Syllabus
for
Master of Science (M.Sc.) Programme
in
Geographic Information System (GIS) and Remote Sensing

आर्यभट्ट ज्ञान विश्वविद्यालय
ARYABHATTA KNOWLEDGE UNIVERSITY

Centre for Geographical Studies
Aryabhatta Knowledge University, Patna

N.K. Singh 27/10/21 Sasbihari 27.10.21 P.S. Singh 27/10/21

M.Sc. IN GIS AND REMOTE SENSING

Semester -1 (REMOTE SENSING) Credits: L: 2 T: 12 P: 2 = 16

COURSE CODE	COURSE TITLE	L	T	P	CREDIT
MSC 101	PRINCIPLES OF REMOTE SENSING	0	3	0	3
MSC 102	DIGITAL SATELLITE IMAGE PROCESSING	0	3	0	3
MSC 103	AERIAL AND SATELLITE PHOTOGRAMMETRY & IMAGE INTERPRETATION	0	3	0	3
MSC 104	STATISTICAL METHODS FOR RESEARCH	0	3	0	3
MSC 105	PRACTICAL/ LAB	2	0	2	4

Semester -2 (GEOGRAPHIC INFORMATION SYSTEM) Credits: L: 2 T: 12 P : 2 = 16

COURSE CODE	COURSE TITLE	L	T	P		CREDIT
MSC 201	GEOGRAPHIC INFORMATION SYSTEM AND SATELLITE NAVIGATION SYSTEMS	0	3	0		3
MSC 202	SPATIAL INFORMATION SYSTEM	0	3	0		3
MSC 203	DIGITAL SURVEYING	0	3	0		3
MSC 204	GEOSPATIAL WEB TECHNOLOGY AND DATA DATABASE	0	3	0		3
MSC 205	PRACTICAL	2	0	2		4

Semester -3 (Elective) Credits: L: 3 T: 12 P: 3 = 18

COURSE CODE	COURSE TITLE
MSC 301	RS AND GIS IN HYDROLOGY AND WATER RESOURCES
MSC 302	RS AND GIS IN AGRICULTURE AND FORESTRY
MSC 303	RS AND GIS IN DISASTER MANAGEMENT
MSC 304	GEOINFORMATICS AND NATURAL RESOURCE MANAGEMENT
MSC 305	GIS FOR URBAN PLANNING AND MANAGEMENT

MSC 306	GIS FOR DEMOGRAPHY AND HUMANITY
MSC 307	GIS AND RS IN REGIONAL DEVELOPMENT PERSPECTIVE OF BIHAR
MSC 308	CLIMATIC CHANGE OF GIS AND REMOTE SENSING
MSC 309	APPLICATION OF GIS AND REMOTE SENSING IN GEOMORPHOLOGY

Total credit – L: 3 T: 12 P: 3

L	T	P	CREDIT
0	3	0	3
0	3	0	3
0	3	0	3
0	3	0	3
3	0	3	6

Semester -4

INTERNSHIP AND PROJECT SUBMISSION (Credits: 20)

SL.NO	**COURSE TITLE**	CREDIT
1	CONCEPTUAL FRAME WORK OF THE PROJECT	1
2	FIELD WORK/LAB	6
3	SUBMISSION OF THESIS	6
4	PRESENTATION	1
5	GROUP TOUR AND PROJECT	5
6	REGULATARY AND PANCTUALITY	1

Semester -1 (REMOTE SENSING)

MSC 101 (PRINCIPLES OF REMOTE SENSING & DIGITAL SATELLITE IMAGE PROCESSING)

UNIT 1: BASIC CONCEPTS

Remote Sensing: History, Development, Definition, Concept & Principles, Electromagnetic Radiation (EMR) and Its Characteristics, Wavelength Regions and their Significance, Interaction of EMR with Atmosphere and Earth's Surface: Absorption, Reflectance and Scattering, Atmospheric Windows, Energy Balance Equation, Spectral Response and Spectral Signature, Spectral, Spatial, Temporal and Radiometric resolutions.

UNIT 2: DATA ACQUISITION

Platform: Balloon, Rocket, Helicopter, Aircraft and Spacecraft, Aerial vs. Satellite Remote Sensing, Satellites and their Specifications: LANDSAT, SPOT, ENVISAT, RADARSAT, IRS, IKONOS, Sensors and their Specifications: MSS, TM, LISS (I,II,III,IV), PAN, WiFS, AWiFS, MODIS, Weather & Communication Satellites.

UNIT 3: OPTICAL, THERMAL AND MICROWAVE REMOTE SENSING

Imaging and Non-Imaging, Active and Passive, Multispectral, Superspectral and Hyperspectral Sensors, Electro-Optical Systems, Opto-Mechanical Scanners, Infrared Scanners, Scatterometer, Thermal Properties of Terrain, Thermal IR Environmental Considerations, Thermal Infrared and Thermal Scanners, Microwave Remote sensing concepts:, Backscattering, Range Direction, Azimuth Direction, Incident Angle, Depression Angle, Polarization, Dielectric Properties, Surface Roughness and Interpretation, Speckle and Its Reduction, Applications of optical, thermal and microwave remote sensing.

UNIT 4: IMAGE ENHANCEMENT AND FILTERING TECHNIQUES

Concepts about digital image and its characteristics, Sources of image degradation - Image restoration and Noise Abatement , Radiometric and Geometric correction technique, linear and non linear transformation for geometric corrections, Look-up Tables (LUT) and Types of image displays and FCC, Radiometric enhancement techniques, Spatial enhancement techniques, Contrast stretching: Linear and non-linear methods, Low Pass Filtering: Image smoothing, High Pass Filtering: Edge enhancement and Edge detection, Gradient filters, Directional and non-directional filtering.

UNIT 5: PATTERN RECOGNITION

Concept of Pattern Recognition, Multi-spectral pattern recognition, Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers, Unsupervised classification methods, Supervised classification techniques, Limitations of standard classifiers

MSC 102 (DIGITAL SATELLITE IMAGE PROCESSING)

OBJECTIVE:

- The objective of the course is to describe about the procedure of satellite data acquisition and analysis.

UNIT I : FUNDAMENTALS

Satellite systems and data – acquisition - storage - orbits – Data formats –Data products – Image processing system – factors to be considered- Image display systems – Image sampling and quantization - Basic relationship between pixels.

UNIT II: SENSOR AND DATA MODEL

Sensor model – pixel characters - Image formation – Histogram -Types- Uni-variate & multi-variate image statistics – spatial statistics – Image registration and ortho rectification - Geometric and radiometric correction - noise models.

UNIT III: IMAGE ENHANCEMENTS

Spectral signatures – Image characteristics, feature space scatterogram- point, local and regional operation – contrast, spatial feature and multi-image manipulation techniques - Fourier transform - principle component analysis - Optimal Rotation Transformation – Scale-space transform, wavelet transform. multi-image fusion

UNIT IV: INFORMATION EXTRACTION

Training sits - Supervised, Unsupervised and Hybrid classifiers -– Baye's Theorem – parametric Classification - -Decision tree – other non-parametric classifiers - sub-pixel and super-pixel classification – Hyper-spectral image analysis – Accuracy assessment.

UNIT V : IMAGE ANALYSIS

Pattern recognition - boundary detection and representation - textural and contextual analysis - decision concepts: Fuzzy sets - evidential reasoning - Expert system - Artificial Neural Network – Case studies

OUTCOME:

On completion of this course, the student shall be able to Get familiarized about various image enhancement and image processing techniques.
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REFERENCES:

1. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007.
2. John A.Richards, Springer – Verlag, Remote Sensing Digital Image Analysis, 2005, ISBN:3540251286..
3. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
4. Robert Shcowebgerdt, Remote sensing models & methods for image processing, 3rd edition, 2004.
5. W.G.Rees - Physical Principles of Remote Sensing, Cambridge University Press, 2nd edition, 2001.

MSC 103 (AERIAL AND SATELLITE PHOTOGRAMMETRY & IMAGE INTERPRETATION)

UNIT 1: ENVIRONMENTAL MAPPING & INTERPRETATION

Importance of Image Interpretation, Image interpretation for delineation of lithology (Rocks), minerals and their characteristics, Geological structures - Folds, Faults and Joints and their field characteristics, Various important land forms, Image characteristics of geological structures and major land forms, Visual and Digital Satellite Image Interpretation, Elements of image interpretation, development of interpretation keys, Image interpretation for LU/LC and Vegetation mapping, Image interpretation for ocean and coastal monitoring.

UNIT 2: GEOMETRY OF AERIAL PHOTOGRAPHS

Need for Photogrammetry, Historical developments in Photogrammetry, Fundamental concepts and Importance of flight planning, End Lap, Side Lap, Scale, Ground Coverage, Weather Conditions, Purpose, Flying Height, Projection, Tilt, Swing, Scale, Image Displacement due to relief, due to lens distortion, due to tilt, Parallax, stereoscopic depth perception, overlaps in stereo pairs, principles of floating marks, Parallax bar and types, measurement of absolute and differential parallax, Parallax ,height measurement, correction to measure parallaxes – contouring from stereometric heights., Types of photographs, Vertical and Tilted photographs.

UNIT 3: ANALYTICALPHOTOGRAMMETRY

Co-ordinate system, air base components, degree of freedom, Elements of interior and exterior orientation of an aerial photographs, Numerical Derivations for Height based on relief displacement, coordinates, parallax, Orientation Procedures, Coordinate Transformation concepts, Epi-polar Geometry, Photo-triangularion: Pass-points for Aerotriangulation, semi-analytical aero-triangulation, analytical aero-triangulation, bundle adjustment with GNSS, Aero-triangulation with Satellite images, strategies for aero-triangulation.

UNIT 4: DIGITAL PHOTOGRAMMETRY

Analogue to Digital conversion, Image measurements, colour balancing, Image matching, Feature extraction- points, lines and regions, Planimetric Measurements, GCPs and Ortho-Rectification, Ortho-photographs, Digital Terrain Model derivation from Satellite images, Limitations, Quality checks and interactive control.

UNIT 5: TERRAIN MODELING WITH UAV

Digital Photogrammetric Images from UAV and associated concepts, UAV flight planning, coverage types, processing methods. Recent trends in its application, automated aerial triangulation: concepts, solutions, analysis, Photogrammetry work-stations, Review of available software.

MSC 104 (STATISTICAL METHODS FOR RESEARCH)

OBJECTIVES :

- This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis.

UNIT I ESTIMATION THEORY

Estimators : Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS

Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F
distributions for testing of means, variance and proportions – Analysis of
r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION

Multiple and partial correlation – Method of least squares – Plane of regression – Properties of
residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and partial correlations in terms of lower
order co - efficient.

UNIT IV DESIGN OF EXPERIMENTS

Analysis of variance – One way and two way classifications – Completely randomized design –
Randomized block design – Latin square design - 2_2 Factorial design.

UNIT V MULTIVARIATE ANALYSIS

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal
density and its properties – Principal components : Population principal components – Principal
components from standardized variables.

OUTCOMES :

After completing this course, students should demonstrate competency in the following topics:

- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Concept of linear regression, correlation, and its applications.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied
mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES :

1. Gupta.S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and
Sons, 11th Edition, 2002.
2. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
3. Johnson, R.A. and Wichern, D. W. "Applied Multivariate Statistical Analysis", Pearson Education, Asia, 6th Edition, 2007.
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4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

MSC 105 (PRACTICAL)

REMOTE SENSING AND PHOTOGRAMMETRY LABORATORY

OBJECTIVE:

- This course will facilitate the students to have hands on experience on different steps of visual interpretation of satellite images & photographs and digital interpretation of photographs.

REMOTE SENSING EXERCISES

1. Map reading - Survey of India Topo sheets. 4
2. Preparation of Base Map from Survey of India Topo sheets 4
3. Preparation of Land use/land cover map using Satellite Data / Aerial Photograph. 4
4. Preparation and analysis of spectral signatures using handheld spectroradiometer for
(a) Vegetation 4
(b) Soil 4
(c) Water 4

PHOTOGRAMMETRY EXERCISES

1. Testing stereovision with test card and Stereoscopic acquity 4
2. Mirror stereoscope- base lining and orientation of aerial photographs 4
3. Use of parallax bar to find the height of point 4
4. Scale of vertical photographs and Photo interpretation 4

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5. Orientations using digital photogrammetric workstation 4
6. ATM using small blocks – Part I 4
7. ATM using small blocks – Part II 4
8. DEM,DSM,DTM and Orthogeneration 4
9. Feature Extraction by Stereoplotting and Monoplotting 4

OUTCOME:

• On completion of this course, the student shall be able to acquire skills to carry out the Lab Exercises independently on visual interpretation of satellite images and digital processing of aerial photographs.

Semester -2 GEOGRAPHIC INFORMATION SYSTEM

MSC 201 (GEOGRAPHIC INFORMATION SYSTEM AND SATELLITE NAVIGATION SYSTEMS)

UNIT 1: BASIC CONCEPTS OF GIS

Definition, Philosophy & Historical evolution of GIS, Spatial vs. non-spatial data, Components of GIS, Spatial data models – Raster and Vector; advantages & disadvantages, Raster Data & its Representation: Data Structure& File format, Data Compression (block code, chain code, run length code, quadtree, MrSID), Vector data representation: Data Structure& File format,Topology, Advantage of DBMS in Context of GIS, Relational and Object Oriented DBMS.

UNIT 2: DATA INPUT AND GEO-CORRECTION

Sources of Spatial Data (Raster and Vector), Data Acquisition Through Scanners and on-screen Digitisation, Projections, Geometric Transformations of Raster and Vector Data (Affine Transformation and Transformation Coefficients), RMS Error, Types of Co-ordinate Systems, Spheroid and Datums, Sources of Errors, Spatial Data Quality: Accuracy, Precision, Error and uncertainty.

UNIT 3: SPATIAL ANALYSIS AND VISUALIZATION

Spatial Analysis: Definition, Steps and classification, Raster Data Analysis Tools – Local, Focal, Zonal and Global, Vector Data Analysis – Buffering, Distance Measurements, Analyzing Geographic Relationship, Overlay Analysis, Quantifying Change, Spatial Interpolation: Introduction, DEM Generation Surface Representation & Analysis, Network Analysis, Linkage Between Spatial and Non-Spatial Data, Basics of Geodatabase Model, Difference between 2D,2.5D, 3D and 4D GIS, Current issues and trends in GIS.

UNIT 4: SATELLITE POSITIONING SYSTEM - AN OVERVIEW

Introduction to Global Navigation Positioning System, Various Global/Regional Satellite constellations, NAVSTAR GPS signals, Geopositioning - Basic Concepts, Pseudo Range Measurement, Phase Difference Measurement, Sources of GNSS errors, DOP, Geoid, Datum/Ellipsoid - definition and basic concepts, Global Datum vs. Indian Geodetic Datum, Coordinate Systems, Transformation of coordinates, GNSS Remote Sensing.

UNIT 5: POSITIONING AUGMENTATION AND GNSS APPLICATIONS

Differential positioning concept, Various Differential survey Methods, GNSS Survey Planning, Data Processing, Site characteristics of Reference Station, Reference Station Equipment, Augmentation Systems (IRNSS, GAGAN, WAAS, LAAS, etc.) Basic concepts, Applications.

MSC 202 (SPATIAL INFORMATION SYSTEM)

SPATIAL INFORMATION SYSTEM

OBJECTIVES:

- Expose the students with concepts of cartography as major components of input and output related to cartography.
- To provide exposure to data models and data structures in GIS and to introduce various Raster and Vector Analysis capabilities.
- To expose the concept of quality and design of cartographic outputs in open GIS environment.

UNIT I FUNDAMENTALS OF CARTOGRAPHY AND GIS 9

Definition of Map - Mapping Organsiation in India- Classification based on Function, Scale, Characteristics – Ellipsoid and Geoid – Co-ordinate Systems - Rectangular and Geographic Coordinates – UTM and UPS - Projection – Function - Types of Map Projections – Transformations – Function - Affine transformation - Choice of Map Projection – Evolution of

cartography- Geo-Spatial, Spatial and Non-spatial data – Definition of GIS – Evolution GIS – Components of GIS.

UNIT II GIS DATA MODELS AND DATA INPUT 9

Point, Line Polygon / Area, elevation and surface –Tessellations - Attributes and Levels of Measurement - Data Sources – Ground and Remote Sensing survey – Collateral data collection –

Input: Map scanning and digitization, Registration and Georeferencing – Concepts of RDBMS - Raster Data Model – Grid – Data Encoding - Data Compression – Vector Data Model

– Topological properties – Arc Node Data Structure – Raster Vs. Vector Comparison – File Formats for Raster and Vector – Data conversion between Raster and vector.

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UNIT III RASTER AND VECTOR DATA ANALYSIS 9

Raster Data analysis: Local, Neighborhood and Regional Operations – Map Algebra – Vector Data

Analysis: Topological Analysis, point-in-polygon, Line-in-polygon, Polygon-in-Polygon – Proximity Analysis: buffering, Thiessen Polygon – Non-topological analysis: Attribute data Analysis- concepts of SQL– ODBC

UNIT IV NETWORK ANALYSIS AND SURFACE ANALYSIS 9

Network – Creating Network Data - Origin, Destination, Stops, Barriers – Closest Facility Analysis, Service Area Analysis, OD Cost matrix analysis, Shortest Path Analysis – Address Geocoding – Surface Analysis – DEM, DTM - Point data to Surface interpolation – DEM

Representaiton - Applications

UNIT V DATA OUTPUT AND WEB BASED GIS 9

Map Compilation – Cartographic functionalities for Map Design – Symbolization – Conventional

signs and symbols – Spatial Data Quality – Lineage, Positional Accuracy, Attribute Accuracy,

Completeness, Logical Consistency - Meta Data – Web based GIS: Definition, Merits - Architecture – Map Server – Spatial Data Infrastructure – Spatial Data Standards

OUTCOMES:

On completion of this course, the student shall

- Acquire knowledge about cartographic principles, spatial data models and spatial analysis.
- Understand the cartographic outputs in open GIS environment.

REFERENCES:

1. C.P. Lo, Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, 2nd Edition, Prentice Hall, 2006, ISBN-13: 9780131495029
2. John Jensen, Ryan Jensen, Introductory Geographic Information Systems, International Edition, Pearson Publishers, 2012, ISBN-10: 0136147763, ISBN-13: 9780136147763
3. Kang-tsung Chang, Introduction to Geographic Information Systems with Data Set CDROM,
6th Edition, Mc Graw Hill, 2013, ISBN-10: 0077805402,. ISBN-13: 978-0077805401

SPATIAL INFORMATION SYSTEM LABORATORY

OBJECTIVES:

- The exercises are designed to give practical exposure to the students to data input, data storage, data analyses and data output capabilities of a standard GIS software.
- It also adds skills in mapping techniques and map outputs.

1. Rectification and Spatial Referencing of Digital Map
2. Onscreen Digitization and Database Creation
3. Projection and Re-projection of spatial data

4. Data Conversion – Vector to Raster, Raster to Vector
5. Populating Attribute data base and querying on attribute data
6. Generation of DEM: from contours, spot heights, GRID and TIN, Isometric mapping
7. Vector Analysis – Buffering, Overlay and Network analysis, flood mapping
8. Raster Analysis – Measurement - Arithmetic overlaying, Logical overlaying, Class interval selection, choropleth maps
9. Map Output - Bar charts, Pie charts and symbols
10. Map compilation
11. Modelling spatial variability
12. Weighted theisson polygon and districting
13. Customisation and scripting

OUTCOME:

On completion of this course, the student shall be able to

• Acquire skills to carry out the Lab Exercises independently on spatial information system analysis and customisation.

MSC 203 (DIGITAL SURVEYING)

OBJECTIVE :

• To understand the working of Total Station, Electronic Distance Measurement and GPS equipments and solve the surveying problems.

UNIT I FUNDAMENTALS OF TOTAL STATION AND GPS

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Global Navigation System, Regional Navigation System and SBAS - Basic concepts of GNSS, Glonass,IRNSS -
Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion
- Keplerian motion – Kepler"s Law - Perturbing forces - Geodetic satellite - Doppler effect- Different Coordinate and Time System.

UNIT II ELECTROMAGNETIC WAVES

Classification - applications of Electromagnetic waves, Propagation properties, wave propagation
at lower and higher frequencies- Refractive index (RI) - factors affecting RI-Computation of group
for light and near infrared waves at standard and ambient conditions-Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity
correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -Total atmospheric correction- Use of temperature - pressure transducers.

UNIT III ELECTRO OPTICAL AND MICRO WAVE SYSTEM

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and
Microwave system. Care and maintenance of Total Station instruments– Applications of COGO
functions -Traversing and Trilateration – Downloading and mapping - Recent trends.

UNIT IV GPS SATELLITE SYSTEM

GPS - Different segments - space, control and user segments - satellite configuration - GPS signal
structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task
of control segment - GPS receivers.

UNIT V GPS DATA PROCESSING

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data -data processing – software modules -solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static
methods with GPS - semi Kinematic, pure Kinematic and Real time kinematic methods - basic
constellation of satellite geometry & accuracy measures - applications- use of different softwares.

OUTCOMES:

On completion of this course students shall be able to

- Understanding the concepts of Electromagnetic waves and impact of Refractive Index.
- Work with Electro optical and microwave Total Station and understand error sources.
- Understand the advantages of electronic surveying over conventional surveying methods
- Understand the working principle of GNSS , its components, signal structure, and error sources
- Understand various GNSS surveying methods and processing techniques used in GNSS observations
- Familiarise various areas of GNSS applications and new developments.

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REFERENCES :

1. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., Fourth Edition, 2015, ISBN: 978-1-118-67557-1.
2. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer Science & Business Media, Second Edition, 2007, ISBN: 3540727159, 9783540727156
3. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.
4. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
5. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1990.
6. Satheesh Gopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2007 isbn: 978-81317 00679
7. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 1998

DIGITAL SURVEYING LABORATORY

OBJECTIVE :

- To train the students to acquire skill in making precise measurements and obtaining accurate results with Total Station, Electronic Distance Measurement and GPS equipments.

EXERCISES:

1. Study of Total Station and EDM
2. Distance and Coordinate Measurement
3. Missing Line Measurement
4. Remote Elevation Measurement
5. Resection
6. Setting out : Point and Line
7. Taking Offsets
8. Area Measurement
9. Total Station Traversing
10. Study of Hand held GPS
11. Study of Geodetic GPS
12. Static and semi kinematic survey
13. Differential Positioning
14. Precise Positioning
15. GPS Traversing

OUTCOMES:

At the end of the course the student will be able to
- Work with Total Station and GPS instruments for measurement and mapping
- Use ofTotal Station and GPS for alignment and setting out works

MSC 204 (GEOSPATIAL WEB TECHNOLOGY AND DATA DATABASE)

OBJECTIVE:
- This course provides skills in learning a set of scripts and their applications for providing web based services using GIS technology.

UNIT I INTRODUCTION ON HTML 6+6
Internet Standards – Introduction to www – www Architecture – Protocols – HTTP, FTP, SMTP.
Markup Language (HTML): Introduction to HTML and HTML5 - Formatting and Fonts – Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames -
HTML Forms.

UNIT II CASCADING STYLE SHEET (CSS)
The need for CSS, Introduction to CSS – Basic syntax and structure - Inline Styles – Embedding
Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and
Padding - Positioning using CSS.
UNIT III JAVA SCRIPT
Data types and Variables - Operators, Expressions, and Statements -Functions - Objects - Array,
Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows
& Frames and Documents - Form handling and validations.
UNIT IV PHP
Introduction - Programming basics - Print/echo - Variables and constants – Strings and Arrays –
Operators, Control structures and looping structures – Functions – Reading Data in Web Pages -
Embedding PHP within HTML – Establishing connectivity with database.
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UNIT V GEOSERVER
Introduction – Web Administration – Geoserver data directory –loading and working with data –
shape file – postgis file – other web format data - styling the layers – services : WMS, WFS, WCS
– security – demos and case studies on Geo server.

OUTCOME:
- On completion of this course, the student shall be able to write scripts for web technology programming for GIS.

REFERENCES:
1. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011. ISBN-13: 978-

0132151009
2. http://docs.geoserver.org/
3. Stefano Iacovella, Brian Youngblood "GeoServer Beginner's Guide" Packt Publishing 2013, ISBN-13: 978-1849516686
4. Steven Holzner, "PHP: The Complete Reference" 1st Edition TATA McGraw Hill ,2008 ISBN: 9780070223622
5. Thomas Powell, "HTML & CSS: The Complete Reference" Fifth Edition, McGraw-Hill, 2010
ISBN-13: 978-0071496292
6. Thomas Powell, Fritz Schneider "JavaScript The Complete Reference" 3rd Edition, TATA McGraw Hill, 2013 ISBN-13: 9781259064685

Semester -3 (Elective)

MSC 301 (RS AND GIS IN HYDROLOGY AND WATER RESOURCES)

UNIT 1: Hydrologic Cycle, Hydrological parameters, porosity, permeability, specific yield, types of
aquiers. Watershed Management: Watershed characterization, delineation and codification, watershed problems and management strategy. Geoinformatics approach for watershed prioritization.

UNIT 2: Remote Sensing in Surface- Subsurface Water Exploration: Application of remote sensing in
hydro- geomorphological interpretation for ground water exploration, water quality monitoring through remote sensing.

UNIT 3: Operational Applications in Water Resources: Flood prediction, drought evaluation, snow cover mapping and reservoir sedimentation evaluation. Geoinformatics Models in Water Resources: Geo informatics based Runoff and hydrological modelling, flood Hazards modelling, snowmelt runoff modelling.

UNIT 4: Case Studies: Hydro-geomorphological mapping in Plateau region, Flood Prone zone mapping in Indo- Gangetic Plains, Water harvesting Initiatives in Urban built up the lands.

MSC 302 (RS AND GIS IN AGRICULTURE AND FORESTRY)

UNIT 1: INTRODUCTION (8L)

Spectral Properties of Vegetation: Natural and Man-made, Crop Yield and Acreage Estimation, Discriminate Analysis, Agricultural Applications: Sensor Requirements.

UNIT 2: DAMAGE ASSESSMENT

Plant Stress, Disease and Change Detection, Various Vegetation and Climatic Indices for Drought Damage assessment and Monitoring, Pest Control and Monitoring, Salt Affected land Mapping and Monitoring., Land degradation (water logging, salinization, erosion) assessment using RS & GIS.

UNIT 3: FORESTRY CONCEPTS AND LAND USE/LAND COVER

Conventional/Recent Remote Sensing Classification and Forest Inventory, Climatic, Altitudinal and Topographical Zones and Vegetation Relation, Forest Types Classification and Retrieval of Biophysical Parameters, Sensor Requirements, Landscape Ecology Concepts.
Basic Concept and Criteria of Land Use / Land Cover Classification, Methodology, Classification System, Level of Classification, Land Capability Assessment.

UNIT 4: VISUAL AND DIGITAL ANALYSIS:

Forest Cover, Canopy Density, Biomass Assessment, Forest Fire and Burnt Area Identification, Indian Forest Fire Alarm, Geospatial Modeling of Forest Fire Risk Zones, Sustainable Management, Criteria & Indicators based Decision Framework., Wildlife and Landscape Relationship, Habitat Assessment and Suitability Modeling, Disturbance Index and Analysis.

MSC 303 (RS AND GIS IN DISASTER MANAGEMENT)

UNIT 1: INTRODUCTION

Natural and human induced disasters, Fundamental concept of Disaster Management, Various natural disasters and their characterization: Cyclones, Floods, Earth quakes, land subsidence and Landslides, Forest fires, Droughts., Disasters and National losses, Historical perspective of disasters in India., Existing organizational structure for managing disasters in India, NGOs and people participation in disaster management.

UNIT 2: RS & GIS FOR HAZARD, RISK AND DAMAGE ASSESSMENT
Hazard evaluation – Zonation – Risk assessment and vulnerability, Damage assessment – Land use planning and regulation for sustainable development, Potential of GIS application in disaster mapping – Disaster management plan.
UNIT 3: LONG TERM MITIGATION MEASURES
Needs and approach towards prevention, principles and components of mitigation, Disaster legislation and policy – Insurance – Cost effective analysis – Utilization of resource, Training – Education – Public awareness –Role of media.
UNIT 4: DISASTER MANAGEMENT PLANNING AND DISASTER MODELING
Spatial and non-spatial data bank creation, Natural disaster management plans, Shelterbelts, Special structures, Disaster preparedness and Mitigation. Information needs of Disaster management, Operational emergency management – Vulnerability analysis of infrastructures, Settlements Population, Pre-disaster and post disaster planning for relief operations, Satellite communications during disasters: networks, use of Internets, Warning system - rehabilitation - Post disaster review, Global Disaster Alert and Coordination System.
Known/Generic Models in managing various disasters, Earthquakes in India, Tsunami Impact Assessment, Floods in Indo Gangetic plains, Landslides in Himalayan region, Drought in Indian plateau regions, Glacial lake outburst floods.

MSC 304 (GIS FOR URBAN PLANNING AND MANAGEMENT)

Objective: *To understand the concepts and principles and use the tools and techniques of GIS for efficient planning and management of urban area.*
UNIT 1 - Urban Planning and Mapping: Importance and types of plans, urban and regional planning, LU/LC mapping, GIS data modeling for urban design, urban infrastructure, urban site selection for urban development, site suitability analysis for utilities and civic amenities; Urban mapping: physical structure and composition of urban areas, urbanization process, growth trend, problems of urbanization, urban sprawl and associated problems.
UNIT 2 - AM/FM applications: GIS applications in Automated Mapping (AM) and Facility Management (FM), water and sewage related, GIS based urban water demand analysis, pipeline planning and alignment, electric and power supply related, telecom applications, radio coverage prediction, signal strength mapping.
UNIT 3 - Demography and Urban Governance: Population distribution map by age, gender, education, occupation, socio-economic grouping, health criteria index, crime rates and types; Urban governance: mapping administrative boundaries, city base map generation, property enumeration and property GIS, tax revenue rationalization, metropolitan information management system.
UNIT 4 - Urban Ecology Applications: Air quality indexing and mapping, monitoring atmospheric haze, smoke, toxic gas movement and prediction of vulnerable zones, noise pollution zonation, natural resources inventory and management, vegetation, soil, surface water and groundwater conservation, site suitability for groundwater recharging and rain water harvesting, urban area heat budgeting.
References
1. **Action Planning for Cities: A Guide to Community Practice** - Hamdi, Nabeel
2. **Applied Remote Sensing for Urban Planning, Governance and Sustainability** - Netzband Maik
3. **Remote Sensing of Urban and Suburban Areas** - Tarek Rashed, Carsten Jürgens
4. **Remote sensing and urban analysis** - Jean-Paul Donnay, Michael John Barnsley
5. **Urban Remote Sensing** - Qihao Weng, Dale A. Quattrochi
6. **Radar Remote Sensing of Urban Areas, Remote Sensing and Digital Image Processing** - Soergel Uwe
7. **Analysis of Urban Growth and Sprawl from Remote Sensing Data** - Basudeb Bhatta

MSC 305 (GIS FOR DEMOGRAPHY AND HUMANITY)

Objective: *This course will enable the students to analyze demographic data, economic data, epidemiological data and others and use it for making spatially informed decision.*

UNIT 1 - Introduction: definition and its importance, spatial distribution of population according to age, gender, racial group and socioeconomic segregation, geo-ethnography, labour market exploration, health equality, crime analysis, GIS for demographic analysis, trade area analysis, site selection for shopping centres, facility management.

UNIT 2 - Health GIS: Spatial epidemiology: RS and GIS in study of epidemics and their control-(malaria, leprosy, polio, TB, filariasis, dengue, chikengunya, cholera, AIDs, cancer), disease mapping, bioterrorism, infectious disease modeling, Health facility location mapping, health and disease atlas of India.

UNIT 3 - Power and Other Networks: Power – site suitability assessment for power plants (thermal, hydroelectric, nuclear, mini-hydro electric power plants), wind power, and impact assessment, GIS in electricity distribution network; Telecommunication – applications of GIS in telecommunication industry; Transportation – vehicle routing and scheduling, vehicle tracking system, Tourism – GIS application in Tourism planning.

UNIT 4 - Archeology: Importance of Archeological and Heritage sites, spotting historical monument and archeological sites, Role of digital mapping and database development for heritage sites, Surveying and mapping methods for heritage sites, digital archeology., 3d visualization of Archeological and heritage buildings; Landscape Archaeology.

References

1. **Transportation Network Analysis** - Bell, M.G.H. and Iida, Y.
2. **Network Analysis in Geography** - Haggett, P. and Chorley, R.
3. **The Geography of Transport Systems** - Rodrique, Jean-Paul
4. **Successful Tourism Management** - Seth, P.N.
5. **The Tourism System: An Introductory Text** - Mill and Morrison
6. **Remote sensing and urban analysis** - Jean-Paul Donnay, Michael John Barnsley
7. **Beyond the map: archaeology and spatial technologies** - Lock, G. and Harris, T.
8. **Digital Archaeology: Bridging Method and Theory** - Patrick Daly
9. **Pattern Recognition and Signal Processing in Archaeometry: Mathematical**

MSC 306 (CLIMATIC CHANGE OF GIS AND REMOTE SENSING)

Objective: *Climate change and its corollary global warming are the much talked-about these days for there is an impending danger to the earth we live in by the climate change caused primarily by the human activities on the earth. Climate change has already brought untold sufferings to the world that the world countries met several times to work towards a strategy for reducing global warming and the consequent climate change. This paper offers deep insights into the working of climate change and how to overcome it.*

UNIT 1 - Earth System Dynamics: Introduction to atmosphere, hydrosphere, biosphere, lithosphere, and human interventions in earth system dynamics and operations, anthropogenic activities and global warming.

UNIT 2 - Climate Change, the Process: Introduction, Concept, causes, effects, measures, importance of climate change, climate change and energy, climate change and emerging diseases, climate and change and community.

UNIT 3 - Issues in Climate Change: Global warming, green house effect, carbon cycle, nitrogen cycle, water cycle, ozone depletion, floods, droughts and weather variations, El-NINO and La-NINA, changing ecosystems, snow / glaciers melting.

UNIT 4 - Geoinformatics Applications: Hazards, risks and vulnerability analysis relating to global warming, floods and droughts, and weather variations, ecosystems changes, and snow/glaciers melting, energy studies, health and diseases studies and other case studies (at least 5).

References

1 **Climate Change: A Multidisciplinary Approach-** Burroughs, W.J.
2 **The Suicidal Planet: How to Prevent Global Climate Change-** Mayer Hillman,
3 **Field Notes from a Catastrophe: Man, Nature, and Climate Change-** Kolbert, Elizabeth.
4 **Cradle to Cradle: Remaking the way we make things** William McDonough,
5 **Integration of GIS, remote sensing, Photogrammetry and cartography: the Geoinformatics approach** -Ehlers, M.

MSC 307 (APPLICATION OF GIS AND REMOTE SENSING IN GEOMORPHOLOGY)

Objective: *This course offers a detailed application of GIS in geomorphology. Landforms evolve in response to a combination of natural and anthropogenic processes. Mapping these changes in landforms, mining and groundwater resources has a vast scope in RS and GIS.*

UNIT 1 - Introduction: Disciplines of geomorphology, role of geomorphology in identification of natural hazards - Soil erosion by water and wind, river floods, Slope instability, ground surface subsidence, volcanoes and earthquakes, management of landslides, coastal management, and urban management.

UNIT 2 - Geomorphological Mapping: Geological survey, geologic mapping and cartographic standards for different scale, mapping geological structures – fold, faults, joints and lineaments, lithological mapping, fracture analysis, Landforms – Deltaic, fluvial, coastal, glacial, tectonic, volcanic, karst/lakes.

UNIT 3 - Geological Resources Exploration: Mineral resources exploration, mineral mapping and mineral resources information system, mineral prospect zonation, mapping mining area, encroachment mapping, GIS in mine remediation and mine reclamation, oil and gas exploration.

UNIT 4 - Ground Water Resources: Groundwater potential assessment, groundwater prospect zones mapping, modeling, planning and management, forecasting, selecting the appropriate site for artificial recharge by using RS and GIS, quality mapping, ground and surface water interactions, fluorosis, nitrate pollution and heavy metal contamination.

Reference:

1. **Introduction to Environmental Remote Sensing** – Barrett E C
2. **Geomorphology and Engineering** - Coates, D.R.
3. **Geomorphology in Environmental Management** - Cooke, R.U. and J.C. Doorn Kamp.
4. **Geomorphology and Environment Sustainability** - S C. Kalwar et.al.
5. **Indian Geomorphology** - Sharma, H.S.
6. **Geomorphology** - Savindra Singh