

**M. TECH – ENVIRONMENTAL GEOMATICS**  
**COURSE STRUCTURE**  
**I YEAR**

**I – SEMESTER**

<b>SUBJECT CODE</b>	<b>SUBJECT TITLE</b>	<b>L</b>	<b>P</b>	<b>CREDITS</b>
EMT 1.1	Ecology and Natural Resources	4	0	4
EGM 1.2	Remote Sensing and Image Interpretation	4	0	4
EGM 1.3	Fundamentals of Surveying, Photogrammetry and Cartography	4	0	4
EGM 1.4	Digital Image Processing	4	0	4
EMT 1.5	Environmental Impact Assessment	4	0	4
EGML 1.6	Environmental Pollution Monitoring Lab	-	8	8
EGML 1.7	Thematic mapping and Digital Image Processing Lab	-	8	8
	Total Credits (5 Theory + 2 Lab)			<b>36</b>

**II - SEMESTER**

<b>SUBJECT CODE</b>	<b>SUBJECT TITLE</b>	<b>L</b>	<b>P</b>	<b>CREDITS</b>
EGM 2.1	Geographical Information Systems	4	0	4
EGM2.2	Statistics and Adjustment Computations	4	0	4
EGM 2.3	Space Geodetic Techniques and GNSS	4	0	4
EGM2.4	Digital Photogrammetry	4	0	4
EGM 2.5	Computer Applications and Modeling	4	0	4
EGML 2.6	Digital Photogrammetry Lab	-	8	8
EGML 2.7	GIS, GNSS and Spectral analysis lab	-	8	8
	Total Credits (5 Theory + 2 Lab)			<b>36</b>

**II YEAR****III & IV SEMESTERS**

<b>SUBJECT CODE</b>	<b>SUBJECT TITLE</b>	<b>L</b>	<b>P</b>	<b>CREDITS</b>
EGMS-3.1	Seminar	-	-	24
EGMP-3.2	Project Work	-	-	48
	Total Credits			<b>72</b>

**L- No. of Lectures per week; P- No. of Practical's per week.**

## EMT-1.1 ECOLOGY AND NATURAL RESOURCES

### UNIT I CONCEPT OF ECOSYSTEM:

Definition, Concept of a system; Biotic, abiotic and ecological systems. structure, functions and classification of ecosystems. Ecological pyramids.

Ecological energetic: Flow of energy through food chains and food webs; Laws of thermodynamics; entropy, Law of thermodynamics; ecological efficiency; food chain concentration. Biogeochemical cycles or Nutrient Cycles: General considerations of recycling; Gaseous and sedimentary cycles; rates of turnover and turnover time. Causes and consequences of disruption of nutrient cycles with reference to Greenhouse gases and SO<sub>x</sub>. Hydrological cycle.

### UNIT II POPULATION ECOLOGY:

Concept of a species and definition of a population. Biological and group attributes of populations. Density, natality, mortality, migrations and growth of populations. Natural regulation of populations. Human population explosion and its consequences.

### UNIT III NATURAL RESOURCES:

Classification of natural resources, biotic resources; Renewable and non-renewable resources: mutable and immutable resources; Different types of resources and their natural sources. Demographic quotient; rate of consumption and depletion. Value system, equitable resource use.

### UNIT IV MINERAL AND LAND RESOURCES:

Distribution and exploitation; environmental implications of mining; strategies for conservation of mineral resources, land evaluation and suitability, land use/land cover mapping, LU/LC for Environmental Planning.

### UNIT V ENERGY RESOURCES:

Renewable and non-renewable resources energy; Alternate and additional sources of energy; depletion of energy resources; Conservation of energy resource; Energy use efficiency. Solar radiation and its technological ways of harvesting; Solar collectors, photovoltaic, solar ponds; Hydroelectric power, Tidal, Ocean Thermal Energy Conversion, Wind, Geothermal Energy, Nuclear energy-fission and fusion, Hydrogen & Fuel cells.

### UNIT VI BIOTIC RESOURCES:

General account of biotic resources; Genetic resources; Food, fodder, fibre, fuel, timber and medicines. Forests and the ecological implication of depletion of forests. Concept of diversity; causes and consequences of loss of biodiversity; conservation of biodiversity.

### UNIT VII SOIL AND WATER RESOURCES:

Soil formation and soil erosion; Changes in land use and land cover pattern; conservation of soil and nutrients.

Water resources: Distribution, exploitation, depletion of water resources; conservation of water; water use efficiency; water poverty index.

### UNIT VIII SUSTAINABLE DEVELOPMENT:

Current concepts of conservation; sustainable development; Homeostasis; Ecological foot print; Carbon foot print; consumerism.

### References:

1. Fundamentals of Ecology by EP Odum, WB Saunders & Co.
2. Environment and Natural Resources conservation by Trivedi R.K.
3. Remote sensing in Geology by Seigal, John Wiley 1999

## **EGM-1.2 REMOTE SENSING AND IMAGE INTERPRETATION**

### **UNIT I REMOTE SENSING – BASIC PRINCIPLES:**

Introduction, Electromagnetic Remote Sensing Process, Physics of Radiant Energy: Nature of Electromagnetic Radiation, Electromagnetic Spectrum. Energy Source and its Characteristics, Atmospheric Interactions with Electromagnetic Radiation: Atmospheric Properties, 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 PARAMETERS:**

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

### **UNIT III REMOTE SENSING PLATFORMS AND SENSORS:**

Earth Resources Satellites: Landsat satellite Program, SPOT Satellite Programme, Indian Remote sensing satellite(IRS), AEM Satellites. Metallurgical Satellites: NOAA Satellites, GOES Satellites, NIMBUS Satellites, Meteosat Series. Satellites Carrying Microwave Sensors: Seasat, European Remote Sensing Satellite-I, Radarsat. OCEANSAT-1 (IRS-P4), IKONOS Satellites Series, Latest Trends in Remote Sensing Platforms and sensors: Quick Bird, Cartosat-1, Resourcesat-1.

### **UNIT VI VISUAL IMAGE INTERPRETATION:**

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

### **UNIT V MICROWAVE REMOTE SENSING:**

Introduction, The Radar Principle, Factors affecting Microwave measurements: Surface roughness, Radars catering mechanism. Radar Wave binds, Side looking Airborne radar (SLAR) systems, Synthetic Aperture Radar (SAR), Interaction between microwaves and Earth's surface: Speckle noise, back scattered radar intensity. Interpreting SAR images. Geometrical characteristics: Slope foreshortening, layover, aspect, radar shadow.

### **UNIT VI HYPER SPECTRAL REMOTE SENSING:**

Spectroscopy, Hyper spectral vs. Multi spectral imaging, Spectral reflectance's, Spectral Libraries – absorption process- analysis of spectral curves, Hyper spectral satellite systems viz., AVIRIS, HyMap, Hyperion, Modis and applications in the field of environmental management.

### **UNIT VII REMOTE SENSING SYSTEM APPLICATIONS:**

Advantages and Disadvantages of Remote Sensing, Applications of - Multi spectral imaging, Microwave imaging and Hyper spectral imaging.

### **UNIT VIII REMOTE SENSING APPLICATIONS:**

Visual image analysis for land use/land cover mapping, geological and soil mapping, agriculture applications for forestry applications, water resources applications, urban and regional planning, environmental assessment, Principles of land form identification and evaluation: sedimentary, igneous and metamorphic rock terrain.

#### **Text books:**

1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. M.Anji Reddy, Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.
3. Remote Sensing: Principles and Interpretation by Floyd F. Sabins.
4. Remote Sensing of the Environment: An Earth Resource Perspective by John R. Jensen.

## **EGM-1.3 FUNDAMENTALS OF SURVEYING, PHOTOGRAMMETRY AND CARTOGRAPHY**

### **UNIT I INTRODUCTION:**

Datum and Reference System, horizontal data and Vertical data, Survey operations, Field work, Office work, Geodetic surveys, Plain surveys and Shape of earth, Classification of plane surveys, Topographical surveys, Photographic surveys, Engineering surveys, Hydrographic surveys, Mine surveys, Cadastral surveys.

### **UNIT II SURVEYING:**

Stages in Surveying, Control Survey, Planimetry and Height control by triangulation and Traverse, Height control by Spirit leveling, Detail survey by Plane Tabling methods, Contour survey and Depiction of heights.

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

Field work, Global Positioning System for ground control and extension, Total station system for detail surveying, Digital Photogrammetry, Remote Sensing, Digital Cartography, Geographical Information System.

### **UNIT IV INTRODUCTION TO PHOTOGRAMMETRY:**

History of Photogrammetry, Definition and terminology, Geometry and Types of photographs, Photographic scale, relief displacement, photographic overlaps, Types of aerial cameras, Flight planning – Crab and drift – Computations for flight planning, Specification for Aerial Photography, Ground control – Basic horizontal and vertical control – Pre pointing and post pointing – Planning for Ground Control

### **UNIT V STEREO PHOTOGRAMMETRY:**

Stereoscopic depth perception – different types of stereoscopes vertical exaggeration – base lining and orientation – principle of floating mark, Photographic co-ordinate systems, Measurement and refinement of image co-ordinates – Methods of parallax measurement, derivation of parallax equations, Elevations by parallax differences, Measurement of parallax differences, computing flying height and airbase, Interior orientation, Empirical and numerical relative orientation, absolute orientation, model deformation. Derivation of the collinearity and coplanarity equations and their applications.

### **UNIT VI DIGITAL PHOTOGRAMMETRY:**

Definitions of digital Photogrammetric image – Creation of digital images – automatic measurements of fiducial mark – automated Photogrammetric point measurement – creation of digital Photogrammetric image – automated surface modelling – Digital Photogrammetric work Station.

### **UNIT VII CARTOGRAPHY:**

Introduction, Cartographic Symbolization, Classification of Symbols, Colours in Cartography, Scale and Purpose of a map, Cartographic Design, Thematic Cartography, Digital Cartography.

### **UNIT VIII MAPPING:**

Conventional Mapping versus Digital Mapping, List of Mapping Organizations, Classification of Maps

### **Textbooks:**

1. Geo-informatics for Environmental Management by M. Anji Reddy, BS Publications
2. Surveying and Mapping, Volume I and II by David Clarke
3. Text book of Photogrammetry by P.R. Wolf, 2<sup>nd</sup> edition.
4. Manual of Photogrammetry – American society of Photogrammetry & R.S by Albert.D

## **EGM-1.4 DIGITAL IMAGE PROCESSING**

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

Introduction: Information Systems – Encoding and decoding, modulation, Satellite data – acquisition, storage and retrieval – generation of data products digital data formats. Computer basics: Hardware and Software, Networks, Image Display Subsystem, Color Display System, Hard copy System, Data Format for Digital Satellite Imagery, Image file Format and Data Compression

### **UNIT II PRE-PROCESSING OF REMOTE SENSING DATA:**

Introduction, Cosmetic Operations- Missing Scan Lines, De –stripping Methods, Geometric Corrections and Registration. Coordinate Transformations, Atmospheric Correction Methods, Illuminations and View Angle Effects, Sensor Calibration and Terrain Effects and radiometric correction methods

### **UNIT III IMAGE ENHANCEMENT TECHNIQUES:**

Introduction, Human Visual Systems, Contrast Enhancement- Linear Contrast Stretch, Histogram Equalization, Gaussian Stretch, Pseudo Color Enhancement- Density Slicing, Pseudo Color Transform.

### **UNIT IV IMAGE TRANSFORMS:**

Introduction, Arithmetic Operations- Image Addition, Subtraction, Multiplication and Division. Empirically Based Image Transforms- Perpendicular Vegetation Index, Tasselled Cap Transformations, NDVI. PRINCIPAL COMPONENT ANALYSIS: Standard PCA, Noise Adjusted PCA, Decorrelation Stretch, Hue -Saturation and Intensity Transform, Fourier Transform

### **UNIT V IMAGE FILTERING TECHNIQUES:**

Introduction, 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 VI IMAGE CLASSIFICATION:**

Introduction, Geometrical Basis of Classification, Unsupervised classification, Supervised Classification Training Samples, Statistical Parameters and Classifiers, Other Approaches to Image Classification, Feature Selection, Contextual Information

### **UNIT VII IMAGE CLASSIFICATION ACCURACY ASSESSMENT:**

Image classification accuracy assessment, Performance analysis, Various Band Data for Land use, Land Cover Classification System with Case Studies.

### **UNIT VIII**

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

### **Text books:**

1. John, R. Jensen, Introductory Digital Image Processing – Prentice Hall, New Jersey, 1986.
2. Robert, A. Schowengerdt. Techniques for image processing and classification in Remote Sensing, 1983.
3. Hord, R.M. Digital Image Processing, Academic Press Pub. 1982.
4. Paul. M. Mather- Computer Processing of RS Images, Wiley
5. M. Anji Reddy - Digital Image Processing, B.S. Publications, Hyderabad

## **EMT-1.5 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

### **UNIT I: CONCEPTUAL FACTS OF EIA:**

Introduction, Definition and Scope of EIA, Objectives in EIA, Basic EIA Principles, 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:**

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.

### **UNIT III: PLANNING AND MANAGEMENT OF IMPACT STUDIES:**

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

### **UNIT IV: OPERATIONAL ASPECTS OF EIA:**

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.

### **UNIT V: METHODS FOR IMPACT IDENTIFICATION:**

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 VI: PREDICTION OF IMPACTS (AIR AND WATER):**

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. 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.

### **UNIT VII: PREDICTION OF IMPACTS (NOISE, SOIL, BIOLOGICAL AND SCIO-ECONOMIC)::**

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. Soil Environment: Human Health and Society, Biological Environment: Basic Information on Biological Systems, Conceptual Approach for Addressing Biological Impacts, Identification of Biological Impacts, Description of Existing Biological Environment Conditions, Procurement of Relevant Legislation and Regulations, Impact Prediction, Assessment of Impact Significance.

### **UNIT VIII: ENVIRONMENTAL MANAGEMENT PLAN (EMP):**

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, 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.

### **Text Books:**

1. Textbook of Environmental Science & Technology by M.Anji Reddy, BS Publications, 2010
2. Technological guidance manuals of EIA. MoEF.
3. EIA by Canter
4. Man and Environment D.H.Carson 1976 Interactions Part I and III.
5. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications
6. Erickson, P.A.1979 Environmental Impact Assessment Principles and applications
7. Basic Concepts in Remote Sensing & Arial Photogrammetry Lillesand & Keifer Printice Hall Intl., 1994.
8. Renewable Energy Environment and Development, Hameswar Dayal Konark Publishers, Pvt., Ltd.
9. Environmental Impact Assessment, Canter, L.W., 1977, McGraw Hills, New York.

## **EMT-1.6 ENVIRONMENTAL POLLUTION MONITORING LAB**

### **Analysis of Physical and Chemical parameters of Water and Soil**

#### **Physical parameters of soil:**

1. Moisture content
2. Bulk density
3. Specific gravity
4. Water holding capacity

#### **Chemical parameters:**

1. pH
2. Electrical conductivity
3. Turbidity
4. Hardness – Calcium, Magnesium and total hardness
5. Alkalinity
6. Nitrates, Nitrites and Ammonical nitrogen
7. Phosphates
8. Sulfates by Spectrophotometric & Nephelometric Method
9. Residual Chlorine
10. Dissolved Oxygen
11. Fluorides
12. Sodium
13. Potassium
14. Biological oxygen demand / organic matter
15. Chemical oxygen demand

#### **Air Pollution Monitoring:**

1. NO<sub>x</sub>
2. SO<sub>x</sub>
3. Particulate matter
4. Hydrocarbons

## **EGM-1.7 THEMATIC MAPPING AND DIGITAL IMAGE PROCESSING LAB**

#### **Thematic mapping:**

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

#### **Digital Image Processing (ON ERDAS, PCI Geomatica, ENVI):**

- Loading of digital data and extraction of study area
- Geometric Correction
- Image rectification
- Merging lines, columns and bands
- Filtering Techniques
- Image classification - Supervised and Unsupervised Classification
- Texture Analysis
- Map Composition and Output Generation

## **EGM-2.1 GEOGRAPHICAL INFORMATION SYSTEMS**

### **UNIT I FUNDAMENTALS OF GIS:**

Map – scale, projection and symbolism. GIS - Introduction, definition and terminology, categories, components, fundamental operations, functional elements. 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:**

Introduction, Defining spatial objects - point, line and area objects based on their attributes, higher level point, line and area objects.

### **UNIT III MEASUREMENT:**

Measuring length of linear objects, measuring polygons, measuring shape, measuring distance. Classification – Principles, Neighborhood functions, Polygonal neighborhoods, Buffers.

### **UNIT IV STATISTICAL SURFACES:**

Surface mapping, sampling the statistical surface, Digital Elevation Model (DEM). Interpolation- linear and non-linear, uses and problems. Terrain reclassification – steepness of slope, aspect, shape or form. Discrete surfaces - dot distribution maps, choropleth maps.

### **UNIT V SPATIAL ARRANGEMENT:**

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

### **UNIT VI OVERLAY ANALYSIS:**

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 VII DATA MODELING:**

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

### **UNIT VIII INTEGRATED MODELING USING GIS:**

Hydrological Modeling - water quality modeling, watershed management and modeling, saltwater intrusion models. Land-surface-subsurface Process Modeling - pipeline alignment studies, solid and hazardous waste disposal site selection, zoning atlas for industrial siting, environmental information system development. Ecosystem modeling, risk and hazard modeling.

### **Text Books:**

1. Fundamentals of GIS by MICHAEL N DEMERS. Published By John Wiley & Sons Inc.
2. Environmental Modeling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Stewart
3. Geographic Information Systems: A Management Perspective by Stan Arnoff.

## **EGM-2.2 STATISTICS AND ADJUSTMENT COMPUTATIONS**

### **UNIT I INTRODUCTION:**

Introduction, Direct and Indirect Measurement, Measurement Error Sources, Definitions, Precision versus Accuracy, Redundant Measurements in Surveying and Their Adjustment, Advantages of Least squares Adjustments

### **UNIT II MEASUREMENTS AND THEIR ANALYSIS:**

Introduction, Sample versus Population, Range and Median, Graphical Representation of Data.

### **UNIT III NUMERICAL METHODS OF DESCRIBING DATA:**

Measures of Central Tendency, Additional Definitions, Alternative Formula for Determining Variance, Numerical Examples, Derivation of the Sample Variance (Bissell's Correction), STATS AND SYS-STAT Program

### **UNIT IV RANDOM ERROR THEORY:**

Introduction, Theory of Probability, Properties of the Normal Distribution Function, Probability of the Standard Error, Uses of Percent Errors

### **UNIT V CONFIDENCE INTERVALS AND STATISTICAL TESTING:**

Introduction, Distributions used in Sampling Theory, Confidence Interval for the Mean: Statistic, Testing the Validity of the Confidence Interval, Selecting a Sample Size, Confidence Interval for a Population Variance , Confidence Interval for the Ratio of Two Population Variances.

### **UNIT VI HYPOTHESIS TESTING:**

Test of Hypothesis for the Population Mean, Test of Hypothesis for the Population Variance:  $\sigma^2$  , Test of Hypothesis for the Ratio of Two Population Variances.

### **UNIT VII ERROR PROPAGATION IN TRAVERSE SURVEYS:**

Introduction, Derivation of Estimated Error in Latitude and Departure, Derivation of Estimated Standard Errors in Course Azimuth, Computing and Analyzing Polygon Traverse Misclosure Errors, Computing and Analyzing Link Traverse Misclosure Errors

### **UNIT VIII ERROR PROPAGATION IN ELEVATION DETERMINATION:**

Introduction, Systematic Errors in Differential Leveling, Random Errors In Differential Leveling, Error Propagation in Trigonometric Leveling

### **Text books:**

1. Adjustment Computations (Statistics and Least Squares in Surveying and GIS ) - Paul R.Wolf & Charles D. Ghilani

## **EGM-2.3 SPACE GEODETIC TECHNIQUES AND GNSS**

### **UNIT I INTRODUCTION:**

Review of Observation Techniques in Space Geodesy, Overview of the Application of the Methods of Space Geodesy to the Relevant Research Field.

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

Global Positioning System (GPS) and GLONASS, Description of the System, GPS/GLONASS Signal Structure, Receivers and the Observables.

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

Orbits of GPS/GLONASS, Tropospheric and Ionospheric Refraction (Modelling and Parameter Estimation), Data Pre-processing.

### **UNIT VI DIFFERENTIAL GPS:**

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

### **UNIT V VLBI, SLR, SATELLITE ALTIMETRY, SATELLITE GRADIOMETRY, INSAR, & DORIS:**

Principals, Observables, Applications, Advantages and Weakness of the methods.

### **UNIT VI MONITORING OF GEODYNAMICAL PHENOMENA UTILIZING THE METHODS OF SPACE GEODESYI:**

Review of Continuum Mechanics, P- and S- Waves, A Brief Introduction to Rheology, Lithospheric Bending, Plate Tectonics, Solid Earth Tides, Ocean and Atmospheric Loading, Regional and Local Deformations (i.e. "Postglacial Rebound").

### **UNIT VII MONITORING OF GEODYNAMICAL PHENOMENA UTILIZING THE METHODS OF SPACE GEODESYII:**

Sea Level Monitoring, Modelling of the Station Coordinates and Velocities, Determination of Earth Rotation Parameters, Realisation of Global, Inertial Reference Frames, Approximation for a Tectonic Model based on strain-/stress-analysis.

### **UNIT VIII APPLICATIONS OF GNSS:**

Advantages and Limitations of GNSS, Development of GPS to GNSS.

### **Reference Books:**

1. Hoffman-Wellenhof, B. H. Lichtenegger, and J. Collins, Global Positioning System: Theory and Practice, Springer, New York, 1997
2. Rotacher, M., and L., Mervart (Editors), Bernese GPS Software Version 5.0, Astronomical Institute, University of Bern, 2001
3. P.J.G. Teunissen, A. Kleusberg (Eds.) GPS for Geodesy Springer, Heidelberg, 1998
4. Mohinder S. G., Lawrence R. W., Angus P. A., Global Positioning Systems, Inertial Navigation, and Integration, John Wiley & Sons, New York, 2001
5. Jekeli, C., Inertial Navigation Systems with Geodetic Applications, Walter de Gruyter, Berlin, 2001
6. Turcotte, D.E., Schubert, G., Geodynamics, second edition John Wiley, New York, 2002
7. Lambeck, K., Geophysical Geodesy, Oxford University Press, Oxford, 1988
8. Global Geodetic Observing System
9. Meeting the Requirements of a Global Society on a Changing Planet in 2020
10. Plag, Hans-Peter; Pearlman, Michael (Eds.)

## **EGM-2.4 DIGITAL PHOTOGRAMMETRY**

### **UNIT I INTRODUCTION:**

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

### **UNIT II HARD WARE AND SOFTWARE COMPONENTS:**

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 III IMAGE MEASUREMENTS:**

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.

### **UNIT IV REFINEMENT:**

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 V ORIENTATION PROCEDURES IN DIGITAL PHOTOGRAMMETRY:**

Inner orientation(Io), Transformation & Its Suitability, Exterior Orientation (Eo), Auto Tie Point Generation, Digital Image Matching Process: Area Based, Feature and Relation Based, Co-linearity Conditions and Equations, Block Triangulation Method and Adjustment, Simultaneous Solution for unknowns in a Block, Space Resection Method, Space Forward Intersection. Use Of GPS And IMU Data In Digital Photogrammetry

### **UNIT VI 3D VISUALIZATION IN DIGITAL ENVIRONMENT:**

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

### **UNIT VII INTRODUCTION TO GENERATION OF DIGITAL TERRAIN MODAL:**

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 VIII AIR BORNE LASER TERRAIN MAPPING (ALTM):**

Introduction to Laser ,Principle of Lidar,, System Components, Range Measurements ,Lidar Error Sources ,Lidar Accuracy, Applications & Advantages of Lidar Data.

#### **Text Books:**

1. Elements of Photogrammetry- Paul r. wolf.
2. Elements of Photogrammetry with application in GIS (3<sup>rd</sup> edition)- Paul R. Wolf & bon A. Dewitt
3. Digital Photogrammetry by –Michel Kasser & Y. Egels.

#### **Reference: -**

1. Manual of Photogrammetry – American society of Photogrammetry & R.S by Albert.D
2. Modern Photogrammetry – Deward M. Midhail.
3. Photogrammetry vol-1 by – Drauss J, Springler- Verlag publication.
4. Geographic information systems an introduction by – tor Bernhardsen, 3<sup>rd</sup> edition.

## **EGM-2.5 COMPUTER APPLICATION AND MODELING**

### **UNIT I COMPUTER BASICS:**

Problem solving using computers- flowcharts-algorithms-CPU-Input and output units-computer memory- Basic concepts of Object oriented Languages

### **UNIT II BASICS OF C++:**

Basic structure of C++ programming- tokens-keywords-data types: basic data types-derived data types-user defined data types- constants-variables-arrays-one, two and multi dimensional arrays-structure-union-enumerated data types.

### **UNIT III OPERATORS:**

Arithmetic operators- relational operators-increment and decrement operators-bit wise operators-arithmetic expression-precedence of operators-Evaluation of expression-type compatibility-expression and implicit conversion-manipulators-

### **UNIT IV FUNCTIONS:**

Control structures: decision making and branching-decision making and looping-Function declaration and definition- argument passing-return values.

### **UNIT V OBJECT FUNCTIONS:**

Class and objects-member functions- array of objects-object as a argument- function overloading- friend function-operator overloading-this pointer-static data member-static member function

### **UNIT VI CONSTRUCTORS, DESTRUCTORS AND INHERITANCE:**

Constructors: default constructor-parameterized-copy constructor-dynamic constructor-destructors-Inheritance-single inheritance-multiple inheritance-multilevel inheritance-pointers virtual functions and polymorphism

### **UNIT VII AIR AND WATER QUALITY MODELING:**

### **UNIT VIII OTHER ENVIRONMENTAL MODELS:**

#### **Text books :**

1. Object Oriented Programming with C++ by E. Balagurusawmy

### **EGM-2.6 DIGITAL PHOTOGRAMMETRY LAB**

- 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

### **EGM-2.7 GIS, GNSS AND SPECTRAL ANALYSIS LAB**

#### **GIS :**

- Scanning and digitization of maps using Autocad Map, Microstation and other digitizing software
- Demonstration of GIS software and its applications – ARC/INFO, Arc View, SPANS etc.,
- Data editing, manipulation and analysis using ARC/INFO GIS software
- Spatial data analysis using ArcGIS
- Map Composition and Output Generation using ArcGIS software.

#### **GNSS**

- Alignment survey by handheld GPS
- Processing of GPS survey data with GIS software
- Plot by Total Station Survey in field
- Downloading and Processing of survey plots
- Generation of survey plots

#### **SPECTRAL SIGNATURES**

- Generation of Spectral Signatures
- Analysis of the Spectra