VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examinations and Syllabus

M.Tech. Geoinformatics

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21

M.Tech (Geoinformatics)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CGI11	Geospatial statistics	03	--	02	03	40	60	100	4
2	PCC	20CGI12	Principles of Remote Sensing	03	--	02	03	40	60	100	4
3	PCC	20CGI13	Geographic Information Systems (GIS) and Spatial Data Analytics	03	--	02	03	40	60	100	4
4	PCC	20CGI14	Principles of Photogrammetry	03	--	02	03	40	60	100	4
5	PCC	20CGI15	Geospatial Database Management Systems and Programming Skills	03	--	02	03	40	60	100	4
6	PCC	20CGIL16	Geoinformatics Laboratory- I	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	02	--	02	03	40	60	100	2
			TOTAL	**17**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.

The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.

The students shall

(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude.
(3) Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(4) Handle advanced instruments to enhance technical talent.
(5) Involve in case studies and field visits/ field work.
(6) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship:

All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note:

(1) Four credit courses are designed for 50 hours Teaching – Learning process.
(2) Three credit courses are designed for 40 hours Teaching – Learning process.
(3) Two credit courses are designed for 25 hours Teaching – Learning process.

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M.Tech (Geoinformatics)

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II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CGI21	Satellite Data Image Processing and Analysis	03	--	02	03	40	60	100	4
2	PCC	20CGI22	Geoinformatics in Natural Resource and Environmental Management	03	--	02	03	40	60	100	4
3	PCC	20CGI23	Cartography, Geodesy and Global Navigation Satellite Systems.	03	--	02	03	40	60	100	4
4	PEC	20CGI24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20CGI25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20CGIL26	Geoinformatics Laboratory- II	--	04	--	03	40	60	100	2
7	PCC	20CGI27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20CGI24X	**Course title**	**Course Code under 20CGI25X**	**Course title**
20CGI241	Web Applications in Geoinformatics	20CGI251	Computational Intelligence in Geoinformatics
20CGI242	Programming C and C++	20CGI252	Programming in .Net, JavaScript and HTML
20CGI243	Advanced Remote Sensing Techniques	20CGI253	Advanced Geographic Information System
20CGI244	Earth Observation Systems	20CGI254	Unmanned Aerial Vehicles (UAV's) Data Acquisition, Analysis and Applications

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed

internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini-Project/ Internship	Skill Development activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20CGI31	Geoinformatics Project Planning and Management	03	--	02	03	40	60	100	4
2	PEC	20CGI32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20CGI33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20CGI34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20CGI35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20CGII36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
TOTAL				**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20CGI32X	**Course title**	**Course Code under 20CGI33X**	**Course title**
20CGI321	Geoinformatics in Urban Planning and Management	20CGI331	Geoinformatics in Disaster Management
20CGI322	Geoinformatics in Marine and Coastal Resources Management	20CGI332	Emerging Trends in Spatial Data Analytics and Location Based Intelligence
20CGI323	Geoinformatics in Demography, Business, Health and Infrastructure	20CGI333	Geoinformatics in Water Resource Management.
20CGI324	Geoinformatics in Public Health Management	20CGI334	Geoinformatics in weather and climate studies

Note:

1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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M.Tech (Geoinformatics)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	20CGI41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Work Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2 shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

Geospatial Statistics			
Course Code	20CGI11	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Basic Concepts: Histogram – univariate and bivariate, estimation of basic statistical parameters, viz., mean, standard deviation, variance, covariance.

Probability Theory: Introduction to probability theory, kinds of probability – classical or apriority probability, A posteriori or Frequency probability, probability models, an inside to set theory, sample space and events, conditional, joint probability and independence.

Module-2

Special Parametric Families of Univariate and Multivariate Distributions: Introduction and summary, Discrete and continuous distributions – binomial, poisson, exponential, Gaussian/Normal distribution functions, joint and continuous distributions, bivariate and multivariate normal distribution.

Estimation Theory: Introduction and summary, methods of finding estimators, properties of point estimators, unbiased estimation, location or scale invariance, Bayes estimators – posterior distribution, loss function approach, min-max estimators, maximum likelihood estimators

Module-3

Stratification and Sampling: Introduction, sampling, sample mean, sampling from normal distribution, stratification and sampling.

Testing of Hypothesis: Introduction and summary, simple hypothesis testing, composite hypothesis, tests of hypotheses – sampling from normal distribution, chi-square tests, tests of hypotheses and confidence intervals, sequential test of hypotheses**.**

Module-4

Geo-statistics for Spatial Analysis and Modelling: Cluster analysis concepts and techniques, Spatial autocorrelation, Multivariate Correlation, Linear regression, Multiple regressions. Statistical Surfaces-Interpolation, Variogram, Kriging. Geostatistical models, stochastic models, probabilistic models, Deterministic models.

Time Series and Forecasting: Introduction, variation in time series, trend analysis, time series analysis in forecasting

Module-5

Introduction to Spatial data analysis in R: Basic data types and data structures in R Looping, functions, Data types in GIS, Visualising Spatial Data, Spatial Data Import and Export, Working with vector data in R, Working with raster data in R, Classification of Remote Sensing Images.

Course outcomes:

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

The students would develop analytical skills, quality assessment and forecasting techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

(1) 1.Richard I.Levin, David S. Rubin, Sanjay Rastogi, Masood Hussain Siddiqui, Statistics for Management, 7th edition, Pearson Education Inc,2013

(2) Spatial Statistics and Computational Methods, ISBN:0387001360

Reference Books

(1) Chris Brunsdon and Lex Comber, SAGE(2015), "An Introduction to R Spatial Analysis and Mapping"

(2)

(3)

PRINCIPLES OF REMOTE SENSING			
Course Code	20CGI12	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of terms, Concepts and types of remote sensing; evolution of remote sensing technology, stages in remote sensing technology, spatial data acquisition, interdisciplinary nature and relation with other disciplines, applications of remote sensing, advantages of RS over conventional methods of survey.

Basic Principles of Remote Sensing: Electro-magnetic radiation; Interactions between matter and electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Definition of radiometry; Black body radiation; Reflectance; spectral reflectance of land covers; Spectral Signatures; Radiative transfer equation; energy interaction in the atmosphere.

Module-2

Sensors: Types of sensors- passive sensors and active sensors; imaging systems, photographic sensors, characteristics of optical sensors; Sensor resolutions, characteristic of optical detectors; non-imaging radiometers, imaging sensors, Panchromatic, Multispectral, hyperspectral, Optical mechanical line scanner; Push broom scanners and whisk-broom scanners; Imaging spectrometer; space borne imaging sensors, microwave sensors; Thermal sensors.

Platforms: Types of platforms- airborne remote sensing, space borne remote sensing; Atmospheric condition and altitude; Attitude of platform; Attitude sensors; Orbital elements of satellite; types of orbits, Satellite positioning systems including GNSS, IRNSS, etc, Various satellites for Land, Ocean, and atmospheric studies.

Module-3

Image Interpretation and Analysis: Fundamentals of aerial photos and satellite image interpretation; Types of imaging, elements of interpretation, Generations of Thematic maps. Importance of ground truth, reference data, use of smart phone, geo-tagging.

Module-4

Digital Image Processing: Data reception and data products**,** Digital data manipulation and analysis; image rectification – Radiometric correction, Atmospheric correction, Geometric correction;

Module-5

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

Course outcomes:
At the end of the course the student will be able to:
The students will be familiarized with the Fundamentals of Remote Sensing

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Fundamentals of Remote Sensing: George Joseph

(2) Remote Sensing and Image Interpretation: Lillesand & Keifer.

(3) Physical aspects of Remote Sensing: PJ Curran.

(4) Remote Sensing Principles and Interpretation: F.F. Sabins.

(5) Introduction to Remote Sensing: J.B. Campbell.

(6) Introductory Digital Image Processing: A Remote Sensing Perspective, John R Jensen, 4th ed, 2016

(7) Remote sensing Models and methods for image processing by Robert A. Schowengerdt, second edition, 1997, Academic Press

GEOGRAPHIC INFORMATION SYSTEMS & SPATIAL DATA ANALYTICS			
Course Code	20CGI13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to GIS: Definitions, history and evolution, place of GIS in Geoinformatics, Components of GIS, interdisciplinary relations, Discrete geographic objects, Continuous geographic features, Vector and Raster Data structures, GIS application areas, careers in GIS.

Spatial Data Types and Models: Spatial Data types, Non-spatial / Attribute Data types, Tessellations to represent geographic objects, Data models: Basic Data Models –raster and vector, Spaghetti model and Topological model, Advanced data models, raster and vector data formats.

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.

Module-3

Data Processing: Hardware and software needed**,** Database Management Systems (DBMS), Linking GIS and DBMS, Raster and Vector data editing, data conversion, Corrections, scale changes, Coordinate thinning, Georeferencing and map projections, sliver removal, edge matching, interactive editing, rubber sheeting.

Data Quality and Standards: Definition of data quality, components of geographic data quality, Sources of error in geographic data, error propagation and error management; quality assurance & quality control (QA/QC). Geographic data standards, components and types of GIS standards, international GIS standards, interoperability of GIS.

Module-4

Spatial Data Analysis and Integration: Spatial Measurements, Queries, Vector Data Analysis, Raster Data Analysis, Network Analysis, Terrain analysis, spatial analysis of 3-Dimentional data, Data integration and map overlay.

Data Visualization: GIS and Maps**,** Visualization process, visualization strategies, mapping qualitative and quantitative data, map / information dissemination.

Module-5

Advanced Spatial Data Analysis and 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.

Course outcomes:

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

The students are equipped with the basics of GIS

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference 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) Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
(4) GIS – A computing Perspective by Michael F. Worboys, Taylor & Francis, 1995.
(5) Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
(6) Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Michael F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
(7) Geographical Information Systems – Principles and Applications, Volume II edited by David J. Maguire, Michael F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

PRINCIPLES OF PHOTOGRAMMETRY			
Course Code	20CGI14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition and terms, history of photogrammetry, concepts; Basics of photogrammetry; Applications; Photo products; Types of aerial photographs: vertical photographs, tilted photographs, Geometry of aerial photograph: scale, relief displacement, scale of tilted photograph; aerial cameras, its accessories and working principles, Resolution, Image movement ; Analog and digital imaging devices; their characteristics and advantages over other analogue cameras; Photo interpretation.

Stereoscopy: Principles of stereoscopic vision, types of stereoscopes, stereoscopic viewing, stereoscopic parallax.

Module-2

Analytical Photogrammetry: Purpose of fiducial marks, Image coordinate system and Object space coordinate system; image measurements in analytical plotter, Minor Control Points (MCPs), analytical interior orientation, analytical relative orientation, analytical absolute orientation, collinearity equations of vertical and tilted photograph, Epipolar geometry co-planarity equations, Relationship between image and object space

Orientation Procedures: Basic photogrammetric operation in digital environment, Inner Orientation, Exterior Orientation procedures in digital photogrammetry, advantage of digital IO and EO over analogue and analytical system.

Module-3

Project Planning: 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, cost estimation and scheduling, use of Drone / Unmanned Aerial Vehicles (UAV) system in image capturing, Ground Sampling Distance (GSD).

Ground Control for Aerial Photogrammetry: General requirements of ground control points; Selecting photo control points and its location on photo, planning Block Control Points (BCP), Artificial targets for photo identifiable control points, pre-pointing and post pointing, indexing ground control points.

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, entering GPS coordinates, 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, reasons for digital AT superior over analogue AT. Artificial Intelligence (AI) in Bundle adjustment**.**

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.

Introduction to DTM: 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.

Photogrammetry and GIS: Data Model Structure (DMS), input data from photogrammetry for GIS database, photogrammetric applications in GIS.

Course outcomes:

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

The students understand the basics of making measurements using aerial photographs and their applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Elements of Photogrammetry with applications in GIS by Paul R Wolf and Bon A. Dewitt, 3rd edition, 2004, ISBN 007-123689-9

(2) Aerial Photography and Image interpretation second edition by David P paine, and James D Kiser, 2003, John Wiley and Sons Inc. ISBN 0-471-20489-7

(3) Interpretation of Aerial Photographs: TE Avery

(4) Elementary Air Survey: W. Kilford.

(5) Manual of Photogrammetry: ASP Falls Church Virginia.

(6) Modern Photogrammetry by Edward M Mikhail

(7) Photogrammetry Vol. I- Kranss

GEOSPATIAL DATABASE MANAGEMENT SYSTEMS AND PROGRAMMING SKILLS			
Course Code	20CGI15	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

Module-2

Record Storage and Primary File Organizations: Secondary storage devices, buffering of blocks, placing file records on disk, operations on files – heap files and sorted files – hashing techniques.

Index Structure of Files: Single level and multilevel ordered indexes, dynamic multilevel indexes using B- tree and B+ tree

Relational Data Model: Concepts and constraints, update operations on relations, relational algebra, simple examples.

Module-3

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.

Structured Query Language: Data definition in SQL, queries, update statements, views in SQL, DDL, and DML. Relation Database Management System, querying operation. Object–relational database management system (ORDBMS), Distributed databases, web services and XML, OLAP (Online Analytical Processing), OLTP (Online transaction processing).

Module-4

Spatial Database Management System: Introduction, concepts and data model, spatial query, spatial indexing (R- tree, Gird, files), Spatial network, Spatial data mining and Warehousing. Concurrency an Recovery concepts.

Module-5

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, Classes & Objects, Classes & functions, Inheritance and Polymorphism.

Course outcomes:

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

Students will be exposed to basics of database, software tools and familiarization with geospatial database creation.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Elmasri R. and Navathe S.B., "**Fundamentals of Database Systems**", Benjamin/Cummings Publishing Co. Inc. (Addison- Wesley world student series), 2002

(2) Dr. R Nageswara Rao., "Core Python Programming" Second edition.

(3) Trembley J.P. and Sirenson P.G., "**An Introduction to Data Structures with Applications**", Tata McGraw-Hill.

(4) Date C.J., "**An Introduction to Database Systems**", Vol-I, Addison-Wesley.

(5) A.Silberschatz, H.F.Korth and S.Sudarshan, "**Database System Concepts**", McGraw-Hill International Editions,

GEOINFORMATICS LABORATORY- I			
Course Code	20CGIL16	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl. NO	Experiments
1	Familiarization with Maps of different scales (SOI Toposheets) Familiarization with Monochromatic and Multispectral Satellite Imagery (Creation of FCC) Downloading Satellite Images
2	Geometric Correction of Satellite Data(Georeferencing, Mosaicking andSubsetting) Atmospheric & Radiometric Correction of Satellite Images
3	Visual Interpretation of Aerial photographs & Satellite Imagery and area measurement
4	Import and Export of Satellite data to various formats using different
5	softwareCreating Geodatabase using ArcGIS Spatial Data creation using field data in GIS Software environment
6	Feature extraction (Vectorization) using GIS Software Familiarization in open source like (Q- GIS)
7	Stereo Test Familiarization with Mirror Stereoscope Familiarization with the use of Parallax Bar Determination of height of objects from stereo pairs
8	Feature extraction and tracing of details from stereo pairs Demonstration on Digital Photogrammetric Station Orthophoto generation, Mosaicking
9	Installation, Connections using CMD, DBCMD, Simple querying and displaying data, exporting output to a file/DB Simple python and R Programs, Listing, Tuples and string. Array,
10	Visualizing of spatial data in R, Layer stacking of bands and generation of program using R program.

Course outcomes:
At the end of the course the student will be able to:
Students will be equipped with modern tools, softwares of GIS and be confident to implement a GIS project independently or as a team effort.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	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 Appropriate Method for Data Collection, Case Study Method.

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.

*** END OF I SEMESTER ***

SATELLITE DATA IMAGE PROCESSING AND ANALYSIS			
Course Code	20CGI21	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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: The histogram and its significance to DIP, metadata, Univariate and multi-variate statistics.

Module-2

Image Enhancement: Contrast Manipulation –Gray-Level Thresholding- Level Slicing Contrast Stretching – Spatial Convolution – Edge Enhancement – Spatial feature manipulation –Fourier Analysis.

Multi Image Manipulation: Spectral Rationing –Principal and Canonical Components– Vegetative Components, Vegetation indices – Intensity – Hue – Saturation – Colour Space Transformation, Texture transformation.

Module-3

Obtaining ground reference information: Importance of ground truth data collection, instruments for reference data collection, Geo- tagging.

Information Extraction: Pattern recognition, Multispectral Classification – Supervised and Un-supervised Classification methods, Hybrid –Classification – Classification of Mixed Pixels.

Output generation: Graphic Products – tabular data, Digital Information files – Post Classification Smoothing – Classification Accuracy Assessment. Classification error matrix, sampling considerations, Kappa analysis.

Module-4

Data Merging and GIS Integration: Multi-temporal Data merging, Multi-sensor image merging – Merging of image data with Ancillary data- Incorporating GIS Data into automated land cover classification

Change detection: Binary change detection, multi-date composite image change detection, and spectral change vector analysis, visual on-screen change detection.

Module-5

Information Extraction using Imaging Spectroscopy: Radiometric & Atmospheric corrections, Hyper spectral data analysis: Spectral angle mapper**,** Hyper-spectral image analysis techniques, Derivative spectroscopy.

Information extraction using Artificial Intelligence: Expert systems, Decision tree classification, machine learning, Artificial Neural Network concepts, genetic algorithms.

Course outcomes:

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

Students will acquire skills of information extraction from raw data; they would also learn data processing, enhancement and output generation.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) John R Jenson 'Introductory Digital Image Processing- A Remote Sensing Perspective" 4th Ed, 2016, Pearson.
(2) R. A. Schowengergt, 'Techniques for Image Processing and Classification in Remote Sensing'; 1983
(3) Robert A Schowengergt, 'Remote Sensing – Models and Methods for Image Processing' Academic Press 1997
(4) Remote Sensing and Image Interpretation: Lillesand, Keifer and Chipmann.

GEOINFORMATICS IN NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT			
Course Code	20CGI22	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Concepts of natural resources management: Types of natural resources, renewable, non-renewable, Linkages of natural resources with the economy, impact of natural resources utilization on Earth system functioning.

Geological Resources Exploration: Geomorphological Mapping: Mapping geological structures like folds, faults, joints and lineaments, Lithological mapping, Mineral resources mapping and Mineral Resources Information System.

Land Resources Management: Classification of soils and soil mapping, Land Use Land Cover Mapping, Wetland Mapping, Wasteland Mapping, Land Degradation Mapping, Soil Erosion Modelling, Land capability Maps, land irritability maps.

Module-2

Agro-ecosystem management: Forecasting Agriculture output through Satellite and Land-based observations (FASAL), crop stress detection and crop insurance programmes, Thermal and Microwave RS applications, Space inputs for precision agriculture, Site suitability studies for agricultural and horticultural crops, Web-GIS applications in agriculture (e.g., Agricultural Planning and Information Bank, SILKS portal, Bhuvan portal etc.).

Forest Resources management: Mapping of forest cover types, Biodiversity assessment, Forest biomass estimation, forest fire risk zonation, Inputs for preparation of working plan / management plan. Environmental Impact assessment of mining and Industrial activities, Thermal and microwave remote sensing application in forestry, Wildlife ecology applications.

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.

Module-4

Introduction to Environment: Components of environment, biotic and abiotic components, laws of conservation of mass and energy, concepts of ecosystem, bio-geo-chemical cycles, ecological pyramids, food webs, energy flow and ecosystem functioning. Applications in EIA and Cost-Benefit Analysis., quantifying impacts of developmental projects and use in the preparation of EMP.

Sustainable Development: Concept of sustainability, Integrated Mission for Sustainable Development, Watershed characterization, watershed prioritization, Acton Plans for Sustainable development, and Space-based Information System for Decentralized Planning (SIS-DP), Sujala Watershed Project in Karnataka.

Module-5

Water Pollution Applications: Point source pollution mapping, non-point source pollution modelling, methane production area mapping and modelling, oil slicks tracing and monitoring, turbidity and sedimentation mapping, Coastal habitat degradation mapping, Groundwater-pollution hazard assessment.

Air and Atmospheric Pollution Applications: Types of air pollutants**,** Aerosol remote sensing, air quality indexing and mapping, modelling spread and dispersion of smoke plumes from industries and power plants, oil wells, etc.

Applications in Managing Diseases: Use of RS+GIS in studying ecology of vector-borne diseases, mapping epidemic vulnerable zones, management of pandemics (e.g., COVID-19), public health administration.

Course outcomes:

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

Learn the basic concepts of natural resources management, environmental protection, earth system functioning, ecosystem services, sustainable development.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference 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.

CARTOGRAPHY, GEODESY, GLOBAL NAVIGATION SATELLITE SYSTEMS			
Course Code	20CGI23	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Cartography: Definitions, history, terms, cartographic concepts, science and art in cartography, applications, essential cartographic process, conventional signs; plan and profile, representation of relief, conventional cartography, cartographic products.

Introduction to Map: Types of map, map scale, classes of maps, map composition, the mapping process; map projection, Map Numbering Systems, Map Legend, Symbols & Border Information, Label placement; Design & Layout of Maps, geographic content of the map, Base map & Thematic map.
Digital Cartography: Digital cartography, Cartography in context of GIS, Principles of cartographic design in GIS, cartographic generalization, atlases and electronic atlases, hyper maps and digital spatial libraries, conventional cartography vs. Digital cartography; web cartography; overview of cartography.

Module-2

Geodesy
Introduction to Geodesy: Definitions, terms, types, history, classification**,** fundamental goals of geodesy; shape and size of the earth, applications.
Projections : Classification of map projections, Scale factor, Introduction to Azimuthal, Conical and Cylindrical projections with emphasis on LCC, Polyconic and UTM; Transformations.
Geometric Geodesy: Earth, Geoid and Reference Ellipsoid; Everest Spheroid, WGS 84, Vertical datum, Mean Sea Level, geometry of ellipsoid, level surfaces, plumb line and deflection of the vertical, coordinate system in geodesy.

Module-3

Satellite Geodesy: Introduction, Fundamentals of celestial mechanics, Normal orbits, Equation of motion and laws of Kepler, geometry of elliptic orbit, perturbed satellite motion, Lagrange and Gaussian Planetary equations, Gravitational perturbation, Doppler surveying, Advantages of satellite geodesy**.**

Module-4

Introduction to satellite-based Positioning systems: GNSS, Definition, concept, GLONASS, GALILEO, GAGAN, India's NavIC. GPS working principle, Components of GPS – Space segment; control segment, user segment; principle of ranging; types of receivers; GPS satellite signals, GPS pseudo range and code phase tracking, Precise Point Positioning (PPP); satellite geometry and accuracy measure, signal propagation error; phase-tracking error, International GPS Geodynamic Services (IGS); GPS modernization,

Module-5

DGPS – History, need for DGPS, concepts and principles, differential corrections, local area DGPS, wide area DGPS, carrier phase DGPS, LAAS, WAAS; rapid methods with GPS – rapid static method, semi kinematic method, Real time kinematic method. GPS accuracy, GPS pseudolites,
Planning and Realization of GPS Observations: Ground control provision by DGPS for geometric correction of satellite imagery / photograph. Ground control points, types, density, planning, reconnaissance survey, field observations, Criteria for selecting reference station, operational procedures, post processing, Receiver Independent Exchange Format (RINEX).

Applications: Applications in Engineering and Monitoring; Special applications of GPS; GPS technique and project cost, Continuously Operating Reference Station (CORS), applications of Location Based Services, Geo-fencing.

Course outcomes:
At the end of the course the student will be able to:
Familiarization with Maps, Map reading, projection systems, Global Navigation, Satellite Systems & their applications in infrastructure planning & facilities of management.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Satellite Geodesy: Gunter Seebar,

(2) GPS satellite surveying: Alfred leick

(3) Essentials of GPS, N K Agrawal

WEB APPLICATIONS IN GEOINFORMATICS			
Course Code	20CGI241	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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.

Web GIS Data. Classification of WEB GIS data, Geospatial data, type, characteristics, distribution, GIS interactive maps, - general maps at regional level, and very detailed maps down to lot level. Level of Service (LOS) Level of Contents (LOC) Level of GIS Functions or Level of Functions (LOF). A Cross Tabular Matrix (CTM) approach.

Module-4

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.

Module-5

Python Scripting in Spatial data analysis: Graphs, Graphs algorithm, Networking programming, GML processing, GUI programming Database Access, Geoprocessing using python, python in GIS.

Course outcomes:

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

Students understand the concept of client-server model, hosting of server/client application. Development of application and integration with database for data reviewed. Functionalities of development of customized web application.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Zhong- Ren Peng, Ming-Hsiang Tsou, (2003) Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks, Wiley.

(2) Paul A Zandbergen ESRI press, (2013) Python : Scripting for ArcGIS.

(3) Korte, G. B., (2001})"The GIS book": 5th Edition, Onward press, Australia.

PROGRAMMING IN C AND C++
(Professional Elective -I)

Course Code	20CGI242	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Functionalities of Computer, Generations of computers, Types of Computers, Components of Computer, Central Processing Unit, Input/output Devices, Memory, RAM,ROM, Motherboard, Memory Units, Ports, Data & Information, Networking

Operating Systems: Operating system Structures, Process Management, memory management, Storage management, Protection & Security, Virtual machines, Distributed systems, Influential Operating systems, Case Studies: Linux, Windows

Module-2

Introduction to C (Procedure Oriented Programming): History of Programming language, importance of computer languages, Understanding Compiler. Input /Output functions: Console input output, Formatted input output, Contants, Variables. Data types and operators: types and uses of various operators and Expressions Control structures: Various looping mechanism, types of loops.

Module-3

Introduction to Array: Understanding Array, Working with Single multidimensional array. Limitations of array, handling the strings Structure Unions. Introduction to functions: Need of function, defining, calling function, different types of functions. Pointer, pointer with function and structure. File handling: Reading and writing the data to file.

Module-4

Introduction to C++ (Object Oriented Programming): Understanding Compiler. Input /Output functions: Console input output, Formatted input output, Importance of OOP Understanding Classes, objects, Methods and properties. Characteristic of OOP: Abstraction, Inheritance, Polymorphism, Encapsulation. OOP and POP: Difference between OOP and POP.

Module-5

Constructors and destructors: Creating classes and objects. Memory allocation for objects. Passing and returning of objects as parameters. Static data members and static member functions Access modifiers: modifying access of Classes, methods using public, private keywords. Functions and Operators: Function overloading and Overriding, Friend functions, Virtual base class, Virtual functions.

Course outcomes:

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

Basics of computer components, Basic of Operating System (OS), CPU & Softwares. Skill will be imparted to web enable the spatial data.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Operating System Concepts – Avil Sillberschatz, Peter Baer Galvin, Greg Gayne

(2) Programming Language Pragmatics - Michael L. Scott, 2nd Edition, Elsevier,2006

(3) Programming Languages Concepts and Constructs - Ravi Sethi, 2nd Edition, Pearson Education, 1996

(4) JavaScript: The Definitive Guide - David Flanagan, 6th Edition

(5) C++: The Complete Reference : The Complete Reference C++ 4th Edition

(6) .Object Oriented Programming with C++ 6th Edition by Balaguru Swamy

(7) The Complete Reference C 4th Edition (English, Paperback, Herbert Schildt)

ADVANCED REMOTE SENSING TECHNIQUES
(Professional Elective-I)

Course Code	20CGI243	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Thermal Remote Sensing: Thermal radiation principles, processes and thermal properties of materials, thermal conductivity, IR detection and imaging technology, thermal sensors and scanners, spatial resolution and ground coverage, geometric characteristics of across track and along track IR imageries, distortions and displacements, radiometric calibration of thermal scanners, interpretation of thermal IR imagery, temperature mapping with thermal scanner data, thermal inertia mapping, apparent thermal inertia, applications of thermal remote sensing in agriculture, geology, hydrogeology, urban heat budgeting.

Module-2

Passive Microwave Remote Sensing: Basics of spectral characteristics of microwave radiometers, passive microwave scanners and sensors, applications in atmosphere, ocean and land.

Module-3

Active Microwave Remote Sensing: RADAR- definition and development, RADAR equation, Radar Systems –airborne and space borne Side Looking Radars (SLR), and Synthetic Aperture Radar (SAR) and their components, imaging systems, scattering theory, factors affecting radar resolution, geometric characteristics of radar imagery, RADARgrammetry, coherence, phase unwrapping, polarization, image registration, baseline determination, measurement of surface topography and deformation analysis, RADAR image interpretation. SAR interferometry- principle, image processing, factors affecting SAR interferometry, Applications of active microwave sensors.

Module-4

LIDAR Remote Sensing: Physics of laser, laser interaction with objects, LiDAR: principle, Multiple return, Components of LiDAR Airborne Laser Terrain Mappers (ALTM), system, INS-GPS integration, measurement of laser range, calibration, flight planning, components of LiDAR, raw data and DEM processing, data classification techniques, LiDAR data integration with spectral data, Space- borne LIDARS, LiDAR Applications

Module-5

Hyper-spectral Remote Sensing: Hyper-spectral Imaging: Hyper spectral concepts, data collection systems, calibration techniques, data processing, N-dimensional scatter-plots, Spectral angle mapping, Spectral mixture analysis, Spectral Matching, Classification techniques, airborne and space-borne hyperspectral sensors and applications.

Course outcomes:

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

Students will get exposure to modern and advanced satellite remote sensing techniques including retrieval of physical parameters like SST, LST, Terrain Analysis etc.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) 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.

(2) Philip N Slater, Remote Sensing, optics and optical systems. 1980

(3) Robert M Haralick and Simmonet, Image processing for remote sensing 1983.
(4) Robert N Colwell Manual of Remote sensing Volume1, American Society of Photogrammetry 1983.
(5) Travett J W Imaging Radar for Resources surveys, Chapman andHall, London 1986.
(6) Remote sensing and Image Interpretation by Thomas M Lillesand and Ralph W. Keifer fourth Edition, 2002, 2003, John
(7) Remote Sensing Geology by Ravi P Gupta, Second edition, 2003, Springer
(8) Remote Sensing Principles and Interpretation by Floyd F Sabins, 1997, W H Freeman And Company

EARTH OBSERVATION SYSTEMS			
Course Code	20CGI244	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Earth Observation system: Introduction 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, Passive Microwave Sensors, Active Microwave Sensors, LiDAR ,The Ground Segment ,Earth-Observing Systems .

Module-2

International Satellite Programmes: The Landsat System, Satellite Pour l' observation De La Terre (SPOT), Pleiades Systems, The Earth Observing System Mission, Terra (Eos-Am), Aqua (Eos Pm), 8 Earth Observing-1 (Eo-1) Mission, Rapid eye.

Module-3

Indian Remote Sensing Satellites Missions: IRS IA/IB, IRS IC/ID, Resource sat series, Cartosat series, OCM series, RISAT series, HySi.

Module-4

Hyperspectral and Hyper Resolution Data: 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.

Module-5

Microwave Missions: Spaceborne Imaging Microwave Systems , Seasat , European Remote Sensing Satellite (Ers-1 And -2) , Sentinel-1 Japanese Earth Resources Satellite (Jers-1), Advanced Land Observation Satellite (Alos-1), Radarsat Missions, Radarsat-1 , Radarsat-2 , Radarsat Constellation Mission (Rcm) , Envisat , Radar Imaging Satellite (Risat) Missions, Radar Imaging Satellite (Risat-2), Radar Imaging Satellite (Risat-1), Soil Moisture And Ocean Salinity Mission (Smos)., Measurement Principle , Soil Moisture Active Passive Mission (Smap).

Course outcomes:

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

- Existing and emerging earth observation system.
- Various satellite platforms
- IRNNS program and its data processing
- Satellite data structures

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Aoki, S., 2006. Nihon no Uchu Senryaku (Japanese Space Strategy), Keio University Press, Tokyo, p. 309.

(2) Richards and jia "Global Earth Observation Systems".

(3) Richards and jia "Global Earth Observation Systems".

COMPUTATIONAL INTELLIGENCE IN GEOINFORMATICS (Professional Elective –II)			
Course Code	20CGI251	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Computational Intelligence: An overview of computational intelligence: various paradigms - Expert Systems, Artificial Neural Network, Fuzzy Logic, Genetic Algorithms/Programming, History and development.

Expert Systems: An Overview of expert systems, Knowledge Representation, Symbolic Representation, Rule- Based Systems, Logic Programming, Knowledge Acquisition, Heuristic Classification, Tools for Building Expert Systems, Machine Learning, Hybrid Systems.

Module-2

Artificial Neural Networks : Fundamental Concepts: Introduction to Neural networks, Biological neurons and their mathematical models such as McCulloch-Pitts, Perceptron and AdaLine, Linear separability problem, Different types of learning algorithms: Supervised, Unsupervised and Reinforcement learning algorithms.

Module-3

Multi-layer Feed Forward Networks: Multi-Layer Perceptron (MLP) with generalized delta rule, delta rule with momentum term, Radial Basis function network (RBF) and its learning algorithms, Neural network design: selection of hidden layer, hidden node, learning rate, number of epoch, initialization of weight matrix and selection of training and testing patterns. Application to function approximation, pattern classification.

Competitive and Recurrent Networks: Competitive network: Hebbian learning algorithm, Winner-Take-All learning, Self-Organizing feature map network, Principal component network and Independent component network, Recurrent network: Basic models, Hopfield network: network dynamics, learning methods, application to pattern recognition and storage problems.

Module-4

Fuzzy Logic: Introduction and background to fuzzy logic: Linguistic variables, Membership functions, Fuzzification, Defuzzification, Basic operations on fuzzy sets, Fuzzy relations, Fuzzy c-means clustering, Applications to pattern recognition, data analysis.

Module-5

Genetic Algorithm and Programming

Introduction and background to genetic algorithm, Darwinian principle, Genetic operators, Schema theorem, Fitness and scaling problems, Introduction to Genetic programming, Introduction to Automatically Defined Functions -- Regression example. Application of GP to pattern recognition problems.

Course outcomes:

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

Artificial Intelligence is the law for Network Route Planning and in Image analysis. Students are exposed to the fundamental of Artificial Intelligence and also concepts of algorithm development. Its application in RS & GIS fields

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Expert Systems and Applied Artificial Intelligence, E. Turban, Macmillan, 1992

(2) Introduction to Expert Systems, Peter Jackson, Harlow, England: Addison Wesley Longman, 1999.

(3) Neural networks: A comprehensive Foundation, Simon Haykins, Prentice Hall Inc., 1999.
(4) Fuzzy sets, uncertainty and information, Geroge J. Klir, Tina A. Folger, Prentice Hall inc., 2000.
(5) Genetic Algorithms in Search, Optimization, and Machine Learning, Goldberg, David Edward, Addison-Wesley Pub. Co.,
(6) Genetic Programming: On the Programming of Computers by Means of Natural Selection, J. Koza, The MIT Press, 1992.

PROGRAMMING IN .NET, JAVASCRIPT AND HTML (Professional Elective -II)			
Course Code	20CGI252	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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, Multi Threaded Programming: What are threads? How to make the classes threadable; Extending threads; Implementing runnable; Synchronization; Changing state of the thread; Bounded buffer problems, read-write problem, producer- consumer problems.

Module-2

Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField;The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable.

Module-3

Introduction to java script: importance of Java script, creating sample program. Data type operators: Various Data type and its importance. Understanding and using various types of operators and Expressions Various are looping mechanism, Understanding loops. If else and Switch case Binding

Module-4

Iterative mechanisms:: Objects, Arrays, Functions, Classes & Modules, Pattern Matching with Regular Expressions. Creating dynamic web pages Understanding DOM API, Dojo Framework and Digits. Debugging in web application: working with developer tools in browser. Layout engines used in various browsers

Module-5

HTML (Hyper Text markeup Language): Syntax, Elements, Attributes, Headings, Paragraphs, Styles, Formatting, Comments, Colours, CSS, Links, Images, Tables, Lists, Blocks, Classes, HTML

Course outcomes:

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

Basics of computer components, Basic of Operating System (OS), CPU & Softwares. Skill will be imparted to web enable the spatial data.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Computer Architecture A Quantitative Approach - John L. Hennessy, David A. Patterson, 4th Edition, Elsevier, 2006

(2) Operating System Concepts – Avil Sillberschatz, Peter Baer Galvin, Greg Gayne

(3) Programming Language Pragmatics - Michael L. Scott, 2nd Edition, Elsevier,2006

(4) Programming Languages Concepts and Constructs - Ravi Sethi, 2nd Edition, Pearson Education, 1996.

(5) How to think like a computer scientist : learning with Python - Allen Downey, Je_rey Elkner, Chris Meyers.

(6) The Complete Reference Java Seventh Edition –Herbert Schildt

(7) JavaScript: The Definitive Guide - David Flanagan, 6th Edition

ADVANCED GEOGRAPHIC INFORMATION SYSTEMS (Professional Elective-II)			
Course Code	20CGI253	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Geodatabase: Basic geodatabase and structure, Types of geodatabase, Advantages of geodatabase, Basic geodatabase structure, Topology, relational classes, geometric networks, raster data - Creating geodatabase, organizing data, defining database structure - Understanding spatial reference in geodatabase – Modifying spatial domain, Simple feature creation in geodatabase, Creating and editing map topology, - Types of geodatabase annotation - Adding behaviour to a geodatabase.

Module-2

Surface Analysis: Slope and aspect - Hydrologic functions - View sheds - Shaded relief maps Spatial analysis - Surface analysis - 3-D analysis – Map algebra - Cell statistics DEM, DTM and TIN

Model Building and Spatial Modelling: Why build models - Anatomy of a model - Model elements - Introduction to scripting. The object model in GIS. Vector and raster data extraction for modeling, Land use classification, Temporal land use analysis, Spatial modeling procedure, Cellular automata modeling, Methods of spatial interpolation.

Data Accuracy, Error Assessment and Propagation: Spatial data standards, Positional accuracy, Accuracy measurement techniques, Error in linear and area feature, Land use classification accuracy, Attribute accuracy, Error propagation in spatial attribute

Advanced Cartography: Annotations, labels, and metadata; Map making with advance tricks Working with labels and annotations – Managing (organizing and modifying) labels and annotations - Metadata file creation and management with new tools.

Module-3

Multi-Criteria Decision Analysis and Spatial Decision support System (SDSS): Elements of multi-criteria decision analysis, classification of decision problems, criteria evaluation, hierarchical decision alternatives and constraints, alternatives and decision variables, deterministic variables, criteria weighting , estimation weights, ranking methods, decision rules, multi-attribute decision rules, sensitivity analysis, SDSS, what is SDSS, requirements multi-criteria spatial decision support systems (SDSS). SDSS for location planning, application-specific capabilities.

Module-4

Expert GIS : Introduction to concepts of Expert GIS, Data formats, Proprietary file formats, translator and transfer formats, open formats, standards, metadata, standards gazetteer, XML and GML, GIS and databases Spatial databases, relational databases, object databases, advanced database technology, derived mapping – generalization, text placement, automated cartography, data from imagery, Web GIS, simple maps in web pages, web software, Mobile GIS –positioning, location based services, personal and vehicle navigation, LBS for mass market, telematics. –Applications

Module-5

Enterprise GIS : User need assessment; old and new spatial database models, SDE layers, Geodatabase, architecture design, capacity planning(Hardware), security planning, RDBMS, RDBMS software selection, GIS software selection, planning for migration. Enterprise GIS management.

Case Studies: GIS analysis in transportation, GIS analysis in water management, urban development, environmental analysis, hydrological modeling, Habitat suitability modeling, virtual cities 3D modeling and visual simulation, Automata based models of Urban system

Course outcomes:

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

Students will be equipped with modern tools, soft wares of GIS and be confident to implement a GIS project independently or as a team effort.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

(1) GIS and Multi-criteria decision analysis by Jacek Malczewski, John Wiley and sons.

(2) Expert Systems by Peter Jackson, third edition, 1999, Pearson Education.

(3) Concepts and Techniques of Geographic Information Systems, CP Lo, Albert K W Yeung, 2005 Prantice Hall of India

(4) Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.

(5) Remote sensing and Image interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.

(6) Geographical Information Systems – Principles and Applications, Volume I & II, edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.

UNMANNED AERIAL VEHICLES (UAV'S) DATA ACQUISITION, ANALYSIS AND APPLICATIONS			
Course Code	20CGI254	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Introduction to Drones, History of Drone/UAS/UAVs, payload, battery life, Specs for good results, Regulations of DGCA and Drone license, Pre, Post Flight planning- Flight execution and photography, data collection.

Module-2

Surveying with UAVs

Consideration for hardware selections, comparison on surveying drone and its accuracy, Techniques of controlling errors, Consideration of GCP in vertical and horizontal accuracies, Planning and estimation of drone surveying jobs, Autonomous flight vs. manual and hybrid flight profiles

Module-3

Image processing and Photogrammetry

Aerial Triangulation, post possessing software's, Analyzing Data, Contouring, DEM, DSM, Cut, Fill, and Volumetric Measurement Calculation and orthophoto generation.

Module-4

Modeling and analysis of UAV data

Introduction to mapping and modeling concepts, Understanding RTK, PPK and GCP's,Overview of popular data processing software platforms and functions. Image interpretations and analysis.

Module-5

Applications of UAV data

Application of drone for Surveying & Mapping, Construction, Agricultural, Engineering Land Survey and Architecture, crop insurance, disaster management, etc.

Course outcomes:

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

- Data collection by UAV'S.
- Surveying with drones.
- Concepts of Image processing techniques.
- Modeling and mapping by drone data.
- Applications of drones.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) One Nation Under Drones: Legality, Morality, and Utility of Unmanned Combat Systems by John E. Jackson

(2) Drones and Support for the Use of Force by James Igoe Walsh.

GEOINFORMATICS LABORATORY- II			
Course Code	20CGIL26	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Sl.NO	Experiments
1	Image Enhancement Techniques(Spatial, Spectral and Radiometric)
2	Classification Techniques – Unsupervised and Supervised Classification and Change Detection Calculation of area and Accuracy Assessment
3	Editing Vector Layers, Spatial and Non spatial querying using open source and proprietary GIS packages, Spatial data quality evaluation
4	Overlay Analysis, Buffer Creation and Analysis,
5	Network Analysis, DEM and TIN Creation
6	Familiarization with GPS Instrument and Software GPS Survey of Natural and Man-made features GPS & GIS data integration and output preparation
7	Delineation of Lithological/geomorphic units Identification of forest types and area estimation Generating the Indices maps Field visit and soil profile study
8	LU/LC Map Preparation Delineation of Watershed
9	Image pre-processing with R programming
10	Vector analysis with R

Course outcomes:

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

Students will be equipped with modern tools, softwares of GIS and be confident to implement a GIS project independently or as a team effort.

TECHNICAL SEMINAR			
Course Code	20CGI27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20CGI27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

*** END OF II SEMESTER***

GEOINFORMATICS PROJECT PLANNING AND MANAGEMENT			
Course Code	20CGI31	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of plan, project, program and scheme. Functions of planning and management. Components of Geoinformatics project. Overview of Geoinformatics projects, types of projects.

GIS Project Planning: Project phases and Project life cycle, project stakeholders, system development lifecycle, Project initiation, systems planning and methodology, systems analysis and user requirements studies, GIS software evaluation and selection, Hardware considerations and acquisition, Geographic database design, Techno-economic feasibility analysis, project formulation, product and project design, project report preparation. Project proposals.

Module-2

Project Costs: Elements of cost, costing techniques, resources planning, cost components of a geo-informatics project-men, Hardware and software costs, cost of Remote Sensed Data /Imageries, Maintenance cost, organizational cost, service charges, outsourcing cost, pricing the product / service. Cost budgeting.

Project Appraisal: Project appraisal Methods -Discounting and non-discounting techniques, Benefit Cost Ratio, Break Even Point Analysis, Cost and Return simulation, return on investment.

Project Time, Quality and Cost Management: Project scheduling- network analysis, PERT and CPM techniques, Gant chart, time and cost crashing. Project cost and time control, feedback mechanisms, quality control / quality assurance. Data standards, interoperability, ISO standards.

Module-3

Planning A Geo-informatics Project: Geo-informatics projects, Corporate or Enterprise GIS, Health GIS, Census GIS, Market/Business GIS, GIS Strategic Plan, Needs Assessment and Requirements Analysis, Organizational Involvement, Evaluating Existing Data, Accuracy, Completeness. Maintenance, Software and hardware Selection, Technical Environment, Assessing Costs and Benefits, Pulling the needs and ends together.

Project Scope and Risk Management: Project scope definition, scope verification, scope change control, risk management planning, project risk identification, quantitative and qualitative risk analysis, risk response planning, risk monitoring and control.

Module-4

GIS Organizations: Vision, mission, goals and objectives, organizational chart, organizational approaches- democratic, authoritative, roles and responsibilities of personnel, recruitments, training, motivation, organizational behaviour, conflict resolving, team building, promotion/ demotion.

Module-5

Management Issues in GIS: Making GIS efficient, effective and safe to use, data as management issue, GIS as a management tool, impact of broad societal issues.

Trends in GIS: Enterprise GIS, Corporate GIS, BPO in GIS, Spatial Data Warehouse, Interoperability and Open GIS, NSDI.

Course outcomes:

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

Students will learn the essentials of project costing, scheduling, monitoring & management of the projects. They would acquire skills related to project appraisal.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books
(1) A guide to the Project Management Body Of Knowledge-2000 edition, Project Management Institute, USA
(2) The Design and Implementation of Geographic Information Systems, John E. Harmon, Steven J. Anderson by Wiley Publishers ISBN: 0-471-20488-9
(3) Geographic Information Systems, abridged by Paul A Longley, Michael F Goodchild, David J. Maguire, and David W. Rhind, second edition, 2005
(4) Project Management using PERT / CPM – Weist & Levy, PHI
(5) Concepts and Techniques of Geographic Information System by C P Lo Albert K W Yeung, 2002, EEEPrantice Hall of India Private Ltd.
(6) Project Management PERT / CPM & Precedence Diagramming
(7) UNIDO Guide to Project Appraisal

GEOINFORMATICS IN URBAN PLANNING AND MANAGEMENT
(Professional Elective- III)

Course Code	20CGI321	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Large Scale Mapping and Cadastral Information System: Technologies for Large Scale Mapping (LSM) of urban areas – Aerial Photography - High- Resolution Satellite Remote Sensing - Issues in Large Scale Mapping (LSM), Integrated approach to LSM using Total Station and DGPS, Concept of Cadastre, History of cadastral survey, Cadastral survey methods and survey maintenance, cadastral map reproduction, development of cadastral information system, need for Land Information System (LIS), SVAMITVA (Survey of villages and mapping with improvised technology in village areas).

Module-2

Urban Mapping and Spatial Analysis: Urban process, the physical structure and composition of urban areas, Urbanisation process, and growth trend, problems of urbanisation, information requirements for perspective planning. Urban GIS, spatial analytical techniques, statistics and visualization, conceptual modelling of urban processes; Urban Sprawl: Change detection in Land Use Land Cover monitoring physical growth of urban area, trends in urban sprawl and associated problems.

Urban Planning: Plans – planning needs, types of plans, urban and regional planning; LU/LC mapping Urban Planning: Zoning of Land Use, Zonal Land Use Plan, Object oriented GIS data modelling for urban design, landscape architecture, urban infrastructure, Site selection for urban development, site suitability analysis for utilities and civic amenities, interim master plan, Master Plan.

AM/FM Applications: GIS/GPS applications in Automated mapping (AM) and Facility Management (FM), Urban infrastructure planning and management.

Module-3

Demographic and Business Applications: Geo-Demographics Population distribution maps by age, gender, education, occupation, socioeconomic grouping, health criteria index, crime rates and types.

Business GIS - Market analysis, retail site selection, retail planning, health care planning, financial services planning, educational institutions planning, water demand modelling and planning distribution network, household analysis, real estate inventory, mapping and GIS. Crime Analysis, Electoral Redistricting.

Network Applications: Transportation demand modelling and analysis, transportation planning, Vehicle Routing and Scheduling, Vehicle Tracking and Navigation: Integration of GPS and GIS data, intelligent transportation systems, streets network analysis; pavement management system (PMS) Water and sewage related- GIS based urban water demand analysis, pipeline planning and alignment.

Module-4

Urban Ecology Applications: Urban area heat budgeting, Logistic management and spatial planning for solid waste management. Noise pollution, Visibility pollution.

Cultural GIS: Mapping heritage buildings, monuments, places of worship, tourism spots, recreation facilities, sports facilities and serving on web GIS.

Module-5

Urban Governance (E- Governance): Governance of urban regions: mapping administrative boundaries, city base map generation, property enumeration and property GIS, Asset mapping; tax revenue rationalization, e-governance, Metropolitan Spatial Data Infrastructure, metropolitan information management system, Urban GIS and Smart Cities.

Course outcomes:

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

Basics of Urban Planning, Demographic changes & an assessment of infrastructure needs will be learnt.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Remote Sensing and Urban Analysis Jean-Paul Donnay et al, GISDATA Series, 2001, Taylor and Francis Inc.

(2) GIS and GPS based asset management for Road and Railway Transportation Systems - GPS based vehicle tracking system. www.gisdevelopment.net, www.esri.com, www.aboutgis.com

GEOINFORMATICS IN MARINE AND COASTAL RESOURCES MANAGEMENT (Professional Elective -III)			
Course Code	20CGI322	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Types of marine and coastal resources, properties of sea water, thermocline and pycnocline, air-sea interactions, Upwelling and Downwelling, El Nino-Sothern Oscillation (ENSO) phenomena.
Generic spatial data-processing tasks: Sensor calibration, Atmospheric correction, Positional registration, Geophysical product derivation, etc.

Module-2

Oceanographic Studies: Interdisciplinary nature of oceanography, Remote sensing of oceans, ocean processes, satellites and sensors for ocean studies, spectral bands for study of ocean parameters,
Physical oceanography applications – Estimation of wind velocity & direction, sea surface temperature, upwelling, sea surface velocities, mixed layer depth, salinity, ocean colour, etc.;
Biological oceanography applications - Phytoplankton mapping, Ocean primary production, potential fishing zones.

Module-3

Coastal Engineering Applications: The Coast- beaches and shoreline processes, Coastal erosion and protection, Hydrodynamics of pollution dispersion, Modelling of suspend sediment. Coastal Bathymetry; Coastal Geomorphology, Coastal habitat (Mangrove, Coral reefs, wet lands etc.); Integrated Coastal Zone Management.

Module-4

Coastal Zone Applications: Introduction – Major issues/problem – coastal wetland classification – thematic maps on coastal resources- site suitability analysis for aquaculture – Coastal Regulation zone – Coastal aquifer modelling using GIS- Integrated coastal Zone Management – conflict analysis – Resources association.

Module-5

Meteorology Applications: Estimation of weather and climate parameters, and modelling aspects, global climatology. Rainfall mapping, potential and actual Evapo-transpiration, Hydrometeorology: atmospheric water content, cloud mapping, rain forecasting, artificial rain, cyclone forecasting.

Course outcomes:
At the end of the course the student will be able to:
Learn the basic relationship between Marine & Coastal Resources Air-Sea interactions & basic of weather monitoring & climate change.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Introduction to Environmental Remote Sensing Barrett E.C., Curtis, I.F., Chapman and Hall, New York, 1982

(2) Remote Sensing principles and Interpretations Sabins, F.F., (Ed) W.H. Freemanand 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) Coastal and Marine Geo-Information Systems: Applying the Technology to the Environment. David R. Green, Stephen

GEOINFORMATICS IN DEMOGRAPHY, BUSINESS, HEALTH AND INFRASTRUCTURE PLANNING
(Professional Elective -III)

Course Code	20CGI323	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Geodemographics: Spatial distribution of population according to age, gender, and socio-group, racial and socioeconomic segregation, geoethnography, labour market exploration, health equality, crime analysis, population and environmental linkage, spatial planning, temporal analysis, spatial dispersal and sparsity, changing pattern of demography, GIS functionality for demographic analysis.

Module-2

Business GIS: Competitive market analysis, trade area analysis, site analysis and selection for distribution centers and shopping centres, customer service stations, facility management, target marketing, market demographics demographic analysis for marketing based on customer profiling, lifestyle matching and consumer behaviour, sales promotion planning, advertisements targeting; geo-market segmentation by product category, sales territory rationalization, forecasting market potential and modeling sales.

Module-3

Health GIS: Spatial epidemiology: RS and GIS in study of epidemics and their control- malaria, leprosy, polio, TB, filariasis, dengue, chikengunya, cholera, AIDs Cancer; disease mapping, ecological analysis, disease clustering, bioterrorism and disease surveillance, infectious disease modeling. Health infrastructure and facility location mapping, planning future health facility requirement, disease surveillance and monitoring and other health indicators, Karnataka Health Systems Development Project, health and disease atlas of India and medical geography, internet and health GIS, integrated disease surveillance system, spatial distribution and spread of diseases.

Module-4

Power: Site suitability assessment for power plants- thermal, hydroelectric, nuclear, mini-hydroelectric power plants, wind power, and impact assessment. Electrification and network planning, GIS in management of electricity distribution network, underground cable maintenance and management in power sector, GIS as decision support system,

Telecommunication: Applications of GIS in telecommunication industry, internet GIS for telecommunication, facility management in telecommunication industry, optical fiber cable alignment.

Transportation: Transportation GIS: vehicle routing and scheduling, optimizing routes and schedules, delivery routing/fleet management, vehicle navigation, vehicle tracking system, intelligent transportation system

Module-5

Tourism: Tourism internet GIS applications, tourism planning, tourism marketing, tourism research, tourism impact, ecotourism planning,

Archeology: RS and GIS applications in mapping cultural heritage, spotting historical monuments and sites, identification of palaeorivers, GIS of historical maps.

Course outcomes:

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

The students will be exposed to the concepts of spatial Based Decision Supports in the areas of Health, Power, Transportation etc., and how the spatial based related data can be analysed and applied for better facilities.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books
(1) "GIS and GPS based asset management for Road and Railway Transportation Systems "- GPS based vehicle tracking system.
(2) www.gisdevelopment.net, www.esri.com www.aboutgis.com

GEOINFORMATICS IN PUBLIC HEALTH MANGEMENT			
Course Code	20CGI324	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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.

Module-2

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

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.

Module-4

Exploring Ecology and Associated Disease Pattern: 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.

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,

Course outcomes:

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

The students will be exposed to the basics of epidemiology, role of environment and climate change in the spatio-temporal dispersion of public health events, get equipped with multiple novel spatial statistical and GIS approaches mange the public health events.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Geospatial Analysis of Public Health, by Gouri Sankar Bhunia and Pravat Kumar Shit, © Springer Nature Switzerland AG 2019.

(2) Climate Change – A Holistic View, by RR Kelakar, 2010. B.S. Publications, Hyderabad

(1) Satellite Meteorology, 2nd Edition, RR Kelakar, 2017, CRC Press, B.S. Publications, Hyderabad.

GEOINFORMATICS IN DISASTER MANAGEMENT (Professional Elective - IV)			
Course Code	20CGI331	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Definition, classification of disasters, Institutional frame work for disaster management in India, importance of Geoinformatics in Disaster Management, Satellites and sensors for disaster management. Role of satellite-based communication systems in disaster management.

Module-2

Drought: Drought types and causes, delineation of drought vulnerable areas mapping, Use of RS and GIS in Meteorological and Hydrological drought assessment. RS and GIS role in agricultural drought severity mapping and monitoring.

Forest Fire: Forest fire causes, forest fire management using geospatial information system, forest fire risk zonation mapping.

Module-3

Cyclones: Causes for cyclone formation, Life cycle of a cyclone, Cyclone tracking, Cyclone early warning, impact assessment and management.

Floods: Types of floods, causes and mitigation measures, flood early warning, flood affected area mapping and damage assessment, flood risk analysis using RS and GIS.

Module-4

Earthquakes and Tsunami: Causes of earthquake, damage evaluation and loss estimation, RS and GIS application for post-quake rehabilitation, micro-level seismic zonation, Tsunami- types, causes, RS and GIS applications for post Tsunami damage assessment and rehabilitation.

Volcano: Causes of Volcanoes, types of volcanoes, role of remote sensing in mapping damage and volcano hazard management.

Landslide: Landslides, causes, types, land slide susceptibility mapping, geospatial technology for landslide management.

Module-5

Soil Erosion: Soil erosion by water and wind. Application of RS and GIS for soil erosion and sediment estimation, desertification studies, estimation of soil erosion, soil erosion mapping, universal soil loss equation, land degradation studies, sodic soil mapping.

Recent Trends: The role of Mobile GIS and SDI as an integrated framework in Emergency Management.

Course outcomes:

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

Learn the impact of disasters on economic development, the causes & effects and major disasters, importance of disaster risk reduction in overall Disaster Management Programme.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Amdahl G (2002) Disaster Response: GIS for Public Safety, Published by ESRI, Redlands California.

(2) http://www.esri.com/news/arcnews/winter0102articles/gishomeland.

EMERGING TRENDS IN SPATIAL DATA ANALYTICS & LOCATION BASED INTELLIGENCE (Professional Elective - IV)			
Course Code	20CGI332	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1: Global and National Scenario and Trends

Hardware and Software Products/Packages & OEM's
GIS software Packages, Remote Sensing Packages, Photogrammetry Packages, GPS Instrument and Chipsets, Survey Instruments and software, Application development framework

Global and Indian Institutions: NASA, JPL, Canadian Institute of Remote Sensing, International Institute of Photogrammetry and Remote Sensing, PERS, GSDI
India- ISRO and its subunits, NRSA, SAC, Antrix, IIRS, RRSSCs; State Remote Sensing Centres; ISG, ISRS, AGI, DST, SOI, NATMO, GSI, NSDI, NGIS, K-GIS,

World and Indian Space Programmes: Satellites and sensors (Optical Imaging, Weather/Meteorology, Microwave, Ocean) and their products and applications; Open data; Geoinformatics usage by Government and Private Sectors - User Departments of Central Govt. and State Govt. and their major projects: Central - SOI, MES, MOEF, MOUD, MOD, few Case studies.

Education and Training facilities in Geoinformatics: Global Geoinformatics Courses, scholarships; Web Resources for e-learning; eBooks; open sources of free software; International Journals, Review magazines, News Letters, e-journals.

Module-2: Advanced Technologies on Survey and Remote Sensing

Positioning Technologies: NAVSTAR GPS / GLONASS / BEIDOU, GALILEO, IRNSS, GAGAN, OMISTAR

Survey and Mapping: Smart Station, Scanners
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

Module-3: Enterprise and Advanced GIS

Vector and Raster Data Formats: CAD / GIS format – DGN, DXF, DWG, Shape file, GDB, PGDB, IMG, GEOTIFF, IMG, JPEG, PNG, GIF, Multiband Image, Data Compression - ECW, MrSID,

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

Module-4: Location Based Services and Data Analytics

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.

Advanced Analytics: Geostatistical Analysis; Google Earth Engine, Virtual Reality, Artificial Intelligence, Machine Learning, Big Data Analytics, Block Chain

Module-5: Geospatial Market - Laws and Policies

Global and Indian Geoinformatics Market: Present trends and future prospects and problems, GIS BPO in private sector in India, GIS companies in India.

Laws and Policy Perspectives and International Co-operations: Laws and policy matters at international and national level with respect to Space, Ocean, photogrammetry, Indian Remote Sensing Data Policy, Open Data sharing policy, data

security, interoperability; Open data initiatives, Global and national Geoinformatics survey reports, case-studies, show cases of best practices.
Course outcomes: At the end of the course the student will be able to: Students will learn modern trends in satellite Remote Sensing and GIS, Various products and OEM, Advanced Analytics, data integration with GIS & in value addition to geospatial data.
Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60. • 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 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.
Reference Books
(1) "GIS Development".net, ESRI web site, NCGIA, UCGIA, Google

GEOINFORMATICS IN WATER RESOURCES MANAGEMENT (Professional Elective - IV)			
Course Code	20CGI333	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Hydrology – definition and its importance, hydrological cycle, water budgeting, water demand estimation, surface water bodies, water content in ocean, sea, ice, lakes, dams, tanks, rivers and ground, water resource scenario in India and Karnataka, RS and GIS applications in water resources development and management.

Module-2

Surface Fresh Water: Rainfall mapping, potential and actual evapo-transpiration, atmospheric water content, rainfall estimation & forecasting, monitoring of snow-covered area and snowmelt runoff estimation, Surface Fresh Water: river diversion studies, site suitability for surface storages and hydro-electric power plants.

Module-3

Irrigation and Watershed Management: Mapping and monitoring of catchment and command areas, land irrigability mapping, agriculture water demand estimation for different crops, tank information system, wetland mapping, siltation mapping; Watershed: delineation, morphometric analysis, rainfall-surface runoff model, reservoir sedimentation, water-harvesting structures, watershed development planning, Concept of Natural Recharge and Artificial Recharge, Uses of DEM.

Module-4

Ground Water: Concepts of Ground water, types of Aquifers, Lineament studies, Groundwater Resources of India, Groundwater Resources of Karnataka. Theory of Groundwater flow- Darcy's law and its applications. Groundwater quality assessment, groundwater prospect zones mapping and groundwater information system.

Module-5

Groundwater development and management: Planning and management of groundwater. Methods of artificial groundwater recharge; rainwater harvesting, problems of over-exploitation of groundwater; water management in rural and urban areas, geological and geophysical methods of groundwater exploration

Water Quality Physical and chemical properties of water, quality criteria for different uses, groundwater quality provinces of India, Groundwater contamination.

Course outcomes:

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

Students would learn the basic concepts of Water resources management, Ground water development water quality assessment and watershed development.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) GIS for Water Resources and Watershed Management - John G Lyon

(2) Application of GIS in Hydrology and Water Resources Management - K.Kovar

(3) Geographic Information Systems in Water Resources Engineering - Lynn E.Johnson

(4) Introduction to Environmental Remote Sensing – Barrett E C

(5) Remote Sensing principles and interpretation – Sabins F. F

(6) Groundwater – C. F. Tolman – McGraw-Hill Book Co. Inc.
(7) Groundwater Hydrology (2nd Ed.) – D. K. Todd, John Wiley and Sons Inc. NewYork
(8) Hydrology – S. N. Davis and R. J. M. Dewiest – John Wiley and Sons Inc. New York.
(9) Groundwater Resources Evaluation-W.C. Walton- McGraw-Hill Book Co. New York
(10) Hydrogeology – K. R. Karanth – Tata McGraw Hill Publishing Co. Ltd.
(11) Ground Water Assessment, Development and Management – K. R. Karanath – Tata McGraw Hill Publishing Co. Ltd.

GEOINFORMATICS IN WEATHER AND CLIMATE STUDIES			
Course Code	20CGI334	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Elements of weather and Climate: Global and regional variations in the temperature, pressure, wind, humidity, precipitation, the modifying factors like latitude, altitude, distance to the ocean and/ or sea, orientation of mountain ranges toward prevailing winds and ocean currents. Atmospheric circulations and Oceanic circulations.

Module-2

Basics of agro-meteorology, Weather-borne Disasters and their Impacts: Identification of critical weather variables affecting crop production, meat production, animal husbandry in each of 10 agro-climatic zones of Karnataka. Weather in relationship to crop growth, productivity**,** crop water requirements, irrigation scheduling, soil and water conservation techniques.

Module-3

The biotic and abiotic components of an ecosystem. Spatial distribution and spread of Crop Pests / diseases, Identification of endemic zones of crop pests and diseases. Spatial information kiosks in the rural development. etc.

Module-4

Satellite Meteorology: Principles of meteorological remote sensing, characteristics of satellite imagery, weather systems observed in satellite imagery, summer monsoons, tropical weather systems, winter weather systems, extra-tropical weather systems, Interaction between tropical and mid-latitude systems**.**

Module-5

Climate Change Management: Causes of climate, Indicators of climate change, Basics of climate change adaptations, Global regulations, International Geosphere Biosphere programmes, Indian National Programmes, role of Geoinformatics in climate change studies, Satellite-based inputs for environmental Management.

Course outcomes:

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

The students will be exposed to the basics of weather and climate, analysis of weather and climate data learns skills for weather forecasting relevant for agriculture and farm management and climate impact management.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Reference Books

(1) Monsoon Prediction by RR Kelakar, 2008, B.S. Publications, Hyderabad.

(2) Climate Change – A Holistic View, by RR Kelakar, 2010. B.S. Publications, Hyderabad

(3) Satellite Meteorology, 2nd Edition, RR Kelakar, 2017, CRC Press, B.S. Publications, Hyderabad.

PROJECT WORK PHASE – 1			
Course Code	20CGI34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20CGI35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

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

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20CGII36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.■

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

PROJECT WORK PHASE -2			
Course Code	20CGI41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. ■

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

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

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.