SCHEME AND SYLLABUS OF

M.Tech Programme in Civil Engineering (2013 Scheme)

with specialisation in GEOINFORMATICS

University of Kerala
Thiruvananthapuram
## M.Tech Programme

**CIVIL ENGINEERING – GEOINFORMATICS**  
**CURRICULUM AND SCHEME OF EXAMINATIONS**  
**SEMESTER I**

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Name of Subject</th>
<th>Credits</th>
<th>Hrs/week</th>
<th>End Sem Exam hours</th>
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<td>Of the 40 marks of internal assessment 25 marks for test and 15 marks for assignment. End sem exam is conducted by the University</td>
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*Students can select a subject from the subject listed under stream/department electives as advised by the course coordinator.

**List of Stream Electives**

**Stream Elective I**
- CRE 2001 Geo Spatial Data Processing
- CRE 2002 Urban Spatial Planning and Analysis
- CRE 2003 Hydroinformatics

**Stream Elective II**
- CRE 2004 Thermal and Microwave Remote Sensing
- CRE 2005 Remote Sensing and GIS for Environmental Engineering
- CRE 2006 Geoinformatics in Transportation Engineering
- CRE 2007 Satellite Oceanography
### SEMESTER III

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<th>Code No.</th>
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*Students can select a subject from the subjects listed under stream electives as advised by the course co ordinator.

**Students can select a subject from the subjects listed under interdisciplinary electives as advised by the course co ordinator.

**List of Stream Electives**

**Stream Elective III**

- CRE 3001 Digital Photogrammetry
- CRE 3002 Geoinformatics for Disaster Management
- CRE 3003 Advanced Techniques in Image Processing

**Stream Elective IV**

- CRE 3004 Digital Terrain Modelling
- CRE 3005 Remote Sensing and GIS applications in Water Resources Engineering
- CRE 3006 Application of Geoinformatics in Coastal Engineering
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*5 % of the evaluation mark is earmarked for Publication in journal/conference

8 hrs of departmental assistance work
List of Department Electives

1. CSD 2001 Design of Bridges
2. CHD 2001 Project Planning in Water Resources
3. CRD 2001 Geoinformatics in Civil Engineering
   (Students of Geoinformatics specialization are not allowed to choose CRD 2001 subject as the contents are dealt with in detail in the core papers)
4. CGD2001-Geoenvironment and landfill
5. CGD2003-Geoenvironment and landfill
7. CTD 2002 Regional Transportation Planning
8. CED 2001 Ecological Engineering
9. CED 2002 Air Pollution Control and Monitoring
10. CED 2003 Environmental Impact Assessment and Risk Analysis
List of Interdisciplinary Electives

1. CSI 3001 Finite Element Analysis
2. CSI 3002 Mechanics Of Composites
3. CHI 3001 Fuzzy Sets And Systems In Engineering
4. CRI 3001 Geoinformatics For Infrastructure Development
5. CGI 3001 Geotechnical Engineering For Infrastructure Projects
6. CTI 3001 Fundamentals Of Reliability Engineering
7. CEI 3001 Philosophy Of Technology
8. CEI 3002 Environmental Management
9. CEI 3003 Environment And Pollution
CMA 1002    Applied Probability and Statistics

Structure of the Course
Lecture: 3 hrs/ Week   Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To teach about the probability and random variable of the various functions
• To understand statistical procedures for data analysis

Learning Outcomes
• To equip the students to make use of the statistical procedures in the modelling of data in their field of study.

Module I
Probability Distributions: Probability mass functions and probability density function, mean and variance. Binomial, Poisson, Exponential, Gamma, Lognormal and Normal distribution, Fitting of the distributions (brief overview only). Sampling Techniques: Simple random sampling, Stratified sampling, Systematic sampling, Sample size determination-application
Statistical Inference: Intervals estimation, Confidence interval for mean, variance and regression coefficients. Sampling distribution, test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Two observed correlation coefficients(Fishers’ z-transformation) (vii) Paired T-test (viii) Regression coefficients (ix) Chi-square test of goodness of fit, Skewness and Kurtosis tests.

Module II
Regression and Correlation: Linear regression and correlation, multiple correlations, multiple correlation co-efficient, standard error of estimate, curvilinear regression-applications Analysis of variance (i) Completely randomized designs (ii) Randomized block designs. Latin Squares, Grecco Latin square designs, Factorial experiments, Graphical presentation techniques.

Module III

References
Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRC 1001  

Photogrammetry and Remote Sensing

Structure of the Course
Lecture: 3 hrs/ Week  
Credits: 3  
Internal Continuous Assessment: 40 Marks  
End Semester Examination : 60 Marks

Course Objectives
- Introduce the concept of Photogrammetry and Remote Sensing  
- Develop an understanding of the types and variety of remote sensing systems available  
- Develop an appreciation for the importance of remotely sensed images and photogrammetric analysis in Civil Engineering

Learning Outcomes
- Students will acquire capability for quantitative assessment from aerial photographs  
- Students will be in a position to understand various satellite images  
- The course will help to develop ability for image interpretation and feature identification from satellite data

Module I
Photogrammetry: Geometric characteristics of aerial photographs; Ground coverage of aerial photographs; Vertical and Tilted Photographs - Photographic Scale, Photo coordinates and Ground co-ordinates, Relief displacement, Tilt distortion. Stereoscopy & Image Parallax: Ground coordinates and Object height from parallax measurement; Mapping with aerial photographs - Ground control for aerial photography; Flight planning; Radial line method, Orthophotos; Introduction to Digital Photogrammetry.

Module II
Remote Sensing: Energy sources and radiation principles; Interaction of EM energy with atmosphere and surface features, Spectral reflectance patterns; Energy recording, Image resolutions, Multistage remote sensing concept. Types of satellites, sensors, orbits, and data products; Multispectral remote sensing – Methods of scanning, Geometric characteristics of satellite images; Thermal remote sensing - Radiation principles, Interaction of thermal radiation with atmosphere and terrain elements, Radiometric calibration of thermal scanners; Microwave remote sensing - Side looking radar system, Synthetic aperture radar, Geometric characteristics of SLR images.

Module III

References

**Structure of the Question Paper**

There will be three questions from each module out of which two questions are to be answered by the student.
CRC 1002    Applied Geomorphology

Structure of the Course

Lecture: 3 hrs/ Week                     Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objective

• Able to describe the morphology of the landscape and the major processes that form it in areas influenced by fluvial, glacial, coastal and semi arid systems.
• Describe major scientific ideas and theories about the development of landscape.

Learning outcome

• Ability to critically analyse geomorphological issues in a scientific context at local, regional and global scales.
• Use topographic maps, basic field techniques and other quantitative techniques to analyse landforms and processes of land formation.

Module I

Fundamental concepts of geomorphology - Geomorphic agents and processes. Weathering and soil formation; Recognition of weathering patterns – NNRMS code on soil types – NBSS SLUP. Mass Wasting and geomorphic significance.

Module II

Fluvial landforms; Stages of stream development; Drainage patterns and morphometric analysis; Specific landform features (Oxbows, Levees, Cut offs, Flood plains, Meanders, etc.) Coastal geomorphology; Development of costal landforms; Recent trends in bathymetry; Arid landforms; Stages of arid landform development; Landform features. Glacial landforms: Erosional and depositional landforms

Module III

Tectonic geomorphology; Tectonic landforms, plate tectonics and its relation to earthquakes; Lineaments; Geospatial technology in structural and tectonic mapping – Ground water potential zone mapping. Geospatial Technology in landform studies.

References:

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRC 1003          Data Acquisition in Geoinformatics

Structure of the Course

Lecture : 3 hrs/ Week                Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives

- To study about the modern survey equipments and their use in precision surveying.
- The ability to apply different data acquisition methods such as Total Station survey, GPS etc. for field problems

Learning Outcomes

- Understand the principles of various modern survey methods
- Understand the concept of surveying using total station and GPS

Module I
Introduction to Geomatics - Modern electronic survey measurements- Use and principle of automatic and digital levels, electronic theodolites, total stations- Field procedure for total stations in topographic survey- overview of computerized survey measurements- EDM

Module II
Satellite Navigational Systems-**Global Positioning Systems:** (NAVSTAR, GLONASS, GALILEO)-Basic concept of GPS: pseudo range and carrier phase measurements, signal structure, etc.-GPS coordinate systems: GPS time; GPS Errors and biases; GPS orbital Geometry and Navigational solution; Position measurements – Continuous Operating Reference stations (CORS)

Module III
Surveying with GPS: Planning and field observations; Data post-processing; GIS and GPS integration; Map concepts, co-ordinates and Map projection-Control surveys using GPS, Total station and triangulation methods (adjustment and computations of coordinates); Cartography and report writing-DGPS.

References:


Structure of the Question paper

There will be three questions from each module out of which two questions are to be answered by the students.
**CRC1004 Introduction to Geographic Information System**

**Structure of the Course**

Lecture: 3 hrs/ Week  
Credits: 3  
Internal Continuous Assessment : 40 Marks  
End Semester Examination : 60 Marks

**Course Objective**

- Expose the students with the concept of GIS  
- To provide exposure to data models and data structure used in GIS  
- To introduce various Raster and Vector Analysis capabilities of GIS

**Learning outcome**

- The ability to understand various components of GIS  
- The ability to do analysis of data using GIS  
- The ability to prepare GIS output maps

**Module I**

Introduction to GIS: Geographical concepts and terminology, Components of GIS, Various GIS packages and their salient features, Applications of GIS. Types of Geo-Spatial Data: Spatial and non-spatial data, Vector and raster data, Primary and secondary data, Characteristics and sources of spatial data, attribute data. Coordinate Systems: Geographic coordinate systems-approximations of earth, ellipsoid and geoid models, Datum-geodetic and vertical, coordinate transformation, Map projections-concepts and properties, classification, common map projections, examples of ellipsoids, UTM coordinate system. Raster and vector data models: Data organisation in a computer, Database Management systems, Relational DBMS, Raster data model- nature and elements, types, data compression, quad tree data representation, Vector data representation- nature and characteristics, topological maps and relationships, geo relational data model, object oriented geospatial data representation, Data conversion, Raster versus vector, Data models for composite features-TIN, regions, routes

**Module II**

Data input and editing: Methods of data input, File formats of raster data, Vector data input-map digitizing procedures, topology building. Geometric transformation- map to map and image to map transformations, transformation methods, Affine transformation, RMS error, Resampling, pyramiding, raster data editing, mosaicking, Spatial data editing- errors, topological and non topological editing, Attribute data input and management-type of attribute data, Relational model, normalisation, types of relationships, attribute data entry. Geospatial Data quality and standards: Data quality-accuracy, precision, errors, uncertainty, sources of errors, components and assessment of data quality, managing errors, Data standards- classification of standards in GIS, components, international geospatial data standards.

**Module III**

Data exploration and analysis: Data exploration- descriptive statistics, graphics, attribute data and spatial data query, map manipulation. Vector data analysis-buffering, overlay, slivers, distance measurement, pattern analysis, network based geo processing, Raster data analysis-
categories, Local operations-reclassification, overlay analysis, Operations on local
neighbourhood- spatial aggregation, filtering, slopes and aspects, Operations on extended
neighbourhood-statistical analysis, distance, proximity, connectivity, buffering, view shed
analysis, Operations on regions, Map algebra-concepts. Data visualization: cartographic
symbolization, types of maps, map design, map production.

References
5. Lo, C. P. And Yeung K.W., Concepts and Techniques in Geographic Information
   Publications, Hyderabad, 2001
7. Heywood, I., Cornelius, S., Carver, S., and Raju, S. An Introduction to Geographic

Structure of the Question paper

There will be three questions from each module out of which two questions are to be
answered by the students.
Structure of the Course
Lecture : 3hrs/week  Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination         : 60 Marks

Course Objectives
- A good understanding of all the components of hydrologic cycle
- To understand the mechanics of rainfall, its spatial and temporal distribution.
- To understand the fitting of probability distribution and statistical analysis of rainfall and runoff.
- To understand the real time data monitoring and management system.

Learning Outcomes
- To understand the principles and applications of engineering hydrology.
- Provide the students with the tools for analysis, management and simulation used for the design of hydrologic systems.
- Understand the modeling of the rainfall runoff process.

Module I
Review: Hydrologic cycle, precipitation - types, time and spatial distribution of precipitation, Graphical representation of rainfall - Estimation of missing rainfall data - Test for consistency of rainfall records - probable maximum precipitation - Analysis of rainfall data - correlation between intensity and duration – intensity, duration and frequency - depth area duration (DAD) curve. Hydrologic abstractions (Brief description only) - Infiltration- Green-Ampt, Richard’s and Philip’s equations for infiltration estimation, Evapotranspiration - modified Penman equation - FAO method – real time data collection.

Module II
Catchment characteristics - stream patterns - stream order - classification of streams - stream flow measurement - Mid section method and mean section method - stage discharge rating curve - Extension of stage discharge curve - Adjustment of stage discharge curve - Runoff- Computation of runoff by curve number method - Rational method - S-hydrograph, synthetic unit hydrograph, concept of IUH - Derivation of IUH using S-curve, convolution integral, and conceptual models - linear reservoir - linear channel - rainfall runoff correlation using linear regression and multiple regression analysis.

Module III

References
7. Ghanshyam Das, Hydrology and soil conservation Engineering, Prentice-hall of India, NewDelhi, 2004

Structure of the Question Paper
For the End Semester Exam, there will be three questions from each module out of which two questions are to be answered by the students.
CRC 1101   Geoinformatics Laboratory

Structure of the Course
Practical: 2 hrs/ Week                     Credits: 1
Continuous Internal Assessment: 100 Marks

Course Objective

- To familiarise the students with maps and map reading
- To understand reading concepts of photogrammetry and GIS with practical experiments

Learning outcome

- The ability to understand maps
- The ability to apply photogrammetry and GIS concepts to practice

Exercise problems on:
SOI Toposheets
  - Map reading
  - Watershed delineation

Introduction to Remote Sensing data products
  - Different types of images
  - Visual image interpretation with 9 key elements
  - Generation of maps

Photogrammetry
  - Stereoscopy- practice and stereo model
  - Relief displacement and elevation
  - Orientation of stereo photographs
  - Parallax bar- practice and measurements
  - Heights from parallax measurements

GIS
  - Data import/ Export
  - Georeferencing
  - Digitization
  - Adding attribute data
  - DEM generation
  - Vector analysis - buffering, overlay and network analysis
  - Raster analysis-Arithmetic overlaying and logical overlaying
    (Practice using ARC GIS software)
  - Data output, customization and scripting
  - Generation of maps

Introduction to various GIS packages like Geomedia, GRAM ++, GRASS, ILWIS,
Open source GIS software, IGIS

Reference
5. NRSC Landuse Land cover manual
CRC 1102    Seminar
Structure of the Course
  Duration: 2 hrs/ Week    Credits: 2
  Internal Continuous Assessment: 100 Marks

The student has to present a seminar in one of the current topics in the stream of specialization. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report.
  Distribution of marks:
    Seminar report : 40 marks
    Presentation    : 60 marks
**Structure of the Course**

- **Lecture:** 3 hrs/ Week
- **Credits:** 3
- **Internal Continuous Assessment:** 40 Marks
- **End Semester Examination:** 60 Marks

**Course Objectives**

- Introduce the concept of digital image acquisition, processing, display and analysis
- Develop an idea regarding the suitability of different satellite images for various applications
- Develop an understanding of potential applications of remotely sensed data, tools and techniques for natural resource management

**Learning Outcomes**

- Ability for enhancing and processing digital images
- Ability to understand the suitability of various satellite images
- Ability for feature identification and classification from satellite data

**Module I**


**Module II**

Image enhancement: Contrast enhancement; Spatial feature enhancement - Spatial filtering, Edge enhancement, Texture enhancement, Convolution, Morphological filters, Gradient filters, Box-filter algorithm, Image resolution pyramids Frequency transformation (Fourier transforms); Multi image manipulation - Multispectral band ratios and differencing, Principal component analysis, IHS transformation.

**Module III**


**References:**


**Structure of the Question paper**
There will be three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Lecture: 3 hrs/ Week  
Credits: 3  
Internal Continuous Assessment:  40 Marks  
End Semester Examination : 60 Marks

Course Objective

- Expose the students with advanced concepts of GIS
- To provide exposure to terrain modelling and analysis
- To introduce modern trends such as web GIS, customisation etc.

Learning outcomes

- The ability to select suitable interpolation techniques
- The ability to do terrain analysis
- Understand and do GIS customisation, programming

Module I

Spatial interpolation: Definition and necessity, methods of interpolation, Global interpolation-classification models, regression methods, trend surface analysis, Local interpolation-nearest neighbours, density estimation, inverse distance weighting, splines, comparison of interpolation methods, Optimal interpolation using geostatistics- regionalised variable theory, variogram models, ordinary kriging, block kriging, nonlinear kriging, probabilistic kriging

Module II

Terrain mapping and analysis: Digital Elevation models- methods of representation, TIN, DEM, conversion of TIN to altitude matrix and vice versa, characteristics of TIN and DEM, Delaunay triangulation, Terrain mapping-contouring, vertical profiling, hill shading, slope and aspect-computing algorithms for raster and TIN, surface curvature. View sheds and watersheds: View shed analysis- parameters, applications, Watershed analysis- operations to delineate watersheds and to derive features such as stream network, applications. Path analysis and network applications: Path analysis- cost distance measures, least cost accumulative path, applications, Network- geometry and attribute data of road network, putting together, Applications - shortest path analysis, allocation.

Module III


References


Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2001  Geo Spatial Data Processing

Structure of the Course

Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objective

• To provide students an introduction to principles and techniques of data base
design and development as they apply to geospatial data.
• To familiarize the principles and techniques in designing and building geospatial
data bases
• To introduce the concept of Mobile mapping and Web GIS

Learning outcome

• Ability to create, edit and document geospatial datasets
• Ability to develop and document a conceptual design of a geospatial database for a
  specific application problem
• Ability to develop custom build GIS applications

Module I

Spatial data acquisition and development: Observations and mathematical model, precision
and accuracy, rejection of observations, weights and cofactors, correlation and covariance,
propagation of errors and variance-covariance.

Module II

Spatial Data bases: characteristics, development, acquisition. Least squares adjustment
computations; Sequential processing and Kalman Filtering; Variance-covariance of adjusted
data, error ellipse and error ellipsoid; Statistical analysis of adjusted data.

Module III

GIS customization concepts, Role of programming languages in GIS customization.
Introduction to Visual Basic Programming Language. Overview of internet GIS, Internet
GIS, Development with open source and other softwares. Fundamentals of Mobile Mapping,
Mobile mapping applications

References

1. Kraak M. and F. Omerling, Visualization of Geo Spatial data, Pearson education,
delhi, 2003
2. Kraak M. and A. Brown, Web Cartography: Development and Prospects, Taylor and
Francies, London,2001
3. Robert A.Schowengerdt, Remote Sensing: Materials and Methods for Image
5. Zong R Peng, Ming H Tsou, Internet GIS Distributed Geographic Information Services for Internet and Wireless Network, John Wiley and Sons, 2003
6. Juliano Lopes de Olivera, Claudia Bauzer Medeiros, Mariano Cilia, “Active Customization of GIS User Interfaces”, ICDE '97, Proceedings of the Thirteenth International Conference on Data Engineering
7. C. V. Tao and J. Li, Advances in Mobile Mapping Technology, Taylor and Francis, 2007

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2002          Urban Spatial Planning and Analysis

Structure of the Course
Lecture : 3 hrs/ Week               Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To equip the students for the effective planning and design of urban systems using spatial modeling

Learning Outcomes
• To understand the concepts used for urban mapping including transportation planning.
• To inculcate the preparation of maps for different spatial analysis carried for urban planning and transportation planning with the aid of remote sensing and GIS

Module I

Module II

Module III

References
3. Rob Gray , Accounting for the Environment, Chartered Association of Certified Accountants, 1003.

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
Structure of the course
Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• Aimed at introducing the techniques and tools developed in information technology for rapid hydrological information analysis and modeling.
• To illustrate the concepts of soft computing techniques for modeling of hydroinformatics.

Learning Outcomes
• Ability to integrate hydrologic and GIS models
• To understand the different data integrative approaches in computation, analysis and modelling in hydroinformatics

Module I

Module II

Module III
References
2. Praveen Kumar, Jay Alameda, Peter Bajcsy, Mike Folk and Momcilo Markus, Hydroinformatics: Data Integrative Approaches in Computation, Analysis and Modelling, Taylor and Francis, 2006

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2004  Thermal and Microwave Remote Sensing

Structure of the Course

Lecture: 3 hrs/ Week                 Credits: 3
Internal Continuous Assessment   : 40 Marks
End Semester Examination           : 60 Marks

Course Objectives

• To cover the fundamentals of thermal and microwave remote sensing
• To provide a summary of the information needed for space based microwave remote sensing systems

Learning Outcomes

• Students will develop knowledge about the various thermal and microwave sensors operating in space
• Ability to apply thermal infrared models for various applications in the field of civil engineering
• Ability to use microwave data for the analysis of various problems in land and water.

Module I

Thermal remote sensing: Introduction, Radiation principles, Interaction of thermal radiation with atmosphere and terrain elements, thermal sensors and their characteristics, radiometric calibration of thermal scanners. Interpretation of thermal images - day and night images, emissivity consideration, thermal inertia considerations. Estimation of land surface temperature from thermal images. Application of thermal remote sensing data in crop health monitoring, pollution monitoring, oil spill detection, glaciology, atmospheric modelling, Sea Surface Temperature, PFZ.

Module II

Introduction to microwave remote sensing - active and passive systems, platforms and sensors. Passive microwave systems: mathematical formulation for microwave radiation and simulation, measurement and analysis of brightness temperature, applications in various fields - oceanography and meteorology. Active microwave systems: basic principles of radar, radar equation, resolution, range, phase and angular measurements, microwave scattering and its measurement, relationships between scene and sensor parameters. Imaging systems - Real Aperture radar (RAR) and Synthetic Aperture radar (SAR), Microwave radiometer, Microwave Scatterometer, Microwave altimeter.

Module III

SAR imagery - their characteristics and interpretation, applications in various fields—land use/land cover, soil/rock, hydrology. SAR interferometry for DEM generation, differential SAR interferometry for surface displacement studies, applications in land subsidence, landslide movements, glacier movements etc. Polarimetry in radar remote sensing, basic equations, propagation of waves and wave polarization. HH, VV, HV and VH polarization data and their applications.
References

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2005  Remote Sensing and GIS for Environmental Engineering

Structure of the Course
Lecture : 3 hrs/ Week               Credits : 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To understand the various remote sensing and GIS technological applications in the field of Environmental Engineering.
• To understand the various satellites and data products that can act as aid in environmental modeling problems

Learning Outcomes
• Capability to make use of remote sensing and GIS data products for analyzing problems in environmental engineering
• Understand the concepts of incorporating spatial data in modeling of soil, water and air quality studies.

Module I
Introduction, Environmental satellites GEOS, NOAA, AVHRR, CZCR Monitoring land, water, atmosphere and ocean using Remote Sensing Data, case studies. Taxonomical classification of soils, soil survey interpretation and mapping, impact of agricultural and industrial activity on soil properties. soil salinity/alkalinity, erosion studies, Applications of GIS in assessing soil salinity, erosion productivity etc.

Module II
Water Quality and Ground Water Pollution : Classification of water quality for various purposes. Data base creation and quality modeling using GIS. Database Creation and maintaining water supply network, sewerage network using GIS. Case studies. Aquifer Vulnerability Intrinsic and specific vulnerability, DRASTIC, SINTACS MODELS MODFLOW, MT3D, contaminant transport model. Case studies.

Module III
Air Quality Modelling : Atmosphere: Chemicals, Particulate matters present in the atmosphere, allowable limits, Remote Sensing technique to monitor atmosphere constituents, air pollution due to industrial activity, modeling using GIS. Case Studies. Environmental Management : Revenue management-environment and ecological concerns- Resource development in remote areas-Impacts of anthropogenic activity- Solid Waste management-Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status

References

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2006  Geoinformatics in Transportation Engineering

Structure of the Course
Lecture : 3 hrs/ Week       Credits : 3
Internal Continuous Assessment   : 40 Marks
End Semester Examination           : 60 Marks

Course Objectives
• To understand the basic concepts of Geoinformatics in the context of transportation and transportation networks.
• To learn the data needs and database development for doing transportation analysis in GIS environment.
• To understand the concepts of transportation networks and algorithms and how they are incorporated into GIS.

Learning Outcomes
• Students will acquire a basic understanding of how GIS processes can be used for efficient transportation modeling and analysis.
• Students will understand various applications of GIS in Transportation (GIS-T) including Intelligent Transport Systems (ITS)

Module I
Traffic Engineering Studies and Analysis: Objectives, Sampling in traffic studies, sample size; Data collection, analysis and interpretation -Spot speed, Speed and delay, Volume, Origin – destination, Parking. Concept of PCU, Factors affecting capacity and level of service, Types of manoeuvres and conflict points.

Module II
Transportation Planning using GIS- Travel Demand Estimation-Application of GIS, Traffic Analysis Zone (TAZ) and screen lines, Four Stage Planning Process (Brief description only), Network representation of a transportation System, Shortest Path determination, GIS based Transportation Planning, Spatial and Non spatial data for land use and transportation.

Module III

Reference
Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 2007 Satellite Oceanography

Structure of the Course
Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objective
- To provide a basic understanding in the fields of oceanography and ocean remote sensing.
- To provide a broad knowledge of the various techniques used in satellite and airborne remote sensing of the sea.
- To appreciate the applications of remote sensing to oceanographic studies.

Learning Outcome
- Students will obtain the basics of physical, chemical, and biological oceanography
- Gain information about the main systems observing ocean from space
- Develop some practical skills on using satellite data for the analysis of ocean ecosystem dynamics.

Module I
The basic concepts of oceanography: Physical, Chemical and Biological Oceanography, Hydrophysical processes in the ocean, external forces driving ocean currents - earth rotation and wind stress, heat flux through the ocean surface - temperature, salinity and density, role of stratification in phytoplankton ecology.

Module II
Remote sensing of the sea: The general principles of remote sensing of the sea, basic elements and sampling characteristics of satellite orbits, Electromagnetic spectrum and satellite sensors, sensor calibration, atmospheric correction, positional registration, Oceanographic sampling. The main types of sensors: Visible wavelength “ocean color” sensors, Infrared radiometers of sea surface temperature, Passive microwave radiometers, Active radar-altimeters of sea surface topography, Active microwave sensors of sea surface roughness.

Module III
Oceanographic Applications: Infrared Measurement of Sea Surface Temperature, Infrared radiometry, Interpretation of sea surface temperature. AVHRR, MSCSST algorithm, GEOS, Radar altimeters: Basic principles of satellite altimetry, TOPEX/Poseidon satellite, Sea Surface Height, Sea Surface Roughness, Microwave scatterometer, Synthetic Aperture Radar Ocean Color: satellite measurements of ocean color, Coastal Zone Color Scanner (CZCS), SeaWiFS, MODIS, ocean color dynamics in different ocean regions. Ocean Color and Phytoplankton Growth: Chlorophyll and photosynthesis, Estimation of phytoplankton biomass from Satellite Ocean color observations, Estimation of chlorophyll fluorescence from MODIS ocean color observations, Global phytoplankton biomass and primary production
References

Structure of the Question paper

There will be three questions from each module out of which two questions are to be answered by the students.
CRD2001  Geoinformatics in Civil Engineering

Structure of the Course
Lecture: 3 hrs/ Week  Credits: 3  
Internal Continuous Assessment: 40 Marks  
End Semester Examination : 60 Marks

Course Objectives
• Expose the students with concept of GIS and remote sensing.  
• To provide exposure to the applications of GIS and Remote sensing in Civil engineering

Learning outcomes
• Understand the concepts of data acquisition and interpretation of satellite images  
• Understand the capabilities GIS Techniques for spatial analysis and representation of data.  
• Capability to make use of remote sensing data and GIS concepts for modeling of Civil Engineering problems.

Module I  

Module II  
Introduction to GIS: Geographical concepts and terminology, Components of GIS, Various GIS packages and their salient features, Applications of GIS. Spatial and non-spatial data, Vector and raster data -Coordinate Systems: Geographic coordinate systems-approximations of earth, ellipsoid and geoid models, Datum-geodetic and vertical, coordinate transformation, Map projections-concepts and properties.Data input and editing: Methods of data input, Spatial data editing-Vector data analysis-buffering, overlay, slivers, Raster data analysis- categories. Data visualization: cartographic symbolization, types of maps, map design, map production

Module III  
Applications: Landuse/land cover mapping, watershed analysis, water resources engineering, EIA, coastal engineering, Topographic mapping, Transportation Engg., Municipal solid waste management, Natural disaster management etc.

References

**Structure of the Question paper**
There will be three questions from each module out of which two questions are to be answered by the students.
Structure of the Course

Lecture: 2 hrs/ Week
Internal Continuous Assessment: 40 Marks
End Semester Examination: 60 Marks

Course Objective:
To formulate a viable research question
To distinguish probabilistic from deterministic explanations
To analyze the benefits and drawbacks of different methodologies
To understand how to prepare and execute a feasible research project

Outcome
Students are exposed to the research concepts in terms of identifying the research problem, collecting relevant data pertaining to the problem, to carry out the research and writing research papers/thesis/dissertation.

Module 1
Introduction to Research Methodology - Objectives and types of research: Motivation towards research - Research methods vs. Methodology. Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical. Research Formulation - Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. Literature review: Primary and secondary sources - reviews, treatise, monographs, patents. Web as a source: searching the web. Critical literature review - Identifying gap areas from literature review - Development of working hypothesis.

Module 2

Module 3

Application of results of research outcome: Environmental impacts - Professional ethics - Ethical issues - ethical committees. Commercialization of the work - Copy right - royalty - Intellectual property rights and patent law - Trade Related aspects of Intellectual Property Rights - Reproduction of published material - Plagiarism - Citation and acknowledgement - Reproducibility and accountability.
References:
1. C.R Kothari, Research Methodology, Sultan Chand & Sons, New Delhi, 1990
CRC 2101 Digital Image Processing Laboratory

Structure of the Course

Practical: 2 hrs/ Week Credits: 1
Continuous Internal Assessment: 100 Marks

Course Objective

- To familiarise the students with reading understanding various satellite images
- To understand the concept of different image processing techniques

Learning outcome

- The ability to understand different satellite images
- The ability to apply image processing techniques for deriving different thematic maps from satellite imagery

Exercise problems on:


References

5. NRSC Landuse Land cover manual
The student is expected to start the preliminary background studies towards the Thesis by conducting literature survey in the relevant field. He/she should broadly identify the area of the Thesis work, familiarize with the design and simulation tools required for the thesis work and plan the experimental platform if any, required for the thesis work. The student will submit a detailed report of these activities at the end of the semester.
CRC 2103                  Seminar

Structure of the Course
  Duration: 2 hrs/ Week  Credits: 2
  Internal Assessment: 100 Marks

The student has to present a seminar in one of the current topics in the stream of specialization. The student will undertake a detailed study based on current published papers, journals, books on the chosen subject, present the seminar and submit seminar report.

  Distribution of marks:
    Seminar report : 40 marks
    Presentation    : 60 marks
CRE 3001 Digital Photogrammetry

Structure of the Course
Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To impart knowledge in digital camera, scanners, photogrammetric Workstation and its Application with GIS and Remote Sensing.
• To familiarize the students with automatic and semi-automatic procedures in photogrammetry.
• To teach the methods of digital evaluation, its models, theories, and applications.

Learning Outcomes
• Will help the student to develop a basic understanding of the remote sensing systems used for 2D and 3D mapping
• Students will learn the basic operations in digital photogrammetry such as image orientation, image matching, and object extraction
• Students will get knowledge about the basic methods and procedures of planimetric and topographic map generation from digital stereo data

Module I
Introduction: Historical development from conventional to analytical and digital photogrammetry, Principles of analog and digital Photogrammetry. Digital cameras and scanner: Digital images and their properties, direct and indirect methods of acquisition of digital images - Digital cameras- CCD, digitizers and photogrammetric scanners; CCD camera - spectral sensitivity of CCD sensor - geometric problem of CCD image -types of CCD systems - use of CCD scanner in high resolution satellites

Module II

Module III
Digital feature extraction and matching techniques for stereo image analysis. Use of GPS and SAR interferometry data in 3D mapping, Cartographic problems of mapping the earth with horizontal and vertical controls,Applications: DEM Generation - accuracy of DEMs, Orthorectification - contour generation - watershed delineation - satellite photogrammetry principles - stereo satellite missions - stereo image products.
References

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 3002  Geoinformatics for Disaster Management

Structure of the Course
Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment : 40 Marks
End Semester Examination : 60 Marks

Course Objectives
• To make aware of the various principles involved and also the various mitigation to be adopted during the disasters.
• To illustrate the use of remote sensing sensors, data and geographical information system in disaster preparedness and evaluation.

Learning Outcomes
• Understand the concepts disaster management.
• Understand the application of RS, EOS, GIS, GPS tools for disaster management and mitigation.

Module I
Fundamental concepts of hazards and disasters: Characterisation and Zonation of Hazards, Hazard management cycle and information requirement for different stages, Hazard zonation principles and methods. Types of disasters and hazards: Hydrometeorological hazards: Floods, Cyclones and Coastal hazards, Drought- Geological Hazards: Landslide, Earthquake, Mining hazards (subsidence, flooding etc.), Volcanic hazards, Glacial hazards - Environmental hazards: Forest hazards (Deforestation, Degradation and Forest fire) - Land, soil degradation and desertification - Pollution (water, air and soil) - Nature of Impacts.

Module II

Module III
Information system management – Spatial and non-spatial data bank creation- Operational emergency management – Vulnerability analysis of infrastructure and settlements – Pre-disaster and post disaster planning for relief operations – Potential of GIS application in development planning – Disaster management plan – Case studies-Case study demonstration describing the capability & utility of EOS & GIS for disaster and hazard monitoring, assessment and mitigation. Flood mapping, Flood risk zoning, Coastal flooding assessment, Coastal erosion Assessment, drought assessment
Reference

2. David Alexander, Natural Disasters, Research Press, New Delhi, 1993
5. Andrew, S., Environmental Modeling with GIS and Remote Sensing, John Willey and sons, 2002

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 3003 Advanced Techniques in Image Processing

Structure of the Course
Lecture: 3 hrs/ Week Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives
- To provide a seminal view on recent advances in techniques for image processing
- To familiarize the techniques that help to deal with the high dimensional nature of the data, and also to integrate the spatial and spectral information

Learning Outcomes
- Students will be familiar with the new trends in algorithm design such as the joint use of spatial and spectral information
- Will help the students to deal with the increasing sophistication in the rapidly maturing field digital image processing

Module I
Advanced Classifiers: Introduction to fuzzy theory and fuzzy classification Methods - Artificial neural networks and classification Methods-Classification accuracy assessment, Error matrix and fuzzy error matrix

Module II
Spatial Transformation Techniques Texture analysis – first order, second order texture parameters. Morphological methods for satellite image analysis. Digital image segmentation concepts - Edge and region segmentation of satellite images. Wavelet transform and its application in RS image analysis

Module III
Hyperspectral remote sensing data acquisition systems, Imaging Spectroscopy. Hyperspectral Image Analysis: Calibration and normalization of hyperspectral images, feature and intensity based geometric and image to image registration, methods and models for atmospheric correction. Hyperspectral image compression - Feature selection and feature extraction techniques - Discriminant analysis, Independent component analysis

References
1. Mather P.M., Computer Processing of Remotely Sensed Images, Wiley, 2004
2. Brandt Tso and P.M. Mather, Classification Methods for Remotely Sensed Data, Taylor and Francis, 2001

**Structure of the Question paper**
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 3004                  Digital Terrain Modelling

Structure of the Course

Lecture: 3 hrs/ Week                      Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objective

• Expose the students with digital terrain modelling
• To provide exposure to the generation of TIN
• To introduce visualization and applications of DTM.

Learning outcome

• Ability to select suitable source of data for DTM
• Ability to do proper interpolation to create surface
• Ability to interpret DTM and apply to various applications

Module I

Module II
Generation of Triangular Irregular Networks: Delaunay triangulation- vector based static, vector based dynamic, constrained. Triangulation from contour data, triangulation from Voronoi diagrams. Interpolation techniques for terrain surface modelling: linear interpolation, bilinear interpolation, bicubic spline interpolation, least square fitting of local surface, point based moving averaging. Quality control in terrain data acquisition: sources and types of errors, filtering of random errors, detection of errors- gross errors based on slope information, isolated gross errors in irregularly distributed data, cluster of gross errors, gross errors based on topologic relations of contour.

Module III
Contouring from digital terrain models: vector and raster based contouring from grid DTM and Triangular DTM. Visualization of digital terrain models: variables for visualisation, 2D and 3D visualisation, texture mapping, animation techniques. Interpretation of digital terrain models: Terrain parameters-geometric, morphological, hydrological, visibility. Applications of digital terrain models: Runoff calculations, Mining, water and soil conservation

References


Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 3005  Remote sensing and GIS Applications in Water Resources Engineering

Structure of the Course

Lecture: 3 hrs/ Week  Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives

• Expose the students with the applications of RS and GIS in water resources Engineering

Learning outcomes

• The ability to understand various data required for water resources projects
• The ability to apply the various remote sensing products in water resources related activities

Module I
Principle of remote sensing in water resources assessment, spectral characteristics of water/snow and surface water inventory, hydrologic elements and classification

Module II
Creation and design of spatial and non spatial data in water resources, DEM applications in water resources, basic concepts of hydrologic modelling, watershed hydrology and physical processes in watershed, Erosion and sediment yield modelling, watershed prioritization, watershed conservation planning

Module III
Geo-engineering consideration for investigation of hydel sources, river valley project planning, Environmental impact assessment of water resources project
Drought monitoring, water balance studies, flood mapping and risk zoning, reservoir sedimentation, watershed modelling, soil moisture studies, ground water modelling, water quality using multi spectral and hyper spectral remote sensing data Infiltration, runoff estimation- SCS-CN, Evapotranspiration, soil moisture, soil properties

References


Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRE 3006  
Applications of Geoinformatics in Coastal Engineering

Structure of the Course

Lecture: 3 hrs/ Week  
Credits: 3
Internal Continuous Assessment: 40 Marks
End Semester Examination : 60 Marks

Course Objectives

- To understand the different coastal processes and coastal protection measures.
- To illustrate the application of RS data and GIS for coastal zone management.

Learning outcomes

- Understand the coastal processes and coastal mitigation measures adopted.
- Capability to use remotely sensed data products for the coastal engineering studies.
- Understand the usage of GIS in Coastal Zone management studies.

Module I


Module II


Module III

References

Structure of the Question paper
There will be three questions from each module out of which two questions are to be answered by the students.
CRC 3101 Thesis Preliminary (Part II)
Structure of the Course
  Duration: 15 hrs/ Week  Credits: 5
  Continuous Internal Assessment: 200 Marks

Thesis Preliminary part II comprises of a preliminary thesis work, two seminars and submission of thesis preliminary report. The first seminar would highlight the topic, objectives, and methodology and the second seminar is on the presentation of the work completed till the third semester and the scope of the work which is to be accomplished in the fourth semester, mentioning the expected results.
CRC 4101            Thesis
Structure of the Course
Lecture: 21hrs/week   Credits : 12
The fourth semester is entirely devoted for the thesis work. There would be an interim
presentation at the first half of the semester to evaluate the progress of the work and at the
end of the semester there would be a Pre-Submission seminar before the Evaluation
Committee for assessing the quality and quantum of the work. This would be the qualifying
exercise for the students for getting approval from the Department Committee for the
submission of Thesis. At least one technical paper is to be prepared for possible publication
in Journals/ Conferences. The final evaluation of the Thesis would be conducted by the board
of examiners constituted by the University including the Guide and an external examiner.

Distribution of marks
Internal evaluation of the Thesis work by the guide: 150 marks
Internal evaluation of the Thesis by the Evaluation Committee: 150 marks
Final evaluation of the Thesis Work by the Internal and External Examiners:
[Evaluation of Thesis: 200 marks *+ Viva Voce: 100 marks (*5% of the marks is earmarked
for publication in Journal/Conference) ] TOTAL – 300 marks