# ACADEMIC YEAR 2017-2019

## CENTRE FOR ENVIRONMENT
## INSTITUTE OF SCIENCE & TECHNOLOGY (Autonomous)
## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
## HYDERABAD

## COURSE STRUCTURE AND SYLLABUS

## M.Tech (ENVIRONMENTAL GEOMATICS)

## (5+2 PATTERN)

# CENTRE FOR ENVIRONMENT
# INSTITUTE OF SCIENCE & TECHNOLOGY
## JAWAHARLALA NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
## KUKATPALLY: HYDERABAD – 500 085.

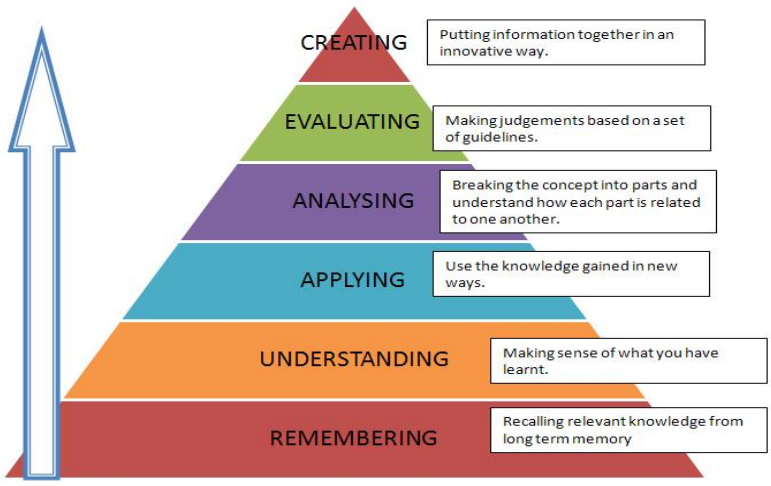
## Vision:

- To disseminate advance knowledge by providing effective instruction and innovative research in environmental science and technology by promoting inter-disciplinary studies and research.
- To respond and to find technological solutions for pollution monitoring, abatement and control through innovation in environmental chemistry, environmental biotechnology and Environmental Geomatics.
- To maintain and develop liaison/collaboration with reputed universities, R&D organizations, industries and consultancy firms in India and abroad.

## Mission:

- Producing highly motivated, technically competent, morally strong graduates with deep roots in our culture and with ability to respond to global challenges, thereby delighting all stakeholders namely parents, employers and humanity at large.
- To excel as a centre of Higher Education and Research in the field of Environmental Science & Technology.

## Blooms Taxonomy:



**ACADEMIC YEAR 2017-2018**
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**CENTRE FOR ENVIRONMENT**
**INSTITUTE OF SCIENCE & TECHNOLOGY (Autonomous)**
**COURSE STRUCTURE AND SYLLABUS**
**M.Tech (ENVIRONMENTAL GEOMATICS)**
**(5+2 PATTERN)**

**PROGRAMME EDUCATION OBJECTIVES:**

To provide the engineering graduates and science post graduates with technical expertise in Environmental Geomatics which will enable them to have a career and professional accomplishment by allowing them to work in multidisciplinary/interdisciplinary areas in the public or private sector.

The program educational objectives of the **M. Tech (Environmental Geomatics)** are:

**PEO1:** To provide students with fundamental knowledge and skills in the Geomatics discipline especially for Environmental protection and Management.

**PEO2:** To generate trained manpower in the applied areas of Environmental Geomatics, and prepare students for a profession in geospatial science and technology in concurrence with the policies of Government of India.

**PEO3:** To demonstrate knowledge and skills product interpretation, analysis, integration with GIS and GNSS and management of geospatial database for land parcels surveying, environmental planning and in EIA studies as per the norms of Ministry of Environment, Forest and Climate change.

**PEO4:** To acquire the ability to start entrepreneurship in the geospatial industry.

**PEO5:** To get involved with state, national, and international organizations, to place the students in their mission projects and industry employability.

**PROGRAM OUTCOMES:**

**PO1**: Ability to independently carry out research/investigation and development work to solve practical problems.

**PO2**: Ability to write and present a substantial technical report/document.

**PO3**: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

**PO4**: To Train and make the student ready with appropriate skills and technologies with special reference to Geomatics industry and sustainable environment development.

**OUTCOMES OF THE PROGRAMME:**

By the time of their graduation, the students are expected to be able to:

1. An ability to independently carry out research/investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4. Understand the environmental, social and economic framework in which environmental management decisions are made understand the life cycle perspective, systems approach and environmental technologies for converting process, products and service related industrial environmental problems into opportunities to improve performance
5. Anticipate, recognize, evaluate, and control environmental issues in a variety of sectors and industries and liaison with federal, state, and local agencies and officials on issues pertaining to environmental protection
6. Recognize, evaluate, and control factors in the workplace and the environment that cause health and environmental hazards and utilize quantitative knowledge and skills and modern tools and technologies using Remote sensing, GIS & GPS to assess, analyze, plan, and implement environmental management systems
7. Engage in critical thinking and contribute to research in solving contemporary environmental problems with professional and ethical responsibility.
8. Pursue lifelong learning as a means of enhancing the knowledge and skills in environmental modeling.
9. Identify, formulate, analyze, and develop management systems and formulate solutions that are technically sound, economically feasible, and socially acceptable.
10. Communicate proficiently in writing and speaking for promoting and coordinating public consultations on environmental matters and for negotiating environmental service agreements and managing associated costs and revenues
11. Collaborate with environmental engineers, planners, technicians, and other specialists, and experts in to address environmental problems.
12. Find professional level employment or pursue higher studies and pursue research for contributing to the betterment of humanity and in shaping a sustainable society.

## Program Educational Objectives (PEOs)

The program educational objectives are

**PEO 1:** To provide students with fundamental knowledge and skills in the Geomatics discipline especially for Environmental protection and Management.

**PEO 2:** To generate trained manpower in the applied areas of Environmental Geomatics, and prepare students for a profession in geospatial science and technology in concurrence with the policies of Government of India.

**PEO 3:** To demonstrate knowledge and skills product interpretation, analysis, integration with GIS and GNSS and management of geospatial database for land parcels surveying, environmental planning and in EIA studies as per the norms of Ministry of Environment, Forest and Climate change.

**PEO 4:** To acquire the ability to start entrepreneurship in the geospatial industry.

**PEO 5:** To get involved with state, national, and international organizations, to place the students in their mission projects and industry employability.

## Program Outcomes (POs) are as follows

**PO1**: Ability to independently carry out research/investigation and development work to solve practical problems.

**PO2**: Ability to write and present a substantial technical report/document.

**PO3**: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

**PO4**: To Train and make the student ready with appropriate skills and technologies with special reference to Geomatics industry and sustainable environment development.

## I YEAR – I SEMESTER

| Course Code | Category | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|---|
| EGM-101 | Core Course I | Principles of Geospatial Technology | 25 | 75 | 4 | -- | 4 |
| EGM-102 | Core Course II | Remote sensing and Image interpretation | 25 | 75 | 4 | -- | 4 |
| EGM-103 | Core Course III | Surveying, Photogrammetry and Cartography | 25 | 75 | 4 | -- | 4 |
| EGM-104 | Core Elective I | 1. Digital Image Processing<br>2. Smart Cities and GIS<br>3. Climate Change and Sustainable Development | 25 | 75 | 4 | -- | 4 |
| EGM-105 | Open Elective I | 1. Programming with open source GIS<br>2. Geodetic Techniques and GNSS | 25 | 75 | 4 | -- | 4 |
| EGM-106 | Laboratory I | Image Processing and Feature Extraction Lab | 25 | 75 | - | 6 | 3 |
| EGM-107 | Laboratory II | Digital Photogrammetry Lab | 25 | 75 | -- | 6 | 3 |
| | Seminar I | Seminar | 50 | -- | -- | 4 | 2 |
| | **Total Credits** | | | | **20** | **16** | **28** |

## I YEAR – II SEMESTER

| | Category | Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|---|---|
| EGM-201 | Core Course IV | Geographical Information Systems | 25 | 75 | 4 | -- | 4 |
| EGM-202 | Core Course V | Environmental Impact Assessment | 25 | 75 | 4 | -- | 4 |
| EGM-203 | Core Course VI | Applied Geomatics | 25 | 75 | 4 | -- | 4 |
| EGM-204 | Core Elective II | 1. Microwave and Hyper spectral remote sensing<br>2. Cadastral, Land use Planning and Management | 25 | 75 | 4 | -- | 4 |
| EGM-205 | Open Elective II | 1. Geomatics for Disaster Risk Reduction & Management<br>2. Digital Photogrammetry<br>3. Remote Sensing for Vegetation | 25 | 75 | 4 | -- | 4 |
| EGM-206 | Laboratory III | GIS, GNSS and Spectral analysis Lab | 25 | 75 | - | 6 | 4 |
| EGM-207 | Laboratory IV | Geospatial Technology Lab | 25 | 75 | -- | 6 | 2 |
| | Seminar II | Seminar | 50 | -- | -- | 4 | 2 |
| | **Total Credits** | | | | **20** | **16** | **28** |

## II YEAR - III SEMESTER

| Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|
| Comprehensive Viva-Voce | -- | 100 | -- | -- | 4 |
| Project work Review | 50 | -- | -- | 24 | 12 |
| **Total Credits** | | | -- | 24 | **16** |

## II YEAR – IV SEMESTER

| Course Title | Int. marks | Ext. marks | L | P | C |
|---|---|---|---|---|---|
| Project work Review II | 50 | -- | -- | 8 | 4 |
| Project Evaluation (Viva-Voce) | -- | 100 | -- | 16 | 12 |
| **Total Credits** | | | **--** | **24** | **16** |

**Total Credits = 88**

## M. TECH. -ENVIRONMENTAL MANAGEMENT
## COURSE STRUCTRURE
## I YEAR
## I SEMESTER

| **Course Title** | **PRINCIPLES OF GEOSPATIAL TECHNOLOGY** | | |
|---|---|---|---|
| **Course code** | **EGM-101** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Course I** | | |
| **Course Outcome (COs)** | **At the end of the course, The student will be able to**<br>**C111.1:** Describe the geospatial technologies, infrastructure and data generation techniques.<br>**C111.2:** List techniques of mapping, positioning and earth's features to the scale and to the reference system.<br>**C111.3:** Relate various GPS Technologies in obtaining positional accuracies of earth surface features.<br>**C111.4:** Define scope of remote sensing, analysis methods. Categorize data analysis methods and required hardware and software.<br>**C111.5:** Demonstrate GST for land and water resources and in governance. | | |
| **UNIT I: INTRODUCTION:** | | | |
| Geospatial data, spatial data infrastructure, three important geospatial technologies, Spatial elements. Methods of spatial data generation. | | | |
| **UNIT II: COORDINATE SYSTEMS AND DATUMS:** | | | |
| Coordinates and coordinate systems, Datum's and geodetic systems, Coordinate transformations. Geodetic datum's, Geodetic reference system, choosing spatial frame work. | | | |
| **UNIT III: GLOBAL POSITIONING SYSTEM:** | | | |
| Introducing the Global Positioning System, Fundamentals of GPS signals and data, GPS mathematical models, GPS projects: some planning issues. | | | |
| **UNIT IV: REMOTE SENSING & GIS:** | | | |
| Definition and Scope, Remote Sensing, Principles, Remote Sensing data acquisition, Remote Sensing data analysis methods, Advantages and Limitations, Geographic Information Systems (GIS) and science, Fundamentals of Geographic Information Systems, Geographic data structures, Hardware and Software required. | | | |

**UNIT V: GIS & GST APPLICATIONS:**

Spatial data and modeling, Case studies relating Land and Water resources.GST for Environmental, Social, Local Government and Commercial applications.

**Books Recommended**


1. Textbook of Remote Sensing and Geographical Information Systems M. Anji Reddy, BS Publication.
2. Manual of Geospatial Science & Technology edited by John D. Bossler (Taylor & Francis ).
3. Fundamentals of GIS by MICHAEL N DEMERS. Published By john Wiley & Sons Inc.
4. Environmental Modeling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Stewart
5. Geographic Information Systems: A Management Perspective by Stan Arnoff.

| Course Title | REMOTE SENSING & IMAGE INTERPRETATION | | |
|---|---|---|---|
| **Course code** | **EGM-102** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Course II** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C112.1:** Identify the interaction of electromagnetic spectrum with atmospheric interactions on earth surface materials.<br>**C112.2:** Interpret remote sensing systems, sensors and their capabilities with varied resolutions.<br>**C112.3:** Extract different features from the satellite imageries and analyze various data products<br>**C112.4:** Discriminate factors affecting microwave measurements using various space and air borne radar systems<br>**C112.5:** Integrate application of multi spectral images in analysis of LULC and agricultural/Forest applications. | | |

**UNIT I: BASIC PRINCIPLES**

i. Introduction, Electromagnetic Remote Sensing Process, Physics of Radiant Energy:
ii. Nature of Electromagnetic Radiation, Electromagnetic Spectrum. Energy Source and its Characteristics,
iii. Atmospheric Interactions with Electromagnetic Radiation: Atmospheric Properties,
iv. Absorption Ozone, Atmospheric Effects on Spectral Response Patterns.

Energy Interactions with Earth's Surface Materials: Spectral Reflectance Curves. Cosine Law

**UNIT II: REMOTE SENSING SYSTEM AND SENSOR PARAMETERS**

i. Introduction, Satellite System Parameters: Instrumental Parameters, Viewing Parameters. Sensor Parameters, Spatial Resolution, Spectral Resolution, Radio metric resolution.
ii. Imaging Sensor Systems: Multispectral imaging sensor systems,
iii. Thermal sensing systems, microwave image systems.

Latest Trends in Remote Sensing Platforms and sensors: Examples of different satellites and sensors

**UNIT III: VISUAL IMAGE INTERPRETATION AND FEATURE EXTRACTION**

i. Introduction, Types of Pictoral Data Products, Image interpretation strategy: Levels of Interpretation Keys.
ii. Process of Image Interpretation, Interpretation of Aerial Photo, General procedure for photo interpretation, Three dimensional interpretation Method.
iii. Basic elements of Image Interpretation, Application of Aerial Photo Interpretation.
iv. Interpretation of Satellite Imagery, Key Elements of Visual Image Interpretation, Concept of Converging Evidence

| **UNIT IV: MICROWAVE AND HYPERSPECTRAL REMOTE SENSING:** |
|---|
| i. Introduction, The Radar Principle, Factors affecting Microwave measurements: Surface roughness, Radars catering mechanism.<br>ii. Radar Wave binds, Side looking Airborne radar (SLAR) systems, Synthetic Aperture Radar (SAR).<br>iii. Spectroscopy, Hyper spectral vs. Multi spectral imaging, Spectral reflectance's, Spectra Libraries – absorption process. |
| **UNIT V: REMOTE SENSING SYSTEM APPLICATIONS** |
| i. Advantages and Disadvantages of Remote Sensing, Applications of - Multi spectral imaging,<br>ii. Microwave imaging and Hyper spectral imaging, Visual image analysis for land use/land cover mapping,<br>iii. Geological and soil mapping, agriculture applications, forestry applications and water resources applications |
| **Books Recommended**<br>1. M.Anji Reddy, Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.<br>2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.<br>3. Remote Sensing: Principles and Interpretation by Floyd F. Sabins, 1997.<br>4. Remote Sensing of the Environment: An Earth Resource Perspective by John R. Jensen, 2009. |

| **Course Title** | **SURVEYING, PHOTOGRAMMETRY AND CARTOGRAPHY** | | |
|---|---|---|---|
| **Course code** | **EGM-103** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Course III** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C113.1:** Discuss photogrammetric surveys related to hydrographic, mining and cadastral surveys.<br>**C113.2:** Demonstrate various surveying and mapping technologies connected with elevation, contour survey, trigonometric leveling.<br>**C113.3:** Focus on Modern surveying trends using GPS, ETS and digital cartography.<br>**C113.4:** Tabulate various types of aerial cameras in relief displacement and flight planning<br>**C113.5:** Evaluate parallax equations and height determinations. | | |

**UNIT I: INTRODUCTION TO SURVEYING AND CARTOGRAPHY**

i. Datum and Reference System, horizontal data and Vertical data
ii. Topographical surveys, Photogrammetric surveys
iii. Engineering surveys:- Hydrographic surveys, Mine surveys, Cadastral surveys

**UNIT II: SURVEYING AND MAPPING**:

i. Conventional mapping versus Digital mapping, list of mapping organizations, Classification of maps.
ii. Control Survey: Horizontal, vertical and both, Contour survey and Depiction of heights.
iii. Introduction to Elevation Determination, Systematic Errors in Differential Levelling
iv. Random Errors In Differential Levelling, Error Propagation in Trigonometric Levelling

**UNIT III: MODERN TRENDS IN SURVEYING AND MAPPING:**

i. Global Positioning System for ground control and extension,
ii. Total station system for detail surveying,
iii. Digital Photogrammetric Survey,
iv. Remote Sensing, Digital Cartography
v. Geographical Information System.

**UNIT IV: BASICS OF PHOTOGRAMMETRY:**

i. History of Photogrammetry, Definition and terminology,
ii. Geometry and Types of photographs, Photographic scale, relief displacement, photographic overlaps,
iii. Types of aerial cameras, Ground control, Photo mosaics.
iv. Flight planning – Crab and drift – Computations for flight planning,

| |
|---|
| v. Specification for Aerial Photography. |
| **UNIT V: PHOTOGRAMMETRY AND CONSIDERATIONS:** |
| i. Stereo photogrammetry introduction,<br>ii. Parallax equations and height determination<br>iii. Overview on applications of Photogrammetry |
| **Books Recommended**<br>1. Geo-informatics for Environmental Management by M. Anji Reddy, BS Publications, 2nd edition, 2004.<br>2. Text book of Photogrammetry by P.R. Wolf, 2nd edition.<br>3. Surveying and Mapping, Volume I and II by David Clarke, 1996.<br>4. Manual of Photogrammetry – American society of Photogrammetry & R.S by Albert.D, 1952 |

| Course Title | DIGITAL IMAGE PROCESSING | | |
|---|---|---|---|
| Course code | EGM-104 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Core Elective IA | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C114.1:** Illustrate satellite data acquisitions, image display subsystems and file formats<br>**C114.2:**Correlate sensor calibration and image enhancement techniques<br>**C114.3:** Compare various image filtering techniques and arithmetic operations.<br>**C114.4**: Prioritize various techniques of image classification techniques for accuracy assessment.<br>**C114.5:** Give reasons for integration of GIS in image classification and software's related to image classification. | | |

**UNIT I : DIGITAL COMPUTERS AND IMAGE PROCESSING**

i. Introduction: Information Systems – Encoding and decoding, modulation, Satellite data – acquisition, storage and retrieval – generation of data products digital data formats.

ii. Computer basics: Hardware and Software, Networks, Image Display Subsystem, Color Display System, Hard copy System ,

iii. Data Format for Digital Satellite Imagery, Image file Format and Data Compression

**UNIT II : PROCESSING OF REMOTE SENSING DATA AND IMAGE ENHANCEMENT TECHNIQUES**

i. Cosmetic Operations- Missing Scan Lines, De –stripping Methods, Geometric Corrections and Registration.

ii. Coordinate Transformations, Atmospheric Correction Methods, Illuminations and View Angle Effects,

iii. Sensor Calibration and Terrain Effects and radiometric correction methods.

iv. Introduction to image enhancement, Human Visual Systems, Contrast Enhancement- Linear Contrast Stretch, Histogram Equalization, Guassian Stretch, Pseudo Color Enhancement- Density Slicing, Pseudo Color Transform.

**UNIT III: IMAGE TRANSFORMS AND IMAGE FILTERING TECHNIQUES**

i. Introduction, Arithmetic Operations- Image Addition, Subtraction, Multiplication and Division.

ii. Empirically Based Image Transforms- Perpendicular Vegetation Index, Tasselled Cap Transformations, NDVI.

iii. PRINCIPAL COMPONENT ANALYSIS: Standard PCA, Noise Adjusted PCA, Decorrelation Stretch, Hue -Saturation and Intensity Transform, Fourier Transform

iv. Introduction to image filtering, Low Pass Filters- Moving Average Filters, Median Filters, Adaptive Filters, High Pass Filters- Image Subtraction Method, Derivative Based Method, Frequency Domain Filters, Filtering for Edge Enhancement

**UNIT IV: IMAGE CLASSIFICATION AND ACCURACY ASSESSMENT**

i. Introduction, Geometrical Basis of Classification,
ii. Unsupervised classification, Supervised Classification Training Samples, Statistical Parameters and Classifiers, Other Approaches to Image Classification, Feature Selection, Contextual Information
iii. Image classification accuracy assessment, Performance analysis, Various Band Data for Land use, Land Cover Classification System with Case Studies.

**UNIT V: IMAGE CLASSIFICATION AND GIS INTEGRATION**

i. Image Classification and GIS,
ii. Integration and Linkage. Software:
- ERDAS,
- EASI /PACE,
- Geomatica and ENVI.

**Books Recommended**

1. M. Anji Reddy, Y. Harishanker - Digital Image Processing, B.S. Publications, Hyderabad, 2nd edition.
2. John, R. Jensen, Introductory Digital Image Processing – Prentice Hall, New Jersey, 1986.
3. Robert, A. Schowengergt. Techniques for image processing and classification in Remote Sensing, 1983.
4. Hord, R.M. Digital Image Processing, Academic Press Pub. 1982.
5. Paul. M. Mather & Magaly Koch - Computer Processing of RS Images- An Introduction, Wiley Blackwell publication, 4th edition, 2011

| Course Title | SMART CITIES AND GIS | | |
|---|---|---|---|
| Course code | EGM-104 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Core Elective I B | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C114.1:** Categorize theoretical models of GIS, GIS data inputs and storage<br>**C114.2**: Analyze data editing/streaming with respective to the accuracy precision and quality.<br>**C114.3:** Integrate various data modeling, simulation with respect to environment<br>**C114.4:** Theorize the institutional, public and participation of government in building the smart cities.<br>**C114.5:** Justify the importance of transformational water distribution and quality assurance in modeling smart cities. | | |

**UNIT I: FUNDAMENTALS OF GIS:**

i. Introduction, Roots of GIS, Overview of Information System, The Four Ms, Contribution Disciplines, GIS Definitions and Terminology, GIS Queries, GIS Architecture, Theoretical Models of GIS. Theoretical Framework for GIS, GIS Categories, Levels/Scales of Measurement.
ii. GIS data Types, Spatial data models, Comparison of Raster and Vector models, and Topology.
iii. **GIS data Input and Storage**: Introduction, The data stream, Data input methods: Keyboard entry, Manual digitizing, Scanning and automatic digitizing; GPS for GIS data capture; Storage of GIS database.

**UNIT II: GIS DATA- EDITING, QUALITY, ANALYSIS AND OUTPUT:**

i. Data editing, Detecting and correcting errors, Data reduction and generalization, Edge matching and Rubber sheeting. Components of data quality, Accuracy, Precision and resolution, Consistency, Completeness, Sources of error in GIS;
ii. Data Analysis- Format and Data medium conversion, spatial measurement methods, Reclassification, buffering techniques and overlay analysis; GIS output- Maps as output and graphical outputs. RS & GIS applications for environmental management: Forestry, Agriculture, water resources, urban & Geological studies

**UNIT III: DATA MODELING**

i. The state of GIS for Environmental Problem Solving, A Perspective on the State of Environmental Simulation Modeling, GIS and Environmental Modeling,
ii. The Role of Software Venders in Integrating GIS and Environmental Modeling, Cartographic Modeling, Scope of GIS and relationship to environmental modeling, data models and data quality

**UNIT IV: SMART CITIES I**

i. Benchmarks; Smart city scheme; Infrastructure pillars—Social, Physical, Institutional and Economic; Instruments; Demand; Citizen participation; Role of Government; conditions precedent for smart city development; Financial architecture; Industrial promotion;
ii. Smart city reference frame wok and Implementation framework; smart mobility; smart environment; smart living; role of GIS and smart services.

**UNIT V: SMART CITIES** II

i. smart city model; principles and spatial planning; Instrumentation; Transportation ; water distribution; sewage treatment; Waste management; Smart communication; Quality assurance; Resilience-- the use of IT; Energy efficiency; Optimisation techniques; Zero emissions; sustainability;
ii. **Case studies**: Singapore; India; Songdo; Lavasa; and Vienna.

**Books Recommended**

1. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2ndEdition, John H. Seinfeld and Spyros N. Pandis, 2006, ISBN 978-0-471-72018-8
2. Fundamentals of Atmospheric Modeling, 2nd Edition, Mark Z. Jacobson, 2005, ISBN 978-0-521-54865-6
3. Air Quality Modeling, Vol. I-III. Paolo Zannetti, EnviroComp/A&WMA.
4. Atmospheric Chemistry and Physics of Air Pollution. Seinfeld, John H., John Wiley and Sons, Inc., New York, 1986.
5. Introduction to Boundary Layer Meteorology. Stull, Roland B., Kluwer Academic Publishers, Norwell, MA, 1988.

| Course Title | CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT | | |
|---|---|---|---|
| Course code | EGM-104 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Core Elective I C | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C114.1:** Categorise the role of aerosols and radiative effects of aerosols on global climate change.<br>**C114.2:** Elaborate changes in global climate and evaluate climate change policies<br>**C114.3:** Debate the impact of ecosystem, water resources developmental planning and their adaption on climate change.<br>**C114.4:** Infer GHG management, inorganic carbon sequestration on mitigation of climate change.<br>**C114.5:** Recommend climate modelling and early warning systems using GST towards Sustainable development in view of SDG's | | |

**UNIT I: INTRODUCTION TO CLIMATE CHANGE**

i. Introduction to atmospheres: vertical structure and residence time.
ii. overview of aerosols, radiative effects of aerosols: direct and indirect; scattering and absorbing behaviour of aerosols
**iii.** Energy budget - and greenhouse effect
iv. Global climate change- Evidences and Observations of climate change; Ice and climate change; Isotope evidence

**UNIT II: CLIMATE CHANGE GOVERNANCE , INTERNATIONAL POLICY AND LEGAL FRAMEWORK**

i. Global Climate Change Governance
ii. Climate change finance sources : Challenges and opportunities to accessing and managing climate finance
iii. Evaluate climate change policies :
- UNFCCC and other entities
- Kyoto protocol
- Climate negotiations

iv. National scenario: NAPCC, India's commitments (INDCs) and National Communication (NATCOM) initiative Policies and regulation : Important agencies and organizations

**UNIT III: CLIMATE CHANGE IMPACTS AND ADAPTATION**

i. Climate Change Adaptation: Importance of adaptation- Adaptation options .
ii. Linkages between climate change adaptation and development planning
iii. approaches to climate change impacts and adaptation practices for :

- ecosystems,
- land use,
- water resources and
- human health

iv. Green Engineering

**UNIT IV: CLIMATE CHANGE MITIGATION**

i. Mitigation options :
   - technological and economic mitigation strategies:

ii. Biological and Inorganic Carbon Sequestration
iii. GHG Management
iv. energy system transformation and renewable energy technologies
v. carbon trading and carbon offsetting.

Key sectors for low carbon development

**UNIT V: CLIMATE CHANGE EARLY WARNING SYSTEM & SUSTAINABLE DEVELOPMENT**

i. Climate Modelling : global and regional climate models, its applications and importance. climate change projections.
ii. Climate Prediction and Early Warning System: Tools and Technologies
iii. Preparedness to Climate Change: Geospatial Approach
**iv.** Human Behaviour and Climate Change
v. Overview on SDG 2030:

**References •** Business and Climate – UNFCCC • GHG protocol – A Corporate Accounting and Reporting Standard • Kyoto Protocol – UNFCCC • Low carbon inclusive growth – GoI • Making Paris Work (Accepted Manuscript) • Fundamentals of Climate change • IPCC – Climate change Action, Trends and Implications for Business • India-Biennial report to UNFCC – 2015 • Global Warming – Six Indias • IPCC technical guidelines for assessing Climate change impacts and adaptation

**TED talks •** Can clouds buy us more time to solve climate change https://www.ted.com/talks/kate_marvel_can_clouds_buy_us_more_time_to_solve_climate_change • A critical look at Geoengineering against climate change - https://www.ted.com/talks/david_keith_s_surprising_ideas_on_climate_change • Let's prepare for our new climate(Adaptation) - https://www.ted.com/playlists/78/climate_change_oh_it_s_real

**Documentaries •** Before the flood (2016) • An inconvenient truth (2006) • National Geographic: Six Degrees Could Change the World (2007) • An Inconvenient Sequel: Truth to Power (2017)

| Course Title | PROGRAMMING WITH OPEN SOURCE GIS | | |
|---|---|---|---|
| **Course code** | **EGM-105** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Open Elective – I A** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C115.1:** Classify GUI application, debugging and console applications<br>**C115.2:** Distinguish Console raster/vector level operations.<br>**C115.3:** Assessment of various maps building and GUI applications.<br>**C115.4:** Discuss fundamentals of Web GIS, WFS, WMTS.<br>**C115.5:** Evaluating the use of Geo server and open layers i9n creative response applications. | | |

**UNIT I:**

i. Principles of Object Oriented Programming - C# - example programmes - console application - GUI application - debugging – deployment

**UNIT II:**

i. Console level Raster operations: Introducing GDAL - OSSIM, format translations, geometric corrections to imagery, reproject the raster, geo-tagging the imagery, georeferencing an image, clip images, altering the radiometric quantization, pyramid building, Kernel-based image processing ( Data to be used: Resourcesat / Cartosat / MODIS / DigitalGlobe / Sentinel imagery)

ii. Console level Vector operations: Introducing OGR, Merging the features of multiple vector files, create KML files, burning vector data onto raster (Data to be used: Open Source Maps)

**UNIT III:**

i. Building map applications - using MAPWINGIS: create a map, adding tool bar for standard map operations, create GUI, load GIS data into application programmatically

ii. Building applications: To load vector data, create basic symbology, change the feature symbology, add labels, create ESRI Shapefile and add a feature

iii. GUI application for handling raster data: Load a DEM file with custom colour-table, getting the metadata such as cell size, corner coordinates, read and display the cursor coordinates, read the map projection

**UNIT IV:**

**i. Web GIS -** Web GIS Fundamentals, Over view and Types of OGC Web Services, Web Ma

Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), Wel Processing Service (WPS), Web Map Tile Service (WMTS)

**UNIT V:**

i. **Geo Server –**Open Source Geo Spatial Tool, Install Geo Server, Loading the data into Geo Server, OGC protocols, Sample data access using Geo Server.
ii. **Open Layers -** Introduction to Open Layers, Java Script Library for Open Layers, Creating Sample Maps using Open Layers, Sample Open Layers Map creationusing data of Geo Server, Applying Custom Styles, Working with Layers, Creating Responsive Applications with Interaction and Controls**,** Controlling the Map, Open Layers for Mobile, 3D rendering with Cesium.

**Books Recommended**

| **Course Title** | **GEODETIC TECHNIQUES AND GNSS** | | |
|---|---|---|---|
| **Course code** | **EGM-105** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Open Elective – I B** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C115.1:** Inspect the problems of geodesy, ellipsoid revolution and satellite geodesy<br>**C115.2:** Discuss on global navigation system, its advantages and limitation<br>**C115.3:** Simplify GPS codes, receivers, pseudo ranging system<br>**C115.4:** Test various models of DGPS and their accuracies<br>**C115.5:** Plan geodetic control surveys for defense, vehicle tracking and navigation | | |

**UNIT I: INTRODUCTION**

i. Definition of Geodesy- problems of Geodesy- Ellipsoid of Revolution- coordinate system of Rotational Ellipsoid and spatial Ellipsoid- computations on the Ellipsoid- Gravity- Satellite Geodesy, reference surface, Geoid models- Indian datum- World Geodetic System.

**UNIT II: GLOBAL NAVIGATION SATELLITE SYSTEM ( GNSS)**

i. Global Positioning System (GPS), Description of the System and their orbits, GPS measurement strategies; Advantages and limitations of GPS, reference frames and other space geodetic techniques (satellite & lunar laser ranging, VLBI, Doppler orbitography, GLONASS, GALILEO).

**UNIT III: GPS SIGNAL STRUCTURE**

i. Carriers, GPS codes: C/A, P, navigational message, GPS receiver: Types and Structure of receivers, Principles of GPS position fixing: Pseudo ranging**.** Determination of GPS satellite coordinates, Types of ephemerides, Data Pre-processing, GPS data formats.

**UNIT IV: DIFFERENTIAL GPS**

i. Principles of DGPS, Real Time Kinematics
ii. Various modes and applications of DGPS
iii. Enhancement of Accuracy.

**UNIT V: APPLICATIONS**

i. Geodetic control surveys, Cadastral surveys, Photogrammetry, Remote sensing,

Engineering and monitoring. Military applications, Geographical Information System, Vehicle tracking and car navigation, LBS and special applications.

**Books Recommended**


i. Linear Algebra, Geodesy and GPS, Gilbert strang Kai Borre, Wellesley- Cambridge press, 1997.

ii. Satellite Geodesy by Gunter Seeber, 1st eition, Walter de gruzter Gmbtl & co.KG, 10785 Berlin, 1993.

iii. Essentials of GPS by N.K. Agrawal, spatial network Pvt.Ltd. Hyderabad, 2004.

iv. Geo-informatics for Environmental Management by M. Anji Reddy, BS Publications, 2nd edition, 2004.

| Course Title | IMAGE PROCESSING AND FEATURE EXTRACTION LAB | | |
|---|---|---|---|
| **Course code** | **EGM-106** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **LABORATORY – I** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C116.1:** Isolate the various thematic layers using SoI toposheets and satellite images<br>**C116.2:** Establish the error free satellite images for classification<br>**C116.3:** Determine the image processing techniques and implementation in preparation of various maps.<br>**C116.4:** Estimate the LULC classification and distinguish the supervised and unsupervised classification using digital image processing techniques.<br>**C116.5:** Evaluate the different features in the satellite image and its classification categories. | | |

**THEMATIC MAPPING:**

- Study of Toposheet
- Base map preparation
- Road network
- Drainage
- Watershed
- Slope
- Land use/land cover
- Geomorphology

**DIGITAL IMAGE PROCESSING on ERDAS, Arc GIS and ENVI:**

- Loading of digital data and extraction of study area
- Geometric Correction
- Image rectification
- Filtering Techniques
- Image classification - Supervised and Unsupervised Classification
- Map Composition and Output Generation

| Course Title | DIGITAL PHOTOGRAMMETRY LAB | | |
|---|---|---|---|
| **Course code** | **EGM-107** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **LABORATORY - II** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C117.1:** Practice the photogrammetric workstation and feature extraction from the images.<br>**C117.2:** Survey the terrain models semi automatic building extraction practices**.**<br>**C117.3:** Evaluating the features in the images and their properties.<br>**C117.4:** Create the triangulation, Ortho rectification and mosaicking<br>**C117.5:** Estimate the Features & its properties using three dimentional Analysis | | |

**Digital Photogrammetry:**

**LPS and DATEM:**

- Digital Photogrammetric Stereo Workstation: hardware, viewing system, measurement system, feature extraction, vector information
- Breaklines for automatic digital terrain model extraction
- Connection to CAD systems
- Automatic generation of terrain models: image matching procedures, analysis
- Semi-automatic building extraction: matching procedures
- Measurement of simple and complex building structures
- Orthophoto production and ortho mosaicking: handling of image blocks, geometric radio-metric adjustment and tools, examining typical problems in different data sets

**M. TECH. -ENVIRONMENTAL GEOMATICS**
**COURSE STRUCTRURE**
**I YEAR**
**II SEMESTER**

| | | | |
|---|---|---|---|
| **Course Title** | **GEOGRAPHICAL INFORMATION SYSTEMS** | | |
| **Course code** | **EGM-201** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Course - IV** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C121.1:** Illustrate Fundamental operations of GIS in Mapping, Data structure, and analysis of spatial and attribute data.<br>**C121.2:** Correlate directionality and spatial arrangement of liner, theissen polygons, in measuring distances.<br>**C121.3:** Discriminate surface mapping and digital elevation models, choropleth maps, and overlay analysis.<br>**C121.4:** Theorize role of GIS in environmental and cartographic modeling.<br>**C121.5:** Compare integrated hydrological and water quality mapping with respect to watersheds. Compare impact of industrial sites on environment and ecological modeling. | | |
| **UNIT I: FUNDAMENTALS OF GIS:** | | | |
| i. Map – scale, projection and symbolism. GIS - Introduction, definition and terminology, categories, components, fundamental operations, functional elements.<br>ii. Data structures, data models, GIS data, acquisition, input, storage, output generation. Data preprocessing, database management, integrated analysis of spatial and attribute data. | | | |
| **UNIT II: GIS SPATIAL ANALYSIS , MEASUREMENT AND SPATIAL ARRANGEMENT:** | | | |
| i. Introduction, Defining spatial objects - point, line and area objects based on their attributes, higher level point, line and area objects. Measuring length of linear objects, measuring polygons, measuring shape, measuring distance.<br>ii. Classification – Principles, Neighborhood functions, Polygonal neighborhoods, Buffers. | | | |

Spatial Arrangement - Point patterns, Theissen Polygons, Area patterns, Linear patterns, Directionality of Linear and Areal objects, Connectivity of Linear objects, Routing and allocation.

**UNIT III: STATISTICAL SURFACES AND OVERLAY ANALYSIS:**

i. Surface mapping, sampling the statistical surface, Digital Elevation Model (DEM). Interpolation- linear and non-linear, uses and problems.

ii. Terrain reclassification – steepness of slope, aspect, shape or form. Discrete surfaces - dot distribution maps, choropleth maps. Cartographic overlay, point-in-polygon and line-in-polygon operations, Polygon overlay, Automating point-in-polygon and line-in-polygon procedures in Raster, Automating Polygon overlay in Raster, Automating vector overlay, types of overlay.

**UNIT IV: DATA MODELING:**

**i.** The state of GIS for Environmental Problem Solving, A Perspective on the State of Environmental Simulation Modeling, GIS and Environmental Modeling

**ii.** The Role of Software Venders in Integrating GIS and Environmental Modeling, Cartographic Modeling, Scope of GIS and relationship to environmental modeling, data models and data quality.

**UNIT V: INTEGRATED MODELING USING GIS:**

i. Hydrological Modeling - water quality modeling, watershed management and modeling, saltwater intrusion models.

ii. Land-surface-subsurface Process Modeling - pipeline alignment studies, solid and hazardous waste disposal site selection,

iii. Zoning atlas for industrial siting, environmental information system development. Ecosystem modeling, risk and hazard modeling.

**Books Recommended**

1. M.Anji Reddy, Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, fourth edition..
2. Fundamentals of Geographic Information Systems by Michael N DeMers. Published By john Wiley & Sons Inc., 3rd edition, 2008.
3. Environmental Modeling with GIS, Michael F. Autor Goodchild, Bradley O. Parks, Louis T. Stewart, publisher- Oxford university press, 1993.
4. Geographic Information Systems: A Management Perspective by Stan Arnoff, WDL publications, 1989.

| Course Title | ENVIRONMENTAL IMPACT ASSESSMENT (EIA) | | |
|---|---|---|---|
| **Course code** | **EGM-202** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Course - V** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C122.1:** Direct, Indirect, cumulative and induced environmental impacts at Regional, sectoral and project level.<br>**C122.2:** Data products, thematic maps, collateral data in planning and management of baseline data acquisition.<br>**C122.3:** Screening of environmental clearance, for category B&B2 industries and feasibility studies.<br>**C122.4:** Predicting impact of Air, Water, Noise, Socio economic status on environment.<br>**C122.5:** Environmental management plans on emission controls and green belt development and hazardous wastes. | | |

**UNIT I: CONCEPTUAL FACTS OF EIA**

i. Introduction, Definition and Scope of EIA, Objectives in EIA, Basic EIA Principles, and Classification of EIA: Strategic EIA (SEIA), Regional EIA, Sectoral EIA, Project Level EIA and Life Cycle Assessment, Project Cycle, Grouping of Environmental Impacts: Direct Impacts, Indirect Impacts, Cumulative Impacts and Induced Impacts. Significance of Impacts: Criteria/Methodology to Determine the Significance of the Identified Impacts.

**UNIT II: BASELINE DATA ACQUISITION, PLANNING AND MANAGEMENT OF IMPACT STUDIES**

i. Environmental Inventory, Data Products and Sources: thematic data, topographical data, collateral data and field data. Environmental Baseline Monitoring (EBM), Preliminary Study to determine impact significance, Environmental Monitoring network Design, Monitoring Stations, Air quality data acquisition, Water Quality data acquisition, soil data, socioeconomic data and biological data acquisition. Impact on Environmental Components: Significance of Impacts, Criteria to determine the significance of the identified Impacts.

ii. Conceptual Approach for Environmental Impact Studies, Proposal Development, Interdisciplinary Team Formations, Team Leader Selection and Duties, General Study Management, Fiscal Control.

**UNIT III: OPERATIONAL ASPECTS OF EIA AND METHODS FOR IMPACT IDENTIFICATION**

i. Screening: Application for Prior Screening for Environmental Clearance, Screening Criteria Category A Projects, Category B Projects, Criteria for Classification of Category B1 and B2 Projects, Consistency with other Requirements and Siting Guidelines. Scoping: Identification of Appropriate Valued Environmental Components (VEC), Identification of Impacts Information in Form 1, Structure of a Pre-feasibility Report. Public consultation: Appraisal Decision Making, Post-clearance Monitoring Protocol.

ii. Background Information, Interaction-Matrix Methodologies: simple matrices, stepped matrices, development of a simple matrix, other types of matrices, summary observations on

matrices, Network Methodologies: Checklist methodologies, simple checklists, descriptive Checklists, summary observations on simple and descriptive Checklists.

**UNIT IV: PREDICTION OF IMPACTS (AIR-WATER- NOISE- BIOLOGICAL AND SOCIO-ECONOMIC)**

i. **Air Environment:** Basic information on air quality, Sources of Pollutants, effects of pollutions, Conceptual approach for addressing air environment impacts, Air quality standards, Impact Prediction, Impact significance.

ii. **Water Environment:** Basic Information on surface-Water Quantity and Quality, Conceptual Approach for Addressing Surface-Water-Environment Impacts, Identification of Surface-Water Quantity or Quality Impacts, Procurement of Relevant Surface-Water Quantity-Quality Standards, Impact Predictions, Assessment of Impact Significance.

iii. **Noise Environment:** Basic Information on Noise Key Federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts, Identification of Noise Impacts, Procurement of Relevant Noise Standards and/or Guidelines, Impact Prediction, Assessment of Impact Significance.

iv. **Biological Environment:** Basic Information on Biological Systems, Conceptual Approach for Addressing Biological Impacts, Identification of Biological Impacts, Description of Existing Biological Environment Conditions.

v. **Socio-Economic Environment:** Procurement of Relevant Legislation and Regulations, Impact Prediction, Assessment of Impact Significance.

**UNIT V: ENVIRONMENTAL MANAGEMENT PLAN (EMP)**

i. Case Study, identification of Impacts, EMP for Air Environment: Dust Control Plan, Procedural Changes, Diesel Generator Set Emission Control Measures, Vehicle Emission Controls and Alternatives, Greenbelt Development. EMP for Noise Environment,

ii. EMP for Water Environment: Water Source Development, Minimizing Water Consumption, Domestic and Commercial Usage, Horticulture, Storm Water Management. EMP for land Environment: Construction Debris, hazardous Waste, Waste from temporary Labour settlements.

**Books Recommended**


i. Textbook of Environmental Science & Technology by M.Anji Reddy, BS Publications, 2010

ii. Technological guidance manuals of EIA. MoEF.

iii. Environmental Impact Assessment by Harry W. Canter, McGraw Hill, 1996, 2nd edition.

iv. Man and Environment D.H.Carson 1976 Interactions Part I and III.

v. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

vi. Erickson, P.A.1979 Environmental Impact Assessment Principles and applications

vii. Basic Concepts in Remote Sensing & Arial Photogrammetry Lillesand & Keifer Printice Hall Intl., 1994.

viii. Renewable Energy: environment and development, Maheswar Dayal, Konark Publishers, 1989

| Course Title | APPLIED GEOMATICS | | |
|---|---|---|---|
| Course code | EGM-203 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Core Course - VI | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C123.1:** Validate Air and space borne sensors with respect to spectral and radiometric resolutions. Appraise satellite navigation systems, outer space explorations, chadrayan and Mangalyan.<br>**C123.2:** Formulate spectral information in estimation of vegetative indexes, precision agriculture, and crop and forest management.<br>**C123.3:** Illustrate role of remote sensing and GIS in Geological mapping, and identification of spectral signature on mining.<br>**C123.4:** Assess crop type classification and estimates, watershed impact on soil erosion and water quality modeling.<br>**C123.5:** Analyze spectral response on upland and wetland vegetation ecosystem, urban and municipal solid waste studies. | | |

**UNIT I: SENSORS AND SATELLITES**

**SENSORS AND PLATFORMS**

i. Introduction, satellite system parameters- instrumental and Viewing, Sensors- Active and passive, classification, sensor parameters- spatial, spectral and radiometric resolutions

ii. Platforms- Airborne and Space borne, constraints of satellite geometry, effects of the local environment, common orbits and details of elevation angle and ground area, types of Scanners

**SATELLITE PROGRAM'S**

i. INSAT series, IRS series, RADAR imaging satellites, other satellites, GAGAN & IRNSS satellite navigation system

ii. Extra terrestrial exploration- chandrayaan-1 and 2 & Mangalayaan, International cooperation of ISRO, future projects of ISRO

**UNIT II: SPECTRAL INFORMATION FOR SENSING VEGETATION & APPLICATIONS**

**SPECTRAL INFORMATION FOR SENSING VEGETATION**

i. Estimation of Vegetation Cove: Spectral Indices -Vegetation indices and vegetation descriptors.
ii. Microwave vegetation indices- estimation of vegetation using Lidar.

**INTEGRATED APPLICATIONS**

i. Detection and diagnosis of plant stress.
ii. Precision agriculture and crop management

iii. Ecosystems and Forestry Management.

**UNIT III: SOIL SCIENCES**

i. Role of Remote sensing and GIS in geological studies and case studies. Evaluation of Geological Mapping
ii. Introduction to Prospection Techniques, History of Remote Sensing in Geological Exploration. Image Lineaments and structural origin, Prospecting, Applications of thermal and Radar remote sensing in structural geology.
iii. Spectral response of Minerals, Rocks, Alterites, case studies

**UNIT IV: WATER RESOURCES, AGRICULTURE AND FORESTRY**

i. The hydrological cycle, Hillslope hydrology, The drainage basin, Channel networks, Automatic derivation of catchment characteristics, The global cycle.Ground water exploration and targeting. Introduction, Characteristics, Watershed and people, Watershed characteristics, watershed management and Integrated approach for sustainable planning. Water quality modeling. Watershed Management in India, Case studies.
ii. Soil and altitude, Soil and aspect, Soil and slopes, Soil landscapes, Soil erosion modeling.
iii. Crop type classification, area estimates, and spectral response of different crops. Crop diseases and Assessment, Crop and Water management and monitoring. Advances in Crop monitoring.

**UNIT V: RESPONSE OF ECOLOGICAL FACTORS AND IMPACT STUDIES, MODELLING**

**i.** Spectral response of vegetation and mapping, Ecosystem Analysis, Environmental impact analysis and monitoring, Ecosystem modeling,
**ii.** Wetland mapping.
**iii.** Urban growth studies
**iv.** Municipal solid waste studies
**v.** Land use land cover change detection studies
**vi.** Spatial Models of Ecological Systems and Process

**Books Recommended**

1. M.Anji Reddy, Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.
2. Principles of Remote sensing, An introductory Text book by the international institute for Geo-Information sciences and Earth Observation (ITC).
3. Satellite Technology: Principles and Applications, 2nd Edition, Anil K. Maini, Varsha Agrawal, ISBN: 978-1-119-95727-0694 pages, June 2011.

| Course Title | MICROWAVE AND HYPER SPECTRAL REMOTE SENSING | | |
|---|---|---|---|
| **Course code** | **EGM-204** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Core Elective – II A** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C124.1:** Illustrate components of Radar System and factors affecting Microwave measurements.<br>**C124.2:** Interpret characteristics of Side looking Airborne Radar on relief, soil, vegetation and urban response.<br>**C124.3:** Infer Passive Microwave radiometers on various ocean bound satellites<br>**C124.4:** Categorize Hyperspectral and Microwave images and their spectral reflectance curves.<br>**C124.5:** Choose Hyperspectral images for environmental management. | | |

**UNIT I: INTRODUCTION TO MICROWAVE REMOTE SENSING**

i. Definition, Radiometric Quantities, Radar System Components, Source of Radiation, Radar Wave Bands, RADAR Equation
ii. Factors Affecting Microwave Measurement, Beam Polarization and Look Angle.

**UNIT II: SLAR, CHARACTERISTICS AND INTERPRETATION OF SLAR IMAGERY**

i. Definition, Radar working principle, range resolution, azimuth resolution, swath width resolution and SAR systems.
ii. Slant range scale distortion, ground range geometry, image displacement due to relief, layover, fore shorting, shadow and speckle.
iii. Geometric characteristics, Electrical characteristics, Effects of polarization, Soil response, Vegetation response, urban area response.

**UNIT III: MICROWAVE SENSORS AND SATELLITES**

i. Passive microwave radiometers SEASAT, SIR, ALMAZ, ERS, ENVISAT, JERS, ALOS, RADARSAT
ii. Applications of microwave remote sensing

**UNIT IV: HYPER SPECTRAL REMOTE SENSING**

i. Hyper spectral imaging, imaging spectrometers, principles of spectroscopy
ii. Hyper spectral vs multi spectral imaging.
iii. Spectral reflectances, spectral libraries, absorption process, analysis of spectral curve.

**UNIT V: SATELLITES AND APPLICATIONS**

i. Hyper spectral satellite systems viz., AVIRIS, HYMAP, HYPERION
ii. Applications of Hyper Spectral Remote Sensing in the field of Environmental management.

**Books Recommended**

i. Textbook of Remote Sensing and Geographical Information Systems M.Anji Reddy, BS Publication, 3rd edition, 2008.

ii. Remote sensing and Image interpretation by Thomas Lilliesand and Ralphw. Keifer Published by John Wiley &Sons.6th edition, 2007.

iii. Remote sensing-Principles and interpretation by Floyd F Sabins.Jr. Published by Freeman & Co., New York, 3rd edition, 2003.

| Course Title | CADASTRAL, LAND USE PLANNING AND MANAGEMENT | | |
|---|---|---|---|
| Course code | EGM-204 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Core Elective – II B | | |
| Course Program outcomes (COs) | **At the end of the course, The student will be able to**<br>**C124.1:** Identify methods and tools for Land use, built environment, and zoning criterion.<br>**C124.2:** Classify relevance of Geomatics in evaluating Land suitability, capability in decision making system.<br>**C124.3:** Discuss sustainability of Land management, Net farm profitability, and Principles of ecology for planners.<br>**C124.4:** Assess concepts of sustainable planning towards smart cities.<br>**C124.5:** Compose Urban growth models in assessing alternative land use for environmental modeling. | | |

**UNIT I: INTRODUCTION TO LAND USE AND LAND COVER TYPES AND DISTRIBUTION**

Study of the methods and tools for managing land use and the built environment. Comprehensive Plan, Zoning Criteria and guidelines, regional, and state-level plans and socio economic issues.

**UNIT II: GEOMATICS FOR LAND USE PLANNING**

i. Land use System: Environmental inputs and impacts, economic inputs and outputs. Role of Geomatics in Land Evaluation and Suitability for land use planning.
ii. Land Capability classification and preference of land use.
iii. Decision Support System for land use planning

**UNIT III: ECOLOGICAL PRINCIPLES FOR PLANNERS**

i. Overview of ecology and the environment. Important ecological issues in land use for environmental planners.
ii. Sustainable land management: Crop Yield, Nutrient Balance, Maintenance of Soil Cover, Soil Quality/Quantity; Water Quality/Quantity; Net Farm Profitability; Conservation Practices

**UNIT IV: SUSTAINABLE URBAN PLANNING & SMART CITIES**

i. Concept of Sustainability in planning practice.
ii. Objectives of (i) urban sustainability initiatives ;(ii)Transportation, solid waste reduction;(iii) Climate change initiatives; and (iv) smart cities policies.

**UNIT V: LAND USE AND ENVIRONMENTAL MODELLING**

i. Fundamentals of GIS and statistics.
ii. GIS-based land use and urban growth models, basins (stream and runoff water quality model)
iii. Visualization and impact assessment models for alternative land use

**Books Recommended**

| | | | |
|---|---|---|---|
| **Course Title** | **GEOMATICS FOR DISASTER RISK REDUCTION & MANAGEMENT** | | |
| **Course code** | **EGM-205** | No. of credits | 04 |
| **Centre/ Department** | Centre for Environment , IST, JNTUH | | |
| **Program** | M. Tech : Environmental Geomatics | | |
| **Course type** | **Open Elective – II A** | | |
| **Course outcomes (COs)** | **At the end of the course, The student will be able to**<br>**C125.1:** Relate definitions, levels of disaster risks and phenomena.<br>**C125.2:** List Disaster trends at Global and regional levels, differentiate natural and manmade disasters.<br>**C125.3:** Compare disaster risk vulnerabilities, hazard mapping prevention and mitigation of disasters.<br>**C125.4:** Assess impact of climate change, Biodiversity loss on desertification and disasters.<br>**C125.5:** Evaluate Disaster Management Policy, organizational frame work in preparation of disaster management plans. | | |

**UNIT I: UNDERSTANDING ECOSYSTEM AND DISASTER PHENOMENA**

i. Concept and definitions and functions of different terms of disaster and Ecosystem, Approaches to understand disaster phenomena (natural science, applied science, progressive and holistic approaches)
ii. Parameters of Disaster Risk, Levels of disaster as per national guideline.

**UNIT II: OVERVIEW, CLASSIFICATION, CHARACTERISTICS, PROBLEM AREAS OF DISASTERS**

i. Disaster trends (Global, national and regional),Selected models for understanding the causes of disaster and disaster risk mitigation, Classification of hazards (natural and manmade),Response time, frequency, forewarning, exposure time of different hazards.
ii. General characteristics and problem areas of different natural and man-made hazards (e.g. flood, erosion, earthquake, landslide, lightning, tropical cyclone, drought, civil unrest etc.),Common approaches to study natural and manmade hazards; vulnerability and disasters.

**UNIT III: DISASTER RISK MITIGATION**

i. Disaster risk assessment (Hazard-Vulnerability-Capacity analysis), Hazard mapping and forecasting; Principles and aspects of Disaster prevention, Disaster mitigation, Preparedness for damage mitigation and coping with disasters; Capacity building for disaster/damage mitigation (structural and non-structural measures);
ii. Contingency planning for damage mitigation of different hazards; Relevance of indigenous knowledge, appropriate technology and local resources in disaster risk mitigation
iii. Community based disaster risk reduction mechanism; Counter disaster resources and their roles.

**UNIT IV: ENVIRONMENT AND DISASTERS**

i. Environment, ecosystem and disasters. Climate change – issues and concerns. Biodiversity loss and DRR; Global water crisis and DRR
ii. Desertification, soil erosion and DRR; ecosystems for urban risk reduction; Industrial

hazards and safety measures; Post disaster impact on environment; Impact of developmental projects on disaster risk; Aspects of environmental management for disaster risk reduction; Environmental Impact Assessment (EIA).

**UNIT V: PLANNING FOR DISASTER MANAGEMENT**

i. Concept of spatial planning for DRR; Community-hazard profile in India; Different phases of Disaster Management (DM cycle; Relief mechanism (needs assessment, relief administration and distribution, management of relief centres, external support etc.);Disaster Management Act (2005); Disaster Management Policy (2009); organizational framework for disaster management in India.

ii. **Case studies**: Hazard mapping of vulnerable areas, Vulnerability assessment (physical, social, organizational, economical, technological), Risk mitigation planning for vulnerable areas.

**Books Recommended**

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W. N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
4. National Policy on Disaster Management, NDMA, New Delhi, 2009.
5. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.

Parasuraman, S & Unnikrishnan, P. V. (ed.), India Disasters Repot Towards a policy initiative. Oxford, 2000

| Course Title | DIGITAL PHOTOGRAMMETRY | | |
|---|---|---|---|
| Course code | EGM-205 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Open Elective – II B | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C125.1:** Summarize digital photogrammetry Vis-à-vis Analogue photogrammetry, and various camera systems and principles of image scanning methods.<br>**C125.2:** Distinguish image measurement, scales, and digitizing methods.<br>**C125.3:** Justify procedures in image transformations, image matching techniques, and use of GPS in adjustments.<br>**C125.4:** Theorize principles of visualization in DEM, DTM & DSM.<br>**C125.5:** Prove role of LiDAR in range measurements and accuracies. | | |

**UNIT I: INTRODUCTION TO DPW SYSTEMS**

i. Definition of Digital Photogrammetry & Its Development, Digital Photogrammetry Vis-À-Vis Analogue Photogrammetry, Advantages of Digital Photogrammetry,

ii. Hardware & Software Components of DPWS, Various Inputs For Digital Photogrammetry: Scanned Photo, Digital Camera Data, Remote Sensing Data, Lidar Data, Video Camera Data, Basic Consideration of Photogrammetric Scanners: Principle of Image Scanning, Configuration of Scanners, Method of Scanning, File Format and Size.

**UNIT II: IMAGE MEASUREMENTS & THEIR REFINEMENT**

i. Introduction to Coordinate Systems And Image Measurements, Simple Scales For Photographic Measurements, Measuring Photo Coordinates With Simple Scales, Trilaterative Method of Photo Coordinate Measurement, Measurement of Photo Coordinates With Tablet Digitizers, Mono Comparator Measurement of Photo Coordinates.

ii. Refinement of Measured Image Coordinates: Distortions of Photographic Films and Paper, Shrinkage Correction, Lens Distortions Corrections, Atmospheric Refraction Correction, Earth Curvature Correction, Reduction of Coordinates to an Origin at the Principal Point.

**UNIT III: ORIENTATION PROCEDURES IN DIGITAL PHOTOGRAMMETRY**

i. Inner orientation(IO),Transformation & Its Suitability, Exterior Orientation (EO),Auto Tie Point Generation, Digital Image Matching Process: Area Based, Feature and Relation Based, Collinearity Conditions, Block Triangulation Method and Adjustment, Simultaneous Solution for unknowns in a Block, Space Resection Method, Space Forward Intersection. Use Of GPS And IMU in Digital Photogrammetry

**UNIT IV: 3D VISUALIZATION & STEREO-COMPILATION**

i. Principle and Method of 3d Visualization: Anaglyph, Polarized and Hybrid Techniques, Feature Extraction, Feature Coding, Data Model and Feature Class.

ii. Definition DEM, DTM, DSM, Various Inputs to DEM/DTM, DTM Specification And Accuracy , Application of DTM, Various Interpolation Techniques: Grid, TIN, Break Lines, Mass Points, Digital Ortho-Photo Generation and its uses.

**UNIT V: AIR BORNE LASER TERRAIN MAPPING (LiDAR):**

i. Introduction to Laser ,Principle of LiDAR,, System Components, Range Measurements

,LiDAR Error Sources ,LiDAR Accuracy, Applications & Advantages.

**Books Recommended**

1. Elements of Photogrammetry- Paul r. wolf, 2nd edition, 1983.
2. Elements of Photogrammetry with application in GIS (3rd edition)- Paul Wolf & Bon Dewitt, Benjamin Wilkinson, McGraw-Hill companies, incorporated, 2013, 4th edition.

**Reference: -**

1. Manual of Photogrammetry – American society of Photogrammetry & R.S by Albert.D, 1952.
2. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009.
3. Digital Photogrammetry by – Y. Egels & Michel Kasser, Taylor & Francis group, 2002.
4. Geographic information systems an introduction by – Tor Bernhardsen, 3rd edition, John Wiley & Sons, Newyork, 2009.

| Course Title | REMOTE SENSING FOR VEGETATION | | |
|---|---|---|---|
| Course code | EGM-205 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | Open Elective – II C | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C125.1:** Relate role of remote sensing in concepts of plant physiology.<br>**C125.2:** Focus on Characteristics of Electromagnetic Sources, radiation, Energy, spectrum on vegetation.<br>**C125.3:** Appraise radiative and back scatter phenomenon of soil, water, plant canopy in microwave regions.<br>**C125.4:** Devise spectral and vegetative indices for microwave and LiDAR technologies.<br>**C125.5:** Integrate applications for detection and diagnosis of plant stress and crop management. | | |

**UNIT I: INTRODUCTION**

i. Introduction , History , introduction and interpretation of Remote sensing, Concepts of Plant Physiology and Remote Sensing. Data availability

**UNIT II: BASICS OF RADIATION PHYSICS FOR REMOTE SENSING OF VEGETATION**

i. Introduction, Radiation characteristics, Electromagnetic Radiation, Electromagnetic Spectrum, Electromagnetic Energy, Sources and terminology.
ii. Energy Interactions with matter and surfaces. The radiation Environment. LAI.

**UNIT III: RADIATIVE PROPERTIES OF VEGETATION, SOILS AND WATER**

i. Optical region: Leaf radiative properties, radiative properties of soil and water, radiative properties canopies.
ii. Thermal region: Emissivity of canopy components, and canopies.
iii. Microwave region: Microwave emissivity, back scatter, and advantages. Plant and Canopy Function: water relations, evaporations and water loss.

**UNIT IV: SPECTRAL INFORMATION FOR SENSING VEGETATION**

iii. Estimation of Vegetation Cover: Spectral Indices -Vegetation indices and vegetation descriptors.
iv. Microwave vegetation indices- estimation of vegetation using Lidar.

**UNIT V: INTEGRATED APPLICATIONS**

iv. Detection and diagnosis of plant stress.
v. Precision agriculture and crop management
vi. Ecosystems and Forestry Management.

**Books Recommended**

1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. Principles of *Geographic Information Systems* by John *Jensen* and Ryan
3. Remote Sensing: Principles and Applications - Kindle edition by Floyd F. *Sabins*.

| Course Title | GIS, GNSS AND SPECTRAL ANALYSIS LAB | | |
|---|---|---|---|
| Course code | EGM-206 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | LABORATORY - III | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C126.1:** Planning survey using total station and hand held GPS.<br>**C126.2:** Describe scale, projection, and coordinate systems and explain importance of each in GIS<br>**C126.3:** Creating Vector data and attribute linking<br>**C126.4**: Establish the Map composition and output generation<br>**C126.5:** Evaluate the spectral signatures of individual bodies. | | |

**GIS :** Arc GIS Software-

- Scanning of maps using software
- Creating GIS data using Arc Catalog
- On Screen Digitization using Arc Map
- Addition of Attribute data to a feature class
- GPS linkage and data entry
- Data editing, manipulation and analysis using ARC GIS software
- Map Composition and Output Generation using ArcGIS software.

**GNSS:**

- Alignment survey by handheld GPS, DGPS
- Processing of GPS survey data with GIS software

**Electronic Total station (ETS):**

Survey using total station, Recording data and Plotting.

**SPECTRAL SIGNATURES**

- Generation of Spectral Signatures
- Analysis of the Spectra

| Course Title | GEOSPATIAL TECHNOLOGY LAB | | |
|---|---|---|---|
| Course code | EGM-207 | No. of credits | 04 |
| Centre/ Department | Centre for Environment , IST, JNTUH | | |
| Program | M. Tech : Environmental Geomatics | | |
| Course type | LABORATORY - IV | | |
| Course outcomes (COs) | **At the end of the course, The student will be able to**<br>**C127.1:** Describe scale, projection, and coordinate systems and explain importance of each in GIS<br>**C127.2:** Creating Vector data and attribute linking, Map composition and output generation<br>**C127.3:** Gives better maps for easy estimation of environmental parameter changes and its consequences.<br>**C127.4:** Estimation of change detection and its factors.<br>**C127.5:** Evaluation of crop suitability, solid waste dumping site selection and lake restoration capacity. | | |

**Exercise using Geomatica, ERDAS, ArcGis, iGIS software and using different satellite datasets viz. High, Medium, Low…** for

i. Watershed development
ii. Forest informnation & change
iii. Agricultural information
iv. Preparation of Village Information System
v. Irrigation system
vi. Urban Expantion studies
vii. Land use Land cover assessment studies

**Site suitability studies for**

i. Crop
ii. Solid waste
iii. Water harvesting
iv. Lake restoration