra, simple examples.
Structured Query Language: Data definition in SQL, queries, update statements, views in SQL, DDL, and DML. Relation Database Management System, querying operation.

Database design: Functional dependencies and normalization for relational databases, Normal forms based on primary keys, gene general definition of second and third normal forms, Boyce-Codd normal form.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain relation data model, SQL queries and design of database system.

Module-3

Introduction to Hadoop: Distributed Computing Challenges, Hadoop Distributed File System, Processing Data with Hadoop Managing Resources and applications, interactive with Hadoop Ecosystem.

Introduction to MongoDB: Data types in MongoDB, MongoDB Query Language

Introduction Hive: Architecture, Data types, File formats, HQL, RCFile implemention, SerDe, User defined Function (UDF)

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading tutorials, periodicals, and exercises for practicing at home), explain advanced concepts of Hadoop, MongoDB, Hive.

Module-4

Python Scripting: Introduction, Environment setup, Debugging, Syntax, Variable Types, Operators, Decision statements, Loops, Numbers, Strings, Lists, Tuples, Dictionary, Modules, File I/O, Exceptions & Exception Handling, Arrays-2D.
Python OOPs and SQLITE in Python: OOPs concepts -Encapsulation, Inheritance, Polymorphism, Abstraction., SQILTE- Create , Insert, Update and Delete

Python Pandas: Introduction to Pandas and Data Frames, Understanding the Usage of Data Frames, Various Data Frame methods and Operations, Selecting and Indexing Operations, Pandas Aggregation Operations. Outlier treatment.	
Teaching-Learning Process	Tutorial methods for the laggards, seminar methods for the groups, demonstration method where the faculty member / instructor himself performs a set of operations/libraries for in python programming.
Module-5	
Python for Spatial Analysis: Introduction to Geopandas, geopy, rasterio & Fiona. Reading and writing files, Installing and using libraries, Building scripts and automating workflows. **Introduction to Python Data Visualization:** Tabular and Vector Data Visualization, Creating charts and plots using Pandas, Creating maps with GeoPandas Raster and Gridded Data Visualization, Raster Data Visualization using Xarray and rioxarray, Interactive Mapping, Creating Interactive Maps with Folium, Creating Multi-Layer Interactive Maps with GeoPandas	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations spatial analysis tools and data visualization using python.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

7. Three Unit Tests each of **20 Marks**
8. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fundamentals of Database Systems by Elmasri and Navathe 5th and 6th edition
2. Big Data and Analytics by Seema Acharya and Subhashini Chellappan
3. Python Geospatial Analysis Cookbook by Michael Diener
4. Arcpy and ArcGIS by Jerry Davis second edition

Web links and Video Lectures (e-Resources):

- Web Tutorial in python programming
- https://github.com/

Skill Development Activities Suggested

- To learn the programming skill with different libraries.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understanding the concepts of DB system architecture and modelling.	I,II
CO2	Acquiring the skills for write the query and designing the DB and model.	II, III
CO3	Understanding the advance concepts of Hadoop, MongoDB and Hive	IV,V
CO4	Understanding the concepts of Python programming skills	II,III
CO5	Acquiring the skills for different libraries of python programming.	V, VI

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	x										
CO2							x				
CO3		x									
CO4								x			
CO5											x

Semester –I (PCCL)

Geoinformatics Laboratory- I			
Course Code	**22CGIL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:2:0	SEE Marks	50
Credits	02	Exam Hours	03.00

Course objectives:

i) Students would be able to model and analyse the spatial data, utilize GIS as navigation guide, decision support and expert tool.

ii) Understand how to use a wide range of vector-based GIS tools to address quarries relevant to natural resource management and hands programming skills.

iii) Analyse the requirements of a proposed application and synthesise an appropriate solution and customise a GIS.

Sl.NO	Experiments
1	Downloading Satellite images from different websites NRSC, USGS etc., Mosaicking and Subsetting Radiometric Correction of Satellite Images.
2	Features extraction (Polygon, Line, Point) ERDAS imagine and ArcMap Creation Geodatabase using ArcGIS for Spatial Data GIS Software environment, Joining the non-spatial with spatial data, editing the vector layers.
3	Familiarization in open source like (Q- GIS)
4	Familiarization with GPS Instrument and Software GPS Survey of Natural and Man-made features GPS & GIS data integration and output preparation
5	Vector based and Raster based analysis
6	Network Analysis and creation DEM and TIN.

7	Spatial and non-spatial data visualization using R statistical software
8	Interpolation Techniques
	Demonstration Experiments (For CIE) if any
9	Creation Data types or Data Objects in R, Linear, Multi regression analysis covariance and time series analysis using R software
10	Vector analysis and Image pre-processing with R programming
11	Basic spatial programs using python libraries.
12	Basic query using SQL, Hadoop, MongoDB, Hive.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Students will be equipped with modern tools, software of GIS and be confident to implement a GIS project independently or as a team effort.
- Students will be able to write code for programs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is 50 Marks.

The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.
SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Suggested Learning Resources:

- Web Tutorial and ESRI guide books.

Semester –I (MCC)

Research Methodology and IPR			
Course Code	22RMI16	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Total Hours of Pedagogy	40	Maximum Marks	100
Credits	3	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. ■

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets,

Utility Models, IPR and Biodiversity, the Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition.

Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),

Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.