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- II (PCC)

Geoinformatics in Natural Resource and Environmental Management			
Course Code	**22CGI21**	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 concepts of natural resources management, linkages with economy, Earth system functioning.

ii) To impart the basics of sustainable development and prepare suitable action plans for sustaining the ecosystem services through geospatial technologies, and

iii) To explore the use of geoinformatics in assessing the natural resources and monitoring the changes in the environment.

Module-1

Introduction to Land Resources Management: Types of natural resources, Linkages of natural resources with the economy, impact of natural resources utilization on Earth system functioning, Geomorphological Mapping, geological structures and lithological mapping, Mineral resources mapping, classification of soils and soil mapping, Land Use Land Cover Mapping, role of land and soil in the climate system.

Teaching-Learning Process	Structured lectures on the fundamentals of NRM and EnM prepared from standard books written by eminent authors through audio-visual technologies. Field visit to mineral rich geological formations in Karnataka, conducting a quick soil survey in the nearby university campus, students will acquire factual knowledge about land resources (The abiotic components of the environment).

Module-2

Agro-ecosystem Forest Resources Management: Forecasting Agriculture output through Satellite and Land-based observations (FASAL), crop stress detection and crop insurance programmes, Space inputs for precision agriculture, Site suitability studies for agricultural and horticultural crops, Web-GIS applications in agriculture. Mapping of forest types, Forest biomass estimation, Inputs for preparation of working plans / schemes, Thermal and microwave remote sensing applications in agriculture and forestry.

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

Module-3

Water Resources Management: Surface water resources mapping and management; Estimation and monitoring of precipitation (rainfall and snow cover), Integrated river basin management, Site suitability for hydro-electric power plants, Digital Terrain Models and their applications, preparation of ground water prospecting and recharging maps.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignments. Students will learn the use of geoinformatics in water resources management.

Module-4

Environment and Sustainable Development: Components of environment, concepts of ecosystem, energy flow and ecosystem functioning and services, Applications in EIA and EMP, quantifying impacts of developmental projects. Concepts of sustainable development, Watershed-based Acton Plans for Sustainable development.

Teaching-Learning Process	Structured lectures through PPTs, seminar methods where the faculty member / instructor himself moderates the discussions, on the components of environment and sustainable development.

Module-5

Environmental Pollution Applications: Point and non-point source pollution, methane production area mapping and modelling, oil slicks tracing and monitoring, turbidity and sedimentation mapping, Groundwater-pollution hazard assessment, Aerosol remote sensing, air quality indexing and mapping, Use of RS+GIS in studying ecology of vector-borne diseases, public health administration.	
Teaching-Learning Process	The faculty members conduct field visits to polluting industries, crop lands treated with agrochemicals, consulting research papers, case studies, and success stories describing the use of geoinformatics in managing environmental pollution.

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:

9. Three Unit Tests each of **20 Marks**
10. 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. Introduction to Environmental Remote Sensing by Barrett E.C., Curtis, I.F., Chapman and Hall, New York, 1982
2. Remote Sensing principles and Interpretations- Sabins, F.F., (Ed) W.H. Freeman and Co., New York, 1986
3. Remote sensing and Image interpretation - Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
4. Remote Sensing in Geology by Ravi P Gupta second edition.
5. Geoinformatics in Environmental Management by M Anji Reddy

Web links and Video Lectures (e-Resources):

- Remote Sensing Application by NRSC
- Indian Society of Remote Sensing Journal https://www.isrs-india.org/
- https://isgindia.org/journal-of-geomatics/

Skill Development Activities Suggested

- Field data collation for Geological features and water sample for test the concentrations of chemical elements.
- Collection air pollution data using instruments.

Sl. No.	Description	Blooms Level

CO1	Understanding concepts natural resources, Geological features, Land and soil resources mapping.	II, III
CO2	Acquiring the knowledge about Agro-ecosystems and Forest Resources Management using RS and GIS.	II, III
CO3	Understanding concepts of Water Resources Management using RS and GIS	III,IV
CO4	Acquiring the concepts of Environment and Sustainable Development.	IV,V
CO5	Assessing Environmental Pollution using Geoinformatics	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 – II (IPCC)

SATELLITE DATA IMAGE PROCESSING AND ANALYSIS			
Course Code	**22CGI22**	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 raster formats using statistical equation.

ii) To acquire skills in image enhancement and transformation techniques

iii) To impart skills for classification techniques raster data merging and advanced computer based algorithms.

MODULE-1

Digital Data: Introduction- Satellite data acquisition –Storage and retrieval – Data Formats – Compression – Digital Image processing hardware and software. Image Quality Assessment and Statistical Evaluation.

Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies. Structures of raster formats are learnt.

MODULE-2

Image Enhancement and Manipulation: Contrast Manipulation –Gray-Level Thresholding- Level Slicing Contrast Stretching – Spatial Convolution – Edge Enhancement – Spatial feature manipulation –Fourier Analysis. Spectral Rationing –Principal and Canonical Components– Vegetative Components, Vegetation indices – Intensity – Hue – Saturation – Colour Space Transformation, Texture transformation.	
Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Computer based image enhancement and transformation techniques are learnt.
MODULE-3	
Information Extraction from Images: Importance of ground truth data collection, instruments for reference data collection, Geo- tagging, training sample separability. Multispectral Classification – Supervised and Un-supervised Classification methods, Hybrid –Classification – Classification of Mixed Pixels. Post Classification Smoothing, Classification Accuracy Assessment.	
Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home). Computer based image classification techniques are learnt.
MODULE-4	
Data Merging and Change Detection: Multi-temporal Data merging, Multi-sensor image merging – Merging of image data with Ancillary data- Incorporating GIS Data into automated land cover classification, Binary change detection, and spectral change vector analysis.	
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 data merging and change detection are learnt.
MODULE 5	
Advanced Imaging Sensors and Analysis: Hyper spectral data analysis: Spectral angle mapper**,** Derivative spectroscopy, Expert systems, Decision Tree classification, Machine learning, Artificial Neural Network concepts, genetic algorithms, etc.	
Teaching-Learning Process	Advancements taking place in imaging sensors and their data analysis will be collated through consulting the latest books, current periodicals, and latest research papers, invited lectures from eminent scientists from ISRO, ESSO, ESRI, IBM, Infosysis, IITs, and other institutions.

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

Sl.NO	Experiments
1	Generate the indices map using Model maker in ERDAS IMAGINE
2	Perform the Unsupervised Classification using ISODATA algorithm in ERDAS IMAGINE
3	Perform the supervised classification of given data using different algorithms. Calculate the accuracy assessment for classification satellite image.
4	Generate the NDVI map using ERDAS Imagine and draw the graph of different objects.
5	Using ERDAS IMAGINE generate the Principle Component Analysis
6	Filtering Techniques.
7	Change Detection of satellite images
8	Land use and Land cover map Preparation using ArcMap.

9	Unsupervised classification using Random Forest algorithm
10	Using Model maker calculate drought index using ERDAS imagine
11	**Perform the supervised classification of given data using different algorithms. Calculate the accuracy assessment for classification satellite image.**
12	**Unsupervised classification using Random Forest algorithm**

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

4. Two Tests each of **20 Marks**
5. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**
6. 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. The**15 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)

5. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
6. The question paper will have ten questions. Each question is set for 20 marks.
7. 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.

8. 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

- Introductory Digital Image Processing A Remote Sensing Perspective by John R. Jensen 4th edition 2014
- Remote Sensing and Image Interpretation by by Lillesand Kiefer Chipman 6th edition 2014

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**
- 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.
- https://1lib.in/book/5243197/3b23f7?dsource=recommend

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

- To learn skill on image processing techniques and classification algorithm.
- To develop skill on ML and AI programming
- To get knowledge about different indices using different software.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the concepts of data formats and hardware and software.	I,II
CO2	To Acquire skills on enhancement and manipulation of satellite images	II,III
CO3	To acquire skills on image classification statistical calculation.	III,IV
CO4	To understand the concepts of image fusion techniques and change of detection.	IV,V
CO5	To acquire skills on advance remote sensing and Artificial Intelligence technology	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				x						
CO5							x	x			x	

Semester- II (PEC)

Web Applications in Geoinformatics (Professional Elective 1)			
Course Code	**22CGI231**	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, computing map, their functionalities and applications in WebGIS.
ii) To understanding the advanced concepts of spatial data analysis using python programming.
iii) To acquire skills on Cloud based platform.

Module-1

Introduction to Web GIS: Definition, concept of Web GIS, History of web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Fundamentals of computer networking – network environment – network communication models –protocols – TCP/IP. Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS, overview of Web GIS.

Client/server Computing: Client – server Concepts, client/server system partition– layered architecture – advantages and disadvantages of client server architecture. Distributed component framework – web mapping – static and interactive web mapping – open GIS web map server.

Distributed geographic information services: Principle – components – logic and data components.

Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain the basics of WebGIS, Client/Server and distributed GIS services.

Module-2

Geographic Markup Language: Principles – characteristics – commercial web mapping programs - mobile GIS. Distributed GIS in data warehousing and data sharing.

Functions of Web GIS: Display of general information for the public, display of planning information, interactive display of spatial information sharing and distribution of spatial data as well as management of spatial data.

Design of User Graphic Interface User friendly interface, characteristics, menus and icons, common terms. Graphic Appearance - colours, sizes, fonts, scales and arrangement.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain GML, function of WebGIS and design of GUI.

Module-3

Software. Proprietary and Open Source for developing server and client applications. Evaluation of different software - ArcIMS, Map Objects, Mapguide, Map Server, Geomedia web map, Openlayers, Geoserver etc.

Applications of WEB GIS: Participatory GIS -Web-based GIS For Collaborative Planning And Public Participation, Digital Democracy for planning, Local Environmental Decision-making, regional and local level planning. Community GIS, Intelligent transportation systems, planning and resource management. E-Governance.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading tutorials, periodicals, and exercises for practicing at home), explain WebGIS Software with their applications.

Module-4

Python Scripting in Spatial data analysis: Graphs, Graphs algorithm, Networking programming, GML processing, GUI programming Database Access, Geoprocessing using python, python in GIS. Introduction to Leaflet API, Map box, cloud based and server less approaches.	
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	
Geo-data processing in Cloud computation platform: Google Earth Engine and Planetary Computing. Fundamentals of JavaScript programming, Working with Image Collections, Creating Mosaics and Composites, Working with Feature Collections, Map/Reduce Programming Concepts, Calculating Indices, Cloud Masking, Calculating Area and Statistics, Time-series Charts.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operationsfor Geo data processing tools and cloud computing platform.

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:

11. Three Unit Tests each of **20 Marks**
12. 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. Internet GIS by Zhong-Ren Peng
2. Python Geospatial Analysis Cookbook by Michael Diener
3. Arcpy and ArcGIS by Jerry Davis second edition
4. Python Scripting for ArcGIS by Paul A. Zandbergen

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

- Working on Cloud based platform.
- Publishing the maps in Web GIS.

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 WebGIS, Client/Server and Distributed GI servers	I,II
CO2	Acquiring knowledge about GML, Functions of Web GIS and GUI.	II,III
CO3	Acquiring knowledge about WebGIS software and application of webGIS.	III,IV
CO4	Acquiring the skills about spatial data analysis using python programming.	IV,V
CO5	Acquiring the skills for geo-data processing tools and assessing the cloud computing platform for generates the maps.	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- II (PEC)

Programming Skills in spatial data analytics
(Professional Elective 1)

Course Code	**22CGI232**	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 installation of software and packages in python programming.
ii) To acquiring skills of spatial data analysis using python programming.
iii) To acquire skills to develop tools in QGIS using python programming.

Module-1

Geospatial Python Environment: Installing Pypro, Numpy, Shapely, matplotlib, Descartes, pyshp, geojson, pands, Scipy, PySAL, Ipythom, GDAL, OGR, geoDjang, and PostgreSQL with PostGIS.

Projection using python: Discovering projection(s) of a Shapefile or GeoJSON dataset, Listing projection(s) from a WMS server, Creating a projection definition for a Shapefile if it does not exist, Batch setting the projection definition of a folder full of Shapefiles, Reprojecting a Shapefile from one projection to another.

Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain the installation different software and packages in python environment and project system in programming.

Module-2

Spatial Data Formats: Converting a Shapefile to a PostGIS table using ogr2ogr, Batch importing a folder of Shapefiles into PostGIS using ogr2og, Batch exporting a list of tables from PostGIS to Shapefiles, Converting an Open Street Map (OSM) XML to a Shapefile, Converting a Shapefile (vector) to a GeoTiff (raster), Converting a raster (GeoTiff) to a vector (Shapefile) using GDAL.

PostGIS: PostGIS ST_Buffer analysis query and exporting it to GeoJSON, Splitting Line Strings at intersections using ST_Node, Executing a spatial join and assigning point attributes to a polygon.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain Spatial data formats and PostGIS using GeoJSON.

Module-3

Vector Analysis using python: Clipping Line Strings to an area of interest, Splitting polygons with lines, Finding the location of a point on a line using linear referencing, Snapping a point to the nearest line, Calculating 3D ground distance and total elevation gain.

Overlay Analysis: Punching holes in polygons with a symmetric difference operation, Union polygons without merging, Union polygons with merging (dissolving), Performing an identity function (difference + intersection).

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading tutorials, periodicals, and exercises for practicing at home), explain vector analysis and overlay analysis using Python programming.

Module-4

Raster Analysis using python: Loading a DEM USGS ACSII CDED into PostGIS, Creating an elevation profile, Creating a hill shade raster from your DEM with ogr, Generating slope and aspect images from your DEM, Merging rasters to generate a color relief map.

Visualization of Spatial Data: Generating a leaflet web map with Folium, Visualizing DEM data with Three.js, Draping an orthophoto over a DEM.

Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations to raster analysis and visualization of spatial data using python programming.

Module-5

QGIS using Python: Automating QGIS, Querying Vector data, Editing Vector Data, Using Raster data, Creating dynamic maps, Composing Static Maps, interacting with the user, QGIS work flows.

Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations to develop the tools in QGIS using Python programming.

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:

13. Three Unit Tests each of **20 Marks**
14. 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:

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

Suggested Learning Resources:

Books

1. Python Geospatial Analysis Cookbook by Michael Diener.
2. QGIS python Programming Cookbook by Joel Lawhead.
3. Python Scripting for ArcGIS by Paul A. Zandbergen

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

- Developing the new tools in QGIS using Python programming
- Generating spatial data maps using python programming

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 installation software and packages in python environment.	I,II
CO2	Understanding the spatial data formats and PostGIS using GeoJSON.	II,III
CO3	Acquiring the skills for vector and overlay analysis using python programming.	III,IV
CO4	Acquire the skills to process the raster data and visualization of maps using python.	IV,V
CO5	Acquire the skills to develop the tools in QGIS using 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- II (PEC)

Geoinformatics in Public Health Management **(Professional Elective 1)**			
Course Code	**22CGI233**	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:

- On completion of study of this subject the student would be able to analyze Spatio-temporal Analysis of Public Health Events, epidemiological data and others and use it for making spatially informed decision and Disease Risk Assessment with Geospatial Technology.

Module-1

Introduction to Geoinformatics in Public Health: Basics of Epidemiological Data, Measures of Disease Frequency, Role of Remote Sensing in Public Health, Geographic Information Systems (GIS) in Public Health Research, Statistical Methods for Spatial Data in Public Health Research, Global Positioning System (GPS) in Public Health Research.

Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain the basics of public health management in geoinformatics.

Module-2

Spatial Database for Public Health and Cartographic Visualization: Spatial Databases for Public Health Scale of Public Health Data, Digital Cartographic Data, Database Integration, Public Health Data Sharing, Data Mapping Health Information, Visualization and Exploration.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain Spatial database creation for public health management and visualization maps.

Module-3

Data Models and Spatio-temporal Analysis of Public Health Events: Data Used in Spatial Analysis, Types of Spatial Analysis, Temporal Data Analysis and GIS, Spatio-Temporal (ST) Methods, Spatial Epidemiology, Case Studies on Spatio-Temporal Distribution of public health events. Benefits of Spatial and Temporal Analysis in Epidemiology, Locating Health Services.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading tutorials, periodicals, and exercises for practicing at home), explain data models and spatio- temporal analysis of public health events.

Module-4

Exploring Ecology and Associated Disease Pattern: Exploring the Ecology of Vector-Borne Diseases, Ecological Conditions and Disease Interaction, Environmental Impacts of Controlling Disease Pattern and Distribution, Ecosystem Modifications, Loss of Predators and Host Species Imbalance, Land Use and Environmental Change, Rehabilitated Habitat, with Propagation of Reservoir or Vector Populations., A few case studies.

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 explain exploring ecology and disease pattern.

Module-5

Disease Risk Assessment with Geospatial Technology: Components of Early Warning System, Role of Earth Observation in Disease Risk Analysis and Early Warning System, Spatial Scale of Early Warning System, Case Studies: Assessment of Visceral Leishmaniasis Risk in Muzaffarpur District (Bihar), Environment and Spatial Technology in Public Health Planning and Policy,

Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations to Disease risk Assessment with Geospatial technology.

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:

15. Three Unit Tests each of **20 Marks**
16. 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:

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

Suggested Learning Resources:

Books

1. Geospatial Analysis of Public Health, by Gouri Sankar Bhunia and Pravat Kumar Shit, © Springer Nature Switzerland AG 2019.
2. GIS and Public Health by Ellen K Cromley and Sara L McLafferty, Guilford publications 2nd edition 2012.
3. Applied Spatial Analysis of Public Health Data by Lance A. Waller, Carol A. Gotway 1st edition 2004 Wiley-Interscience

Web links and Video Lectures (e-Resources):

- https://1lib.in/book/499542/d6f577

Skill Development Activities Suggested

- Collecting locations of disease affected areas and mapping the same.

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 public health issues,	I, II
CO2	To create Spatial Database for Public Health and Cartographic Visualization	II,III
CO3	Developing Spatio-temporal Analysis of Public Health Events	III,IV
CO4	Understanding the Ecology and Associated vector borne Disease Patterns	V
CO5	Developing Disease Risk Assessment models.	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- II (PEC)

Advanced Earth Observation Systems and Applications (Professional Elective 1)			
Course Code	**22CGI234**	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 physical basis of advanced Earth observations.

ii. To learn interpretation and analysis of Hyper spectral and Hyper spatial resolution data.

iii. To use the advance EO systems in understanding Earth system functioning and climate change.

Module-1

Introduction to Earth Observation system: Definition of Earth Observation System, Sensing Platforms, Airborne Platforms, Spaceborne Platforms, Near-Polar Orbits, Geosynchronous Orbits, Sensors, Optical Sensors, Photographic Cameras, Digital Aerial Cameras, Video Cameras, Radiometers, Electro-Optical Scanners, Microwave Sensors, LiDAR ,The Ground Segment ,Earth-Observing Systems.

Teaching-Learning Process	Structured lectures prepared from standard books written by eminent authors through audio-visual technologies, explain the basics of EOS.

Module-2

International Earth Observation Systems: The Earth Observing System (EOS) program of NASA, Japan (NASDA), Satellite Pour l' observation De La Terre (SPOT), Pleiades Systems, The Earth Observing System Mission, Terra (EoS-Am), Aqua (EoS Pm), Earth Observing-1 (EO-1) Mission, Rapid eye, Sentinel series of satellites under Copernicus programme. Intergovernmental Agencies and Partnerships.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class, explain International EOS.

Module-3

Hyperspectral and Hyper Resolution Data Systems: IRS IA/IB, IRS IC/ID, Resourcesat series, Cartosat series, OCM series, Megha-Tropiques, RISAT series, HySiS, SCATSAT, SARAL, EOS-04, INSAT-series having EO payloads. High Spatial Resolution Remote Sensing Systems, Early bird & Quick bird, IKONOS, Orbview-3, Geoeye-1, Worldview Missions, Hyperspectral resolution sensors of India and world-wide systems.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading tutorials, periodicals, and exercises for practicing at home), explain Hyperspectral and Hyper resolution Data Systems.

Module-4

Microwave Missions: European Remote Sensing Satellite (ERS-1 and -2, ENVISAT), Sentinel-1, Japanese Earth Resources Satellite (JERS-1), Advanced Land Observation Satellite (Alos-1), Canada's RADARSAT Missions, India's Radar Imaging Satellite (RISAT) Missions, Soil Moisture And Ocean Salinity Mission (SMOS)., Soil Moisture Active Passive Mission (SMAP).

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 to exploring Microwave mission and their sensors.

Module-5

Applications of EOSs: Natural resources management, Forest and environmental applications, Cartography and land survey applications, Disaster management, LULC and climate change studies, Meteorological and oceanographic applications, Integrated Water resources conservation and development, River basin management, etc.

Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs to learn the application of EOSs.

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:

17. Three Unit Tests each of **20 Marks**
18. 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:

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

Suggested Learning Resources:

Books

9. Fawaz T Ulaby, Richard K Moore and Adrian K Fung, Microwave Remote Sensing active and passive, Vol. 1, 2 and 3 Addison – Wesly Publication company 1981, 1982, and 1986.
10. Remote sensing and Image Interpretation by Thomas M Lillesand and Ralph W. Keifer fourth Edition, 2002, 2003, Joh
11. Remote Sensing Principles and Interpretation by Floyd F Sabins, 1997, W H Freeman And Company
12. Hyperspectral Imaging Remote Sensing by Dimitris Manolakis, Ronald Lockwood, Thomas Cooledy, 2016

Web links and Video Lectures (e-Resources):

- https://1lib.in/book/499542/d6f577

Skill Development Activities Suggested

To get knowledge about interpretation of Hyper spectral data and Microwave data.

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 advances in Remote Sensing (RS) in terms of sensors specifications	II
CO2	Acquire information about development of EOS in the developed countries.	II, III
CO3	Get familiarised with advanced EO data formats and data types and products.	III,IV
CO4	Develop interpretation and analysis skills for information extraction.	IV,V
CO5	Develop innovative solutions through spatial data analytics (raster data)	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- II (PEC)

Artificial Intelligence in Geoinformatics **(Professional Elective 2)**			
Course Code	**22CGI241**	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 concepts of computational intelligence algorithms and programming.
ii. To acquiring advance technologies like ANN, ML, Deep learning.
iii. To acquire advanced skills to develop genetic algorithms and programming.

Module-1

Introduction to AI: Heuristics, Knowledge Representation, Expert Systems, Neural Computing, Evolutionary Computation, Natural Language Processing, Major Parts of AI. Introduction to Machine Learning: Supervised learning -Naïve Bayes Classifier Algorithm, SVM, Linear, Logistic regression, Decision Tree, Random Forest, Nearest Neighbours, Unsupervised learning- K Means Clustering, Reinforcement learning (ANN).

Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies, explain introduction to Artificial intelligence and Machine learning.

Module-2

Neural Networks: Introduction to neural networks, Building a Perceptron-based classifier, Constructing a single-layer neural network, Constructing a multi-layer neural network, Building a vector quantizer, Analyzing sequential data using recurrent neural networks, Visualizing characters in an optical character recognition database, Building an optical character recognition engine. **Deep Learning with Convolutional Neural Networks:** The basics of Convolutional Neural Networks, Architecture of CNNs, Types of layers in a CNN, Building a perceptron-based linear regressor, Building an image classifier using a single-layer neural network, Building an image classifier using a Convolutional Neural Network,

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class and give lectures on the Neural Networks with deep learning techniques.

Module-3

Recurrent Neural Networks and Other Deep Learning Models: The basics of Recurrent Neural Networks, Architecture of RNNs, A language modeling use case, Training an RN, **Creating Intelligent Agents with Reinforcement Learning:** Reinforcement learning versus supervised learning, Real-world examples of reinforcement learning, Building blocks of reinforcement learning, Creating an environment, Building a learning agent, Self-Organizing Maps in ANN.

Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, exercises for practicing at home), explain RNN and other deep learning techniques.

Module-4

Image Recognition: Importance of image recognition, OpenCV, Frame differencing, Tracking objects using color spaces, Object tracking using background subtraction, Building an interactive object tracker using the CAMShift algorithm, Optical flow-based tracking, Face detection and tracking, Eye detection and tracking.) and Natural Language Processing

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, give the lectures image recognition and NLP.
Module-5	
Genetic Algorithms and Genetic Programming: Understanding evolutionary and genetic algorithms, Fundamental concepts in genetic algorithms, Generating a bit pattern with predefined parameters, Visualizing the evolution, Solving the symbol regression problem, Building an intelligent robot controller, Genetic programming use cases **Artificial Intelligence on the Cloud:** Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs to learn the genetic algorithms and programming and AI on the cloud.

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:

19. Three Unit Tests each of **20 Marks**
20. 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:

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

Suggested Learning Resources:

Books

- Artificial Intelligence, Machine Learning, and Deep Learning by Oswald Campesato 2020
- Artificial Intelligence with Python 2nd edition by Alberto Artasanchez Prateek Joshi packt publications 2020.
- Neural networks and Learning Machines 3rd edition by Simon S Haykin pearson publications 2009.
- Machine learning with R 2nd edition by Brett Lantz packt publications 2015.
- Mastering machine learning with R 2nd edition packt publications 2017

Web links and Video Lectures (e-Resources):

- https://1lib.in/
- Web Tutorials
- GitHub

Skill Development Activities Suggested

- To develop the skill on Machine learning techniques in RS and GIS
- To develop the skills on ANN techniques in RS and GIs.

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 AI and Machine Learning with algorithms.	I,II
CO2	Acquire advance technology ANN with algorithms and programming skills.	II,III
CO3	Acquire advance technology RNN and Reinforcement and programming skills.	III,IV
CO4	Develop skills on image recognition and NLP.	IV,V
CO5	Create and Develop new algorithms and cloud based processing in AI.	V,VI

Mapping of COS and POs

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

Semester- II (PEC)

Programming in .Net, JavaScript and HTML, Cloud Computing **(Professional Elective 2)**			
Course Code	**22CGI242**	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 concepts of Java and HTML programming.
ii. To acquiring advance programming skill on JavaScript working with objects.
iii. To acquire advanced skills to develop Angular JS Modules and Forms.

Module-1

Introduction to Java: Classes: Classes in Java; Declaring a class; Class name; Super classes; Constructors; Creating instances of class; Inner classes. Inheritance: Simple, multiple, and multilevel inheritance; Overriding, overloading. Exception handling: Exception handling in Java.

Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies, explain concepts of Java programming.

Module-2

Introduction to HTML
HTML Basics, Elements, Attributes, Styles, Forms, Form Elements, Input Element Types, Input Attributes, File Paths, Script tag, HTML &XHTML.
Introduction to CSS
CSS Introduction, Syntax, Selectors, Styling, Pseudo class, Pseudo Elements, CSS Tables, CSS Box Models, CSS Opacity, CSS Navigation Bar, Dropdowns.

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class and give lectures on the HTML and CSS programming.

Module-3

Introduction to JavaScript: JavaScript Statements, Keywords, Functions, JavaScript Programs, Operators, Functions Function Parameters, Function Return Types, Data Types, Primitive Types
Working with Objects Object Oriented Programming, Object Creation, Adding Methods of Objects, JavaScript Loops & Iteration, Adding Properties of Objects, JavaScript Conditional Statements, Enumerating Properties, Call-backs, JSON
Angular JS Basics: What is Angular JS? Why Angular JS? Why MVC matters, MVC-The Angular JS way, Features of Angular JS, Model-View-Controller, My First Angular JS app

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 learn concepts of JavaScript with objects and Angular JS basics.

Module-4

Angular Expressions: All about Angular Expressions, How to use expressions, Angular vs JavaScript
Filters: Built-In Filters, Using Angular JS Filters, Creating Custom Filters
Directives: Introduction to Directives, Directive Lifecycle, Binding controls to data, Matching directives, Using Angular JS built-in directives, Creating a custom directive

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, give the lectures on Angular expressions, filters and dircetives.

Module-5

Controllers: Role of a Controller, Controllers & Modules, Attaching Properties and functions to scope, Nested Controllers, Using Filters in Controllers, Controllers in External Files
Angular JS Modules: Introduction to Angular JS Modules, Bootstrapping Angular JS
Angular JS Forms: Working with Angular Forms, Model Binding, Forms Events, Updating Models with a Twist, Form Controller, Validating Angular Forms, $error object
Scope:
What is scope, Scope Lifecycle, Scope Inheritance, Scope & Controllers, Root scope, Scope Broadcasting, Two-way data binding, Scope Inheritance Scope & Directives, $apply and $watch, Scope Events

Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs to set operations of controllers, angular JS Modules, JS Forms and scope.

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:

21. Three Unit Tests each of **20 Marks**
22. 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:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

i. The question paper will have ten full questions carrying equal marks.

ii. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.
The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:
Books

- JavaScript: The Definitive Guide - David Flanagan, 6th Edition
- The Complete Reference Java Seventh Edition –Herbert Schildt
- Programming Language Pragmatics - Michael L. Scott, 2nd Edition, Elsevier,2006
- Operating System Concepts – Avil Sillberschatz, Peter Baer Galvin, Greg Gayne
- Programming Languages Concepts and Constructs - Ravi Sethi, 2nd Edition, Pearson Education, 1996.

Web links and Video Lectures (e-Resources):

- Tutorial on Java and JavaScript and HTML
- https://github.com/
- https://1lib.in/book/499542/d6f577

Skill Development Activities Suggested

- To learn the skills on web development using JavaScript and HTML programming.

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 Java programming skills.	I,II
CO2	Acquire programming skills on HTML and CSS.	II, III
CO3	Get familiarised the JavaScript working with objects and Angular JS Modules.	III, IV
CO4	Develop skills on Angular Expression, Filters and Directives.	IV,V
CO5	Develop skills on Controllers, Angular JS Modules, Angular JS Forms and scope.	V,VI

Mapping of COS and POs

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

Semester- II (PEC)

Location Based Intelligence and Supply Chain Management. **(Professional Elective 2)**			
Course Code	**22CGI243**	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 basics of location science and services
ii. To apply the location science for collecting business intelligence.
iii. To develop network models for supply chain management.

Module-1

Introduction: Location Based Intelligence (LBI) and Location Based Services (LBS) World and Indian Navigation and Positioning Systems, GPS, GALILEO, GLONASS, BEIDOU, NavIC, GAGAN, OMISTAR, Japanese SBAS, etc.

Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies, Explain concepts of LBI and LBS.

Module-2

Advance Remote Sensing: Airborne LIDAR, Terrestrial LIDAR, Mobile LIDAR, Close Range Photogrammetry, Videogrammetry, Integrated Sensor for Asset Mapping (Laser, Image Compass), RADAR, SAR, GPR.
Communication - Sensor / IoT Devices: GSM, Bluetooth, Wi-Fi, Modems, Sensors - Automatic weather station, Rain Gauge, Water / Air Quality monitoring

Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Explain advance remote sensing sensors and communication sensors.

Module-3

Concept of Enterprise GIS: n-Tier Architecture, Database (SQL and No SQL database), Web / Application Engines, Middleware – Enterprise Service Bus, Mobile Application, **Application Development Framework:** COTS / Open Source (.NET / Java); UI Design / Style; AJAX, Modular / Object Oriented Framework, Mobile Platforms (Android, iOS, Windows, Hybrid), **Data Interoperability:** GML, XML, City GML, OGC Compliance - WMS, WFS, WCS, WFS-T, REST, SOAP, Geo JSON.

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 the concepts of enterprise GIS and applications frame works.

Module-4

Advanced data analytics and Location Based Services: Concept of Location, Introduction and General aspects of Location Based Services, Navigation System, Spatial Database, Middleware for LBS, Interoperability through standards, data collection, Data Transmission in Mobile communication systems, Architecture and Protocol for LBS, Network Architecture, Functional entities, Procedures, Privacy options in LBS, Location Intelligence Social Media Network, Crowd Sourcing, Data mining.

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, Acquire knowledge on the advanced data analytics and LBS.

Module-5	
Supply Chain Management: Meaning of supply chain, the components of management supply chain, a few success stories of using LBS in supply chain management.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations, about supply chain management using LBS.

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:

23. Three Unit Tests each of **20 Marks**
24. 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:

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

Suggested Learning Resources:

Books

- Location Based Services Handbook Application, Technologies and security by Syed A Ahson and Mohammad Ilyas 1st edition 2010
- Location-Based Services and Geo-Information Engineering (Mastering GIS: Technol, Applications & Mgmnt) by Allan Brimicombe, Chao Li 1st edition 2009
- Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management by David B. Grant, Chee Yew Wong, Alexander Trautrims 2nd edition 2017

Web links and Video Lectures (e-Resources):

- https://1lib.in/book/499542/d6f577
- On line courses on LBS and Supply chain Management.

Skill Development Activities Suggested

- Learn the Location Based services and information.
- Learn the supply chain models

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 basics of LBS and LBI.	I,II
CO2	Learn the concepts of communication systems used in LBI.	II,III
CO3	Apply the knowledge about global and Indian navigation systems.	III
CO4	Create database and Analyse the location information.	V

CO5	Produce different models for network operation and generate an optimum supply chain.	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	x						
CO5											x	

Semester- II (PEC)

Unmanned Aerial System (UAS) and Applications **(Professional Elective 2)**			
Course Code	**22CGI244**	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 impart basics of UAS, rules regulating their operations.
ii. To familiarise them with data acquisition, processing and analysis.
iii. To develop applications in various sectors.

Module-1	
Introduction: History of Drone/UAS/UAVs, classification of UAV platform, advantages, payload, battery life, system specifications, Regulations for flying drones and DGCA licensing policy, Flight planning, Flight execution(pre, during and post), characteristics of smart UAV.	
Teaching-Learning Process	Structured lectures on the fundamentals prepared from standard books written by eminent authors through audio-visual technologies, Explain the classification of UAV platform, payload structure. Acquire knowledge on flying regulations and flight planning.
Module-2	
Surveying with UAVs: Components of drone survey, large scale project survey, i-base establishment, data acquisition, Consideration for remote sensing payloads, main hardware components, comparison on Total station, GPS and UAV surveying and its accuracy, Techniques of controlling errors, Consideration of GCPs in vertical and horizontal accuracies, Autonomous flight vs. manual and hybrid flight profiles.	
Teaching-Learning Process	Encouraging students to give seminars, testing the outcome of teaching through conduct of internal tests, assignments, discussion in the class. Acquire knowledge on UAV survey, error control techniques, provision of Ground Control Points and flight profiles.
Module-3	

Image processing and Photogrammetry: UAV-based image processing, influencing factors of imaging, Image alignment-Aerial Triangulation, Block adjustment, structure from motion (sfm) photogrammetry, post processing software, point cloud evaluation, drone-based LiDAR technology, DEM, DSM, Contouring; Cut, Fill and Volumetric measurement calculation; orthophoto generation.	
Teaching-Learning Process	Interactive/participative methods, through lectures, discussion, remedial instruction, study assignment (reading books, periodicals, research papers, and exercises for practicing at home). Understand the stages of image data processing, evaluation of point clouds, measurement of volume from 3-D.
Module-4	
Modeling and analysis of UAV data: Concept of modeling, tools in UAV modeling, evaluation of output, Understanding RTK, PPK and GCPs, Overview of popular data processing software platforms and functions. Image interpretations and analysis.	
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, Acquire knowledge on the concept of modeling, usage of popular software, image interpretation.
Module-5	
Applications of UAV data: Application of drone for Surveying, Mapping, Construction, Agricultural, Engineering Land Survey and Architecture, crop insurance, disaster management, etc.	
Teaching-Learning Process	Demonstration method where the faculty member / instructor himself performs a set of operations, Apply the technology in various fields such as Agriculture, Engineering, Disaster Management, etc.

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:

25. Three Unit Tests each of **20 Marks**
26. 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:

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

Suggested Learning Resources:

Books.

- Theory, design, and applications of unmanned aerial vehicles by A. R. Jha Ph.D CRC Press / Taylor & Francis Group 2016.
- UAV or Drones for Remote Sensing Applications, Volume 1 by Felipe Gonzalez Toro, Antonios Tsourdos volume1 2018
- Unmanned Aerial Vehicle: Applications in Agriculture and Environment by Ram Avtar, Teiji Watanabe Springer 2019
- Drone Technology in Architecture, Engineering, and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation by Daniel Tal, Jon Altschuld Wiley 2021

Web links and Video Lectures (e-Resources):

- https://1lib.in/book/11728318/96c900?dsource=recommend

Mapping of COS and POS

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

Skill Development Activities Suggested

i. To develop the UAS system and fly in the field.

ii. To analyse the drone images in different software.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand UAV technology in image capturing. Illustrate flight planning within flying regulations.	I, II
CO2	Develop a plan for large scale survey integrated with Total station and GPS, hardware components and compare different flight profiles.	II,III
CO3	Image processing and Block adjustment. Analyse the products such as DSM, Orthophoto, etc.	III,IV
CO4	To develop different types of models compare RTK, PPK and GCP in model frames, evaluate different software and image interpretation.	IV,V
CO5	Design UAV application in different fields and show it as an essential GIS tool.	V,VI

Semester –II (PCCL)

Geoinformatics Laboratory- II			
Course Code	**22CGIL26**	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) Understand how to use a wide range of vector-based GIS tools to address quarries relevant to natural resource management and hands programming skills.
ii) Understand how to use cloud based programming skills for raster and vector data.
iii) Raster and vector based solution using python programming.

Sl.NO	Experiments
1	Delineation of Lithological/geomorphic units Identification of forest types and area estimation
2	LU/LC Map Preparation, Delineation of Watershed
3	Make the different indices using Model Maker using ERDAS Imagine.
4	Semi Automation algorithm using QGIS.
5	Practical using Google Earth Engine
6	Image classification using R software
7	Raster data processing using python
8	Practical using Google Earth Engine
	Demonstration Experiments (For CIE) if any
9	Practical using Google Earth Engine
10	Raster data processing using python
11	practical on Map server and web server
12	Vector analysis using python programming

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.