Malad Kandivli Education Society's
NAGINDAS KHANDWALA COLLEGE
OF COMMERCE, ARTS & MANAGEMENT STUDIES
AND SHANTABEN NAGINDAS KHANDWALA COLLEGE OF SCIENCE
(Re-accredited (3rd cycle) by NAAC with 'A' Grade)
ISO 9001 : 2015 Certified
Educational Excellence Award By Indus Foundation, U.S.A.
IMC Ramkrishna Bajaj National Quality Commendation Certificate
Autonomous (2016-17)

Providing Syllabus copy of the courses highlighting the focus on employability/ entrepreneurship/ skill development along with their course outcomes.

Sr. No.	Courses	2016-17	2017-18	2018-19	2019-20	2020-21	Total
1	Bachelor of Commerce (B.COM)	✓	✓	✓	✓	✓	5
2	Bachelor of Arts (B.A)	✓	✓	✓	✓	✓	5
3	Bachelor in Management Studies- (BMS)	✓	✓	✓	✓	✓	5
4	Bachelor of Commerce (Accounts and Finance)- BAF	✓	✓	✓	✓	✓	5
5	Bachelor of Commerce (Banking and Insurance)-BBI	✓	✓	✓	✓	✓	5
6	Bachelor of Commerce (Financial Markets)-BFM	✓	✓	✓	✓	✓	5
7	Bachelor of Science - Information Technology (B.Sc IT)	✓	✓	✓	✓	✓	5
8	Bachelor of Science- Computer Science(B.Sc CS)	✓	✓	✓	✓	✓	5
9	Bachelor of Arts- Multimedia and Mass Communication (B.A.MMC)	✓	✓	✓	✓	✓	5
10	Bachelor of Management Studies- Sports Management (BMS-SM)	X	X	✓	✓	✓	3
11	B. Com. Honours in Actuarial Studies	X	X	X	✓	✓	2
12	B.A. Honours in Apparel Design and Construction	X	X	X	✓	✓	2
13	B. Com. Honours in International Accounting	X	X	X	✓	✓	2
14	Bachelor of Management Studies- E commerce operations	X	X	X	X	✓	1
15	B.Sc. (Honours) in Integrative Nutrition & Dietetics	X	X	X	X	✓	1
16	BBA in Tourism and Travel Management	X	X	X	X	✓	1
17	B.Sc. in Interior Design	X	X	X	X	✓	1
18 19	Master Of Commerce-(M.COM)-Accountancy Master Of Commerce-(M.COM)-Management	✓	✓	✓	✓	✓	5
20	Master of Arts (Economics)	✓	✓	✓	✓	✓	5
21	Master of Arts (Geography)	✓	✓	✓	✓	✓	5
22	Master of Arts (Psychology)	X	X	X	✓	✓	2
23	Master of Science (Information Technology) (M.Sc IT)	✓	✓	✓	✓	✓	5
24	Master's Degree - Sports Management (MSM)	X	X	✓	✓	✓	3
25	Master of Science (Geo-informatics) (M.Sc GeoInformatics)	X	X	X	X	✓	1
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MDatta.

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Semester I

Paper 101: Fundamentals of Remote Sensing

Course Objectives:

1. To introduce basic concepts of remote sensing
2. To explain the various platforms, types of senor and remotely sensed products
3. To apply the technology of aerial photography for analysis
4. To analyze the various satellite imageries and aerial photographs
5. To develop understanding of GPS and its functioning
6. To assess real time projects using the relevant technology

Course Outcome:

1. CO 1: Learners will be able to recognize the basic concepts of remote sensing (Level :Knowledge)
2. CO 2: Learners will be able to explain the various platforms, types of senor and remotely sensed products (Level : Comprehension)
3. CO 3: Learners will be able to apply the technology of aerial photography for analysis (Level : Application)
4. CO 4: Learners will be able to analyze the various satellite imageries and aerial photographs (Level : Application)
5. CO 5: Learners will be able to develop understanding of GPS and its functioning (Level : Synthesis)
6. CO 6: Learners will be able to assess real time projects using the relevant technology (Level : Evaluation)

Unit 1: Introduction to Remote Sensing **15 Lectures**

1.1 Concept and Scope of Remote Sensing: Definitions, Process and Characteristics of Remote Sensing System, Advantages and limitations.

1.2 Concept of Electromagnetic Radiation (EMR): Wavelength-frequency-energy relationship of EMR, EMR Spectrum and its properties, EMR wavelength regions and their applications

1.3 Atmospheric windows, Interaction of EMR with matter, Spectral signatures.

1.4 Remote Sensing Scenario in Indian Context

Unit 2: Platforms, Sensors, Orbits **15 Lectures**

2.1 Introduction: Sensor materials, Sensor System - Framing and Scanning System, Whiskbroom scanners, Push-broom scanners, Side Looking scanner

2.2 Types and Characteristics of Sensor: Imaging and non-imaging sensors, Active and passive sensors, Resolution of Sensors - Spectral, Spatial, Radiometric & Temporal, Scale, Mapping unit, Multi-band concepts and False Colour Composites

2.3 Remote Sensor Platforms and Satellite Orbits: Ground, Airborne and Space borne Platforms, Orbital Characteristics – Coverage, Passes, Pointing Accuracy, Geostationary, sun synchronous, shuttle orbit. Semi synchronous orbit (Molniya orbit) and Quasi-zenith satellite orbit

2.4 Historical development of satellites, Indian satellites

Unit 3: Aerial photography **15 Lectures**

3.1 Historical Development and Fundamentals of aerial photography, Vertical and Oblique aerial photography, Classification of Aerial Film Cameras, Digital cameras, components of aerial Cameras, Camera Calibration, Photogrammetric Applications and Products

3.2 Scale, Geometry and Ground Coverage of Aerial Photographs, Area calculation & Flight Planning.

3.3 Binocular and Stereoscopic vision, Conditions for Stereovision, Photographic overlap, Image Parallax, Height determination from stereo pairs - Parallax Equation, Ground Control.

3.4 Co-ordinate Systems used in Photogrammetry, Relief distortion and Tilt distortions, Rectification, Ortho Rectification, Height determination from single photograph, Planimetric map compilation, Digital Elevation Model (DEM), Digital orthophotos.

Unit 4: Surveying and Global Positioning System **15 Lectures**

4.1 Validation of data: importance of field survey, collection of ground truth, introduction to conventional field survey techniques: plane and geodetic surveying (Traversing, Triangulation and Levelling), Topographic, Cadastral, Engineering and Hydrographic surveys.

4.2 Surveying Instruments: Principles of using Plane Table, Principles of Prismatic Compass, Theodolite traversing, Utility of Total Station

4.3 Global Positioning System: Introduction, Satellite constellation, GPS signals and data, Geopositioning-Basic Concepts. NAVSTAR, GLONASS, Indian Regional Navigational Satellite System (IRNSS), Control Segment, Space Segments, User Segment, GPS Positioning Types- Absolute Positioning, Differential positioning

4.4 GPS Surveying Methods and Accuracy: Methods-Static & Rapid Static, Kinematic-RealTime Kinematic Survey- DGPS-GPS Data Processing and Accuracy, Factors Affecting GPS Accuracy, Reference Station: Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna

References:

1. Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India

2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi

3. Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W. H. Freeman and Company, San Francisco

4. Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey

5. Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford

6. Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London

7. Anji Reddy, M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication, Hyderabad

Semester I

102: Fundamentals of the Earth's System

Course Objectives:

1. To introduce basic concepts and components of basic geography

2. To explain the role of climate, weathering process, landforms and soil on Earth
3. To apply knowledge of the main components of the Earth system
4. To analyze the basic understanding of the Earth as a holistic system
5. To develop skills to understand the climate and its effects and soil formation
6. To assess the changing face of Earth's surface as a result of landform development

Course Outcome:

1. CO 1: Learners will be able to recognize the basic concepts basic concepts and components of basic geography (Level :Knowledge)
2. CO 2: Learners will be able to explain the role of climate, weathering process, landforms and soil on Earth (Level : Comprehension)
3. CO 3: Learners will be able to apply knowledge of the main components of the Earth system (Level : Application)
4. CO 4: Learners will be able to analyze the basic understanding of the Earth as a holistic system (Level : Application)
5. CO 5: Learners will be able to develop skills to understand the climate and its effects and soil formation (Level : Synthesis)
6. CO 6: Learners will be able to assess the changing face of Earth's surface as a result of landform development (Level : Evaluation)

Unit-1: Basic Geography **15 Lectures**

1.1 Earth - Orbit, Rotation, Time
1.2 Oceans - Depth, Bottom relief, temperature, salinity, density of seawater
1.3 Oceans - Waves, Tides, Currents
1.4 Climate and the atmosphere – Origin, nature, composition and vertical division of the atmosphere.

Unit-2: Advanced Geography (Skill development) **15 Lectures**

2.1 Meteorological parameters and their measurements - Geographical, seasonal and vertical distribution of temperature, pressure, wind and precipitation.
2.2 Solar and terrestrial radiation: Distribution in clear, cloudy and average conditions, mean heat balance.
2.3 Weather disturbances: Air mass and front, cyclone and anti-cyclone, thunderstorm and tornado.
2.4 Weather analysis and forecasting, climate and agricultural factors in crop production.

Unit-3: Climate and Geomorphology **15 Lectures**

3.1 Climate Change: Causes and Impacts
3.2 Monsoons: Concepts of the origin of monsoon - Indian Monsoons
3.3 Fundamental concepts of Geomorphology, weathering, mass wasting and erosion.
3.4 Landforms- fluvial, aeolian, glacial, folds and faults

Unit 4: Soil formation **15 Lectures**

4.1 Soil forming processes, Soil profile, Soil components
4.2 Pedogenic regimes
4.3 Classification of soils
4.4 Soils of India

References:

1. Structural Geology by Billings, M. 1984
2. Earth History & Plate Tectonics by Carl K. Seyfert, Leslie A. Sirkin
3. Geology of India & Burma by M.S. Krishna 6th, Ed.
4. General Climatology by H.J. Critchfield
5. Physical Geology by Arthur Holmes
6. Physical Geography by Strahler
7. The Atmosphere by Frederick K. Lutgens and Edward J. Tarbuck

Semester I

Paper 103: Fundamentals of Mathematics

Course Objectives:

1. To introduce the concepts Trigonometric functions, Matrix and Determinants
2. To explain numerical and vector algebra
3. To apply knowledge of fundamental concepts of Elementary Mathematics and Matrices & Determinants and their applications
4. To enhance the ability of using mathematics in analyzing the real world problems
5. To develop skills of applying advanced numerical methods
6. To assess data with the help of matrices

Course Outcome

1. CO 1: Learners will be able to recognize the concepts of Trigonometric functions, Matrix and Determinants (Level :Knowledge)
2. CO 2: Learners will be able to explain numerical and vector algebra (Level : Comprehension)
3. CO 3: Learners will be able to apply fundamental concepts of Elementary Mathematics and Matrices & Determinants and their applications (Level : Application)
4. CO 4: Learners will be able to enhance their ability of using mathematics in analyzing the real world problems (Level : Application)
5. CO 5: Learners will be able to develop skills of applying advanced numerical methods (Level : Synthesis)

CO 6: Learners will be able to assess data with the help of matrices (Level : Evaluation)

Unit 1: Elementary Mathematics

15 Lectures

1.1 Trigonometric functions, trigonometric ratios of standard angles, allied angles, compound angels

1.2 Cartesian rectangular coordinate system, distance formula, section formula, straight lines, slopes, types of straight lines.

1.3 Application in solving life science problems - Solutions of simultaneous linear equations, quadratic equations, progressions, permutations and combinations

Unit 2: Matrices & Determinants **15 Lectures**

2.1 Introduction to Matrix, Transpose of a Matrix
2.2 Elementary row and column operations of Matrix
2.3 Determinants Properties of determinants (Without Proof) Rank of a Matrix
2.4 Minor and Co-factors Inverse of a matrix.

Unit 3: Numerical Method **15 Lectures**

3.1 Gauss Jordan, Jacobi and Gauss sidle methods, Newton-Raphson method.
3.2 Transcendental function- Logarithmic and exponential functions,
3.3 Application in solving Biological science problems

Unit 4: Vector Algebra **15 Lectures**

4.1 Definition, Types of Vectors, two- and three-dimensional vectors,
4.2 Scalar (dot) and Vector (cross) product
4.3 Application in solving Biological science problems

References:

1. T.B: SCHAUM Series books of calculus, vectors, statistics & matrices
2. Pharmaceutical Mathematics with Application to Pharmacy – Pharm Med Press, A Unit of BSP Books Pvt Ltd, 4-4-309/316, Giriraj Lane, Sultan Bazar, Hyderabad – 500 095-Panchaksharappa Gowda D.H.
3. Introduction to Mathematics for life scientist – Publisher- Springer (India) Pvt. Ltd. Edward Batschelet

Semester I

Paper 104: Fundamentals of Computers

Course Objectives:

1. To introduce the basics of computers and related terminology

6. To explain the basic working of an operating system
7. To apply the basics of computer programming
8. To enhance the ability to use the style sheets and presentation tools
9. To develop skills of debugging and executing a program.
10. To assess written Python code and write the same to solve problems

Course Outcome

1. CO 1: Learners will be able to recognize t the basics of computers and related terminology (Level :Knowledge)
2. CO 2: Learners will be able to explain the basic working of an operating system (Level : Comprehension)
3. CO 3: Learners will be able to apply the basics of computer programming (Level : Application)
4. CO 4: Learners will be able to enhance the ability to use the style sheets and presentation tools (Level : Application)
5. CO 5: Learners will be able to develop skills of debugging and executing a program. (Level: Synthesis)
6. CO 6: Learners will be able to assess written Python code and write the same to solve problems (Level : Evaluation)

Unit 1: Basic Structure of a Computer **15 Lectures**

1.1. Introduction: Computer Types, Functional Units, Basic Operational Concepts, Performance, Historical Perspective.
1.2. Number System: Bits, bytes, analog system, digital system, binary number system, octal number system, hexadecimal number system.
1.3. Number System Conversion: Conversion from one number system to another, floating point numbers
1.4. Weighted codes, binary coded decimal

Unit 2: Operating Systems and application Softwares **15 Lectures**

2.1 Definition of Operating system, Operating System's role, Operating-System Operations
2.2 Functions of Operating System, Computing Environments, Operating-System Services
2.3 Introduction to word processor
2.4 Style sheets and presentation tools

Unit 3: Web Programming **(Skill Development)** **15 Lectures**

3.1 Internet and World Wide Web: What is Internet? Introduction to internet and its applications, E-mail, e-commerce, video conferencing, e-business. Internet service providers, domain name server, internet address,
3.2 World Wide Web (WWW): World Wide Web and its evolution, uniform resource locator (URL)
3.3 Browsers – internet explorer, Netscape navigator, opera, Firefox, chrome, Mozilla. Search engine, HTTP protocol
3.4 HTML5: Introduction, Why HTML5? Formatting text by using tags, using lists and backgrounds, Creating hyperlinks and anchors. Style sheets, CSS formatting text using style sheets, formatting paragraphs using style sheets

Unit 4: Introduction to Programming **15 Lectures**

4.1. Introduction to Programming: History of Programming language, importance of computer languages, Understanding Compiler and interpreter.

4.2. Introduction to Python: Input /Output functions, Data types and operators: types and uses of various operators.

4.3. Control statements: Branching (if, if-else, if-elif-else), Looping (while, for, break and continue statement) Variables, Strings, Numeric Types, Typecasting, Python operators,

4.4. List, Tuples, Dictionaries, copy, search, append, sort operations.

References

1. Patterson and Hennessy, Computer Organization and Design, Morgan Kaufmann, ARM Edition, 2011.
2. Abraham Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts, Wiley,9th Edition, 2012
3. Achyut S. Godbole, AtulKahate, Operating Systems, 2nd Ed.,Tata McGraw Hill, 2009
4. HTML5 Black Book: Covers CSS3, JAVASCRIPT, XML,XHTML, AJAX, PHP and JQUERY DreamTech Press.
5. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
6. Michael Dawson, Python Programming for the Absolute Beginner, Paperback, Second Edition, Published November 8th, 2005 by Course Technology PTR

Semester I

105: Tools and Techniques in Geoinformatics I

Course Objectives:

1. To introduce the basics of remote sensing and the concepts of projections and scales
2. To explain and interpret the remotely sensed data
3. To apply the basics of cartography
4. To enhance the ability to use free data from BHUVAN website
5. To develop skills to construct appropriate maps and diagrams
6. To assess maps prepared by NATMO

Course Outcome

1. CO 1: Learners will be able to recognize the basics of remote sensing and the concepts of projections and scales (Level :Knowledge)

2. CO 2: Learners will be able to explain and interpret the remotely sensed data (Level : Comprehension)
3. CO 3: Learners will be able to apply the basics of cartography (Level : Application)
4. CO 4: Learners will be able to enhance the a the ability to use free data from BHUVAN website (Level : Application)
5. CO 5: Learners will be able to develop skills to construct appropriate maps and diagrams (Level: Synthesis)
6. CO 6: Learners will be able to assess maps prepared by NATMO (Level : Evaluation)

Unit 1: Basics of Remote Sensing (Skill Development) 20 Lectures

1.1 Interpretation of remotely sensed data- satellite imagery and aerial photographs
1.2 Calculation of scale, height, distance in aerial photographs
1.3 Downloading and using satellite data from free platforms
1.4 Use of BHUVAN website

Unit 2: Projections and Scale (Skill Development) 20 Lectures

2.1 Construction of projections- all types
2.2 Advantages, disadvantages and uses of projections
2.3 Concept of scale, types, conversion, drawing scale from maps
2.4 Map layout components

Unit 3: Understanding the World through Maps and Pictures (Skill Development) 20 Lectures

3.1 Cartographic techniques of mapping- choropleth, isopleth, dot
3.2 Interpretation of various maps- NATMO, thematic, weather
3.3 Construction of maps- mental maps, pace surveys
3.4 Construction of pictures- diagrams, sketches, cartoons

References

1. Anson, R. W. and Ormeling, F. J., (Ed.) (1993): Basic Cartography for Students and Technicians, Vol.I, International Cartographic Association and Elseiver Applied Science Publishers, London.
2. Monkhouse F.J.- Maps & Diagrams, Methuen and Co., London, 1971 (3rd Edition, Revised)
3. Misra R. P. and A. Ramesh, (1969): Fundamentals of Cartography, Prasaranga, University of Mysore
4. Sarkar Ashis – Practical Geography, Orient Black Swan – 2015
5. Robinson, A. H. and Others (1995): Elements of Cartography, VI Edition, John Wiley & Sons, New York.

Semester I

106: Tools and Techniques in Geoinformatics II

Course Objectives:

1. To illustrate the application software and operating systems
2. To explain the use of internet for geographical data sets
3. To apply the basics of MS-Office
4. To enhance the ability to use Linux commands
5. To develop web pages and to write computer programs
6. To assess the programs prepared using Python

Course Outcome

1. CO 1: Learners will be able to illustrate the application software and operating systems (Level :Knowledge)
2. CO 2: Learners will be able to explain the use of internet for geographical data sets (Level : Comprehension)
3. CO 3: Learners will be able to apply the basics of MS-Office (Level : Application)
4. CO 4: Learners will be able to enhance the ability to use Linux commands (Level : Application)
5. CO 5: Learners will be able to develop web pages and to write computer programs (Level: Synthesis)
6. CO 6: Learners will be able to assess the programs prepared using Python (Level : Evaluation)

Unit 1: Operating Systems **(Skill Development)** **20 Lectures**

1.1 Working with Windows Desktop and utilities a) Notepad b) Word pad c) Paint d) Taskbar e) adjusting display resolution f) Using the browsers

1.2 **Installing and connecting various Devices**– Printers, scanners, Ethernet, Blue tooth, wireless, mobile, modem, projector

1.3 Linux commands: **Working with Directories**:

a) pwd, cd, absolute and relative paths, ls, mkdir, rmdir

b) file, touch, rm, cp. Mv, rename, head, tail, cat, tac, more, less, strings, chmod

1. 4 Linux commands: **Working with files**:

a) ps, top, kill, pkill, bg, fg

b) grep, locate, find, locate

c) date, cal, uptime, w, whoami, finger, uname, man, df, du, free, whereis, which

d) Compression: tar, gzip

Unit 2: Internet and Web Designing and office Tools: (Skill Development) 20 Lectures

2.1 Use of Indian Geo-portals: Bhuvan, Mosdaik, Vedas

2.2 (a) Use of Basic HTML Tags

(b) Design a webpage using different text formatting tags.

2.3 (a) Design a webpage with links to different pages and allow navigation between webpages.

(b)Design a webpage demonstrating all Style sheet type

2.4 (a) Create a word document such as resume, a research paper using a word processor.

(b) Working with spreadsheets, applying formulae

(c) Working with Presentation tools

Unit 3: Introduction to Programming: (Skill Development) 20 Lectures

3.1 Basic Python programs

3.2 Use of control statements

3.3 Implementing sequences

3.4 Working with sequences

References:

1. HTML5 Black Book: Covers CSS3, JAVASCRIPT, XML,XHTML, AJAX, PHP and JQUERY DreamTech Press.
2. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
3. Michael Dawson, Python Programming for the Absolute Beginner, Paperback, Second Edition, Published November 8th, 2005 by Course Technology PTR
4. Randy, Microsoft Office 2016: In Practice 1st Edition, Nordell professor of Business Technology.

Paper 201: Introduction to Geo Informatics

Course Objectives:

1. To define the fundamental concepts of remote sensing
2. To explain the various remote sensing platforms and sensors
3. To construct spatial data models in GIS
4. To associate GIS with GPS
5. To compare between satellite imageries, aerial photographs, and GIS outputs
6. To justify the reasons for the existing land uses from the imageries, photographs and other maps

Course Outcome:

1. CO 1: Learners will be able to define the fundamental concepts of remote sensing like electromagnetic spectrum, aerial photography, principles of photogrammetry, etc. (Level : Knowledge)
2. CO 2: Learners will be able to explain the various remote sensing platforms and sensors, basics of projections, datum and coordinate reference system (Level : Comprehension)
3. CO 3: Learners will be able to construct spatial data models in gis for solution modeling (Level : Application)
4. CO 4: Learners will be able to associate gis with GPS and work with them together (Level : Analysis)
5. CO 5: Learners will be able to compare between satellite imageries, aerial photographs, and gis outputs for better results (Level : Synthesis)
6. CO 6: Learners will be able to justify the reasons for the existing land uses from the imageries, photographs and other maps (Level : Evaluation)

Unit – I

Fundamentals and Concepts of Remote Sensing **15 Lectures**

1.1 Fundamentals of Remote Sensing: Definition, Concept and Scope, Stages in Remote Sensing data acquisition, Development of remote sensing – Global and Indian, Advantages and limitations

1.2 Electromagnetic Spectrum: Definition and Concept, EMR Bands, Interaction of EMR with atmosphere and Earth's surface features, Applications of different bands (Local development needs), Atmospheric window, Black body radiation

1.3 Spectral Reflectance Curve: Concept, curves for land, water bodies/oceans, vegetation In Optical, IR, Thermal and Microwave bands, Application of Thermal and microwave data

1.4 Fundamentals of aerial photography: Historical Development and Fundamentals of Aerial Photography, Vertical and Oblique aerial photography, Scale, Geometry and Ground Coverage of Aerial Photographs, Flight Planning, Stereoscopic image, Marginal information of the Aerial Photographs, Aerial Mosaics, Uses of Aerial Mosaics(Regional development needs)

Unit – II **15 Lectures**

Platforms and Sensors

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2.1 Platforms and Orbits: Types of Platforms, Types of Orbits

2.2 Sensing of electromagnetic energy: Measurement of radiance, conversion of radiance to digital number

2.3 Resolutions and Sensors: Types of resolutions, Types of sensors, Spatial, Spectral, Radiometric and Temporal -Overview of space borne sensors.

2.4 Visual Image Interpretation: Image display and color composites, elements of visual image interpretation (Global development need)

Unit – III **15 Lectures**

Fundamental of GIS, Spatial data models

3.1 Fundamentals of Databases: Data storage, basic file structures, types of database, advantages of database, spatial and non-spatial databases, scales of measurement, Entity – Relationship Model, SQL,

3.2 Geographic Information System: Definition, concept, components, Variables-points, lines, polygon, functions, applications, advantages and limitations of GIS

3.3 Spatial Data Models: Raster, Vector data models, Attribute data model, FCC digital data, Concepts of arc, node, vertices and topology.

3.4 Coordinate Reference Systems: Geographic and Projected, Map Projections and Datum for GIS data

Unit – IV **15 Lectures**

Global Navigation Satellite System

4.1 Vector-based spatial analysis: single layer operations (extraction and proximity) and multilayer operations (overlay operations),

4.2 Raster-based spatial analysis: Georeferencing, Spatial Interpolation and raster generation, raster reclassification, arithmetic, relational and logical operations

4.3 Global Positioning System: Concept, Development, GPS Satellite Navigation System (Skill development) and their Segments, Main Systems – NAVSTAR, GLONASS, Galileo and Indian GPS

4.4 Principles of positioning: Positional Accuracies, Relative Positioning, errors and sources

References:

1. Agrawal, N.K.(2006), Essentials of GPS (Second Edition), Book Selection Centre, Hyderabad

2. American Society of Photogrammetry (1983): Manual of Remote Sensing, ASP PalisChurch,V.A.

3. Barrett, E.G. and Curtis, L.F. (1992): Fundamentals of Remote Sensing in Air Photointerpretation, McMillan, New York. 7.

4. Bernhardsen, Tor (2002): Geographical Information Systems: An Introduction, Third Edition, John Wiiey& Sons, Inc., New York.

5. Burrough, Peter A and McDonnell, R.A. (1998): Principles of Geographical Information Systems, Oxford University Press, Mumbai.

6. Campbell. J. (1989): Introduction to Remote Sensing, Guilford, New York.

7. Clarke, Keith C. (1998): Getting Started with Geographic Information Systems, Prentice-Hall Series in Geogl. Info. Science, Prentice-Hall, Inc. N.J.
8. Curran, Paul, J, (1988): Principles of Remote Sensing, Longman, London.
9. Heywood, I.et al (2002): An Introduction to Geological Systems, Pearson Education Limited, New Delhi.
10. Iliffe, J.C (2006), Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, New York.
11. Jonson. R. J. (2003): Remote Sensing of the Environment-An Earth Resources Perspective, Pearson Education Series in Geographical Information Science, Keith C. Clarke (Series editor) Pearson Educators Private Limited. (Singapore), New Delhi.
12. Joseph, G. (2009): Fundamentals of Remote Sensing, Universities Press (India) Pvt. Ltd., Hyderabad.
12. Lillesand ,Thomapson and RelphKiffer (1994). Remote Sensing and Image Interpretations, John Wiley and Sons, Inc., New York.
13. Parker, R, N. (2008),GIS and Spatial Analysis for the Social Sciences, Routledge, New York.
14. Paul Longley (2005), Geographic Information Systems and Science, John Wiley & Sons.
15. Pickles, John (2006), The Social Implications of geographic Information Systems, Rawat Publications, Jaipur.
16. Star, Jeffrey and John Estes (1996), Geographical Information Systems: An Introduction, Prentice-Hall, inc., N.J.
17. Shekar, S and Chawla, S, (2009), Spatial Databases: A Tour, Pearson Education, Delhi. 18. Tempfli, T. K., Kerle, N., Huurememan, G.C., and Janssen, L.L.F (2009), Principles of Remote Sensing, ITC, Netherlands

Semester II

Paper 202: Spatial Analysis on Statistical Methods

Course Objectives:

1. To define the basics of spatial analysis using statistics
2. To explain the various raster and vector analysis
3. To construct a network model and analyze it
4. To associate spatial modelling to real world problems
5. To compare between several datasets
6. To justify the output of spatial data analysis

Course Outcome:

1. CO 1: Learners will be able to define the basics of spatial analysis using statistics (Level : Knowledge)
2. CO 2: Learners will be able to explain the various raster and vector analysis (Level : Comprehension)
3. CO 3: Learners will be able to construct a network model and analyze it (Level : Application)
4. CO 4: Learners will be able to associate spatial modelling to real world problems (Level : Analysis)

5. CO 5: Learners will be able to compare between several datasets (Level : Synthesis)
6. CO 6: Learners will be able to justify the output of spatial data analysis (Level : Evaluation)

Unit 1: Introduction to Spatial analysis and Statistical Methods **15 Lectures**

1. Sources, types, discrete and continuous series, scales of measurements, measures of central tendency and dispersion. Normal, Binomial and Poison Probability & Residual mapping, Methods of Interpolation by Lagrange's and Newton's.
2. Multivariate regression and correlation. Principal Component Analysis (PCA), Correlation and spatial autocorrelation, Regression Analysis. Scatter Diagram
3. Mathematical operations: Image overlay, scalar image operations, image attribute transformation.
4. Distance operators: Distance analysis (spherical distance, cost distance), buffer analysis, direction variable cost distance, dispersion distance, least cost path analysis, spatial allocation and reallocation, Thiessen Polygon. Context operators: Surface analysis, filtering pattern analysis, grouping watershed, determination, hinterland determination.

Unit 2: Spatial analysis –Vector based and Raster based **15 Lectures**

1. Overlay operations: Point-in-polygon, Line in-polygon, polygon-in polygon. Single layer operations: Feature identification, extraction, classification manipulation.
2. Multilayer operation: Union, intersection, symmetrical difference, update, merge, append and dissolve
3. Map algebra, grid-based operations, local, focal, zonal and global functions, cost surface analysis, optimal path and proximity search

Unit 3: Network, Point &Surface analysis **15 Lectures**

1. Concepts, evaluation of network complexity using Alpha-gamma indices. C-matrices for evaluating connectivity of the network.
2. Network data model. Path analysis.
3. Linear referencing and segmentation. Types of network analysis: Optimum cyclic path, vehicle routing, path determination and costpath analysis.
4. Spatial Sampling techniques- Interpolation methods: Trend surface analysis, IDW, kriging, measures of arrangement and dispersion, autocorrelation, semi-variogram, DEM, TIN, slope, aspect, hillshade and view shed

Unit 4: Spatial modeling **15 Lectures**

1. Role of spatial model, explanative, predictive and normative models.
2. Correlation-regression analysis in model building.

3. Handling complex spatial query and case, Object oriented models: advantages and disadvantages.

References:

1. Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York
2. Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGrawHill, New York
3. Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
4. Makrewski, J. (1999): GIS Multi-criteria Analysis, John Wiley and Sons, New York
5. Longley, P. A., Goodchild, M. F., Maguire, D. J. Rhind, D. W. (2002): Geographical Information Systemsand Science, John Wiley & Sons, Chichester
6. Lo, C. P. Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hallof India, New Delhi

Semester II

Paper 203: Digital Image Processing

Course Objectives:

1. To define the basics of image processing through digital platforms
2. To explain the basics of remote sensing
3. To construct an image with supervised classification
4. To associate concept of LiDar with remote sensing
5. To compare between images and interpret them
6. To justify the output of classified imageries

Course Outcome:

1. CO 1: Learners will be able to define the basics of image processing through digital platforms (Level : Knowledge)
2. CO 2: Learners will be able to explain the basics of remote sensing (Level : Comprehension)
3. CO 3: Learners will be able to construct an image with supervised classification (Level : Application)
4. CO 4: Learners will be able to associate concept of LiDar with remote sensing (Level : Analysis)
5. CO 5: Learners will be able to compare between images and interpret them (Level : Synthesis)
6. CO 6: Learners will be able to justify the output of classified imageries (Level : Evaluation)

Unit 1: Photogrammetry (Skill Development) **15 Lectures**

1. Fundamentals of aerial photography, Vertical and Oblique aerial photography, Aerial cameras, Photogrammetry; Basic concepts of scale, object height and length, object area and

perimeter, grayscale tone/color of objects, Photo interpretation techniques, Stereo photogrammetry and stereo vision, Parallax bar and its applications.

2. Stereo Photogrammetry: Stereovision & Stereoscopes, Stereoscopic Parallax & Parallax Equations
3. Digital photogrammetry: Model deformation & Rectification, Relief displacement, Vertical exaggeration, Triangulation, Control &Mapping. Digital Terrain Model (DTM/DEM)

Unit 2: Digital image classification & Image Interpretation (Skill Development) 15 Lectures

1. Unsupervised classification. Classification accuracy assessment and error matrix: Supervised classification: Training sites selection and statistical information extraction, Discriminate functions. Classifier: Maximum Likelihood, Euclidian distance, Mahalanobis distance, Paralellopiped.
2. Digital Image interpretation, Pattern recognition, shape analysis, Textural analysis, Decision concepts, fuzzy sets and Evidential reasoning, Change detection, multi band data merging, multi sensor image merging, merging of panchromatic and landsat image- merging image data with ancillary data, Expert system, Artificial Neural Network; Integration with GIS.

Unit 3: Thermal and Hyper spectral Remote Sensing 15 Lectures

1. Thermal Infrared: Introduction, Radiation Properties, Kinetic Heat, Temperature, Radiant Energy and Flux, methods of transferring heat Thermal properties of terrain: Heat Capacity, conductivity, Inertia, Infrared, Interpreting Thermal Scanner Imagery, Radiometric Calibration of Thermal Scanners, Temperature mapping with Thermal Scanner Data
2. Comparison of Multispectral and Hyperspectral Image Data, Hyperspectral sensors and image characteristics, (Spectrographic imagers- hyperspectral sensors, AVIRIS, CASI, NOAA, Moderate Resolution Imaging Spectrometer (MODIS), Hyperion.

Unit 4: Introduction to LiDAR 15 Lectures

1. Concepts of LiDAR sensor system Introduction to Lasers and Lidar –Definitions - History of Lidar Development - Lidar System Components - LIDAR sensors single-return, multi return, waveform, Characteristics of Lidar Data - interaction of laser energy with earth surface features

References:

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2. Burrough, P.A. and McDonnell, R. (1998): Principles of Geographic Information Systems. Oxford University Press, Oxford.
3. Cha, B., Dattaa, D., Majumdar (2001): Digital Image Processing Analysis, Prentice Hall of India, New Delhi
4. Curran, P.J. (1985): Principles of Remote Sensing, Longman, London.
5. George, J. (2003): Fundamentals of Remote Sensing. Universities Press (Pvt.) Ltd, Hyderabad.

6. Girard, M. C. and Girard, C. M. (2003): Processing of Remote Sensing Data. Oxford & IBH, New Delhi.
7. Floyd, F., Sabins, Jr. (1986): Remote Sensing : Principles and Interpretation, W.H. Freeman, New York
Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
8. Guham, P. K. (2003): Remote Sensing for Beginners. Affiliated East-West Press Pvt. Ltd., New Delhi.
9. Harry, C.A. (ed.) (1978): Digital Image Processing, IEEE Computer Society.
10. Hord, R.M. (1982): Digital Image Processing of Remotely Sensed Data, Academic Press, New York.
11. Leuder, D.R. (1959): Aerial Photographic Interpretation: Principles and Application. McGraw Hill, NewYork.
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13. Nag, P. Kudrat, M. (1998): Digital Remote Sensing, Concept Publishing Company, New Delhi
14. Reeves, R.G. (ed.) (1983): Manual of Remote Sensing, Vols. 1 & 2, American Society of Photogrammetry &Remote Sensing, Falls Church, Virginia.
15. Richards, J. A, Jia, X. (1999): Remote Sensing and Digital Image Processing, Springer, Verlag Berlin
16. Sabins, F. F. (1996): Remote Sensing: Principles an Interpretation, W. H. Freeman Company, New York
17. Swain, P.H. and Davis, S.M. (ed.), (1978): Remote Sensing: The Quantitative Approach. McGraw Hill, NewYork.

Semester II

Paper 204: Programming with Python

Course Objectives:

1. To define the basics of computer systems and internet
3. To explain programming using Python
4. To develop Python programs for raster and vector data processing
5. To associate geographical data sets with Python code
6. To compare between various image geometries using Python programming
7. To assess histograms, attribute tables and virtual raster format

Course Outcome:

1. CO 1: Learners will be able to define the basics of computer systems and internet (Level : Knowledge)
2. CO 2: Learners will be able to explain programming using Python (Level : Comprehension)
3. CO 3: Learners will be able to develop Python programs for raster and vector data processing (Level : Application)
4. CO 4: Learners will be able to associate geographical data sets with Python code (Level : Analysis)

5. CO 5: Learners will be able to compare between various image geometries using Python programming (Level : Synthesis)
6. CO 6: Learners will be able to assess histograms, attribute tables and virtual raster format (Level : Evaluation)

Unit 1: Functions, Modules and Files **15 Lectures**

1.1. Function: introduction, function definition, parameters, function call, recursions.
1.2. Working with Libraries: import statement. Visualizing data with Matplotlib: Introduction to Matplotlib, Plotting vector data, Plotting raster data, Plotting 3D data.
1.3. File Handling: Reading and writing in files.
1.4. Introduction to PYQGIS: Python console in QGIS, Using PyQGIS in scripts.

Unit 2: Object Oriented programming **15 Lectures**

2.1 Introduction to Object Oriented Programming
2.2 Classes and Objects: Objects
2.3 Classes, Operators overloading
2.4 Polymorphism, Inheritance.

Unit 3: Vector data Processing with Python **15 Lectures**

3.1 Reading and writing vector data with OGR: Introduction to OGR, reading vector data: accessing specific features, and displaying data, writing vector data: Creating new data sources and new fields, Updating existing data.
3.2 Filtering data with OGR: Attribute filters, Spatial filters, Using SQL to create temporary layers.
3.3 Manipulating geometries with OGR: Working with points, lines, and polygons.
3.4 Using spatial reference systems: OSR and pyproj.

Unit 4: Raster Data Processing with Python **15 Lectures**

4.1 Introduction to GDAL, Reading writing and resampling raster data with GDAL.
4.2 Working with raster data: Ground control points, Converting pixel coordinates
4.3 Histograms, Attribute tables, Virtual raster format.
4.4 Map algebra with NumPy and SciPy

References:

1. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
2. Michael Dawson, Python Programming for the Absolute Beginner, Paperback, Second Edition, Published November 8th, 2005 by Course Technology PTR
3. James Payne, Beginning Python: Using Python 2.6 and Python 3, Wiley India, 2010
4. AllenDowney.Thinkpython.http://greenteapress.com/thinkpython/thinkpython.pdf,2012.
5. ChrisGarrard.GeoprocessingwithPython."ManningPublications",2016.
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8. ShellScottM.Anintroductiontonumpyandscipypy.https://engineering.ucsb. edu/~shell/che210d/numpy.pdf, accessed25-Feb-2017.
9. John V Guttag. Introduction to Computation and Programming Using Python, Prentice Hall of India
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Semester II

205: Tools and Techniques in Geoinformatics III

Course Objectives:

1. To define the basics of statistical analysis
2. To explain techniques of spatial analysis
3. To develop understanding of statistical tools and their application
4. To associate vector layer operations to geometrical tools
5. To compare between various data sources and maps
6. To assess spatial data with the help of various spatio-statistical tools

Course Outcome:

1. CO 1: Learners will be able to define the basics of statistical analysis (Level : Knowledge)
2. CO 2: Learners will be able to explain techniques of spatial analysis (Level : Comprehension)
3. CO 3: Learners will be able to develop understanding of statistical tools and their application (Level : Application)
4. CO 4: Learners will be able to associate vector layer operations to geometrical tools (Level : Analysis)
5. CO 5: Learners will be able to compare between various data sources and maps (Level : Synthesis)
6. CO 6: Learners will be able to assess spatial data with the help of various spatio-statistical tools (Level : Evaluation)

Unit 1: Quantitative Techniques for Spatial Analysis using SPSS (Skill Development) 20 lectures

1.1 Inferential statistics: Introduction; Hypothesis Testing - Chi square test, T-test applications

1.2 Analysis of variance (ANOVA)

1.3 Time Series Analysis- growth and decline- index numbers- logarithmic scale- trendline by least square method

Unit 2: Quantitative Techniques for Spatial Analysis using SPSS (Skill Development) 20 lectures

2.1 Correlation: Types of correlation; Methods of correlation- Spearman's rank correlation and Karl Pearson D s coefficient of correlation; Partial Correlation

2.2 Regression: Introduction; Dependent and independent variables; scatter-gram regression lines and residuals; construction of regression lines; least square method, Regression residuals: mapping and interpretation

Unit 3: Basics of Geo informatics (Skill Development) 20 lectures

3.1 Data acquisition from various sources, georeferencing, digitization

3.2 Data joining, creation of thematic maps, map layout

3.3 Vector layer operations- geoprocessing, geometrical, analysis tools

3.4 Raster layer operations- calculation, analysis, extraction, conversion

Reference Books

1. Hilton, P. et.al (2012): SPSS Explained, Rutledge, London.

2. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis A Reader in Statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.
3. Levin, J. (1973): Elementary Statistics in Social Research, Harper and Row, New York
4. Yeates, W.M.(1974): An Introduction to Quantative Analysis in Human Geography, McGraw Hill, New York.
5. Norcliff, G.B.(1982):Inferential Statistics for Geographers, Hutchinson, London.
6. Cressie, N.(1991): Statistics for Spatial Data, John Wiley and Sons, New York
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8. Rogerson, P.A.(2010): (3rdEd,) Statistical Methods for Geography, a Students Guide, Sage

Semester II

206: Tools and Techniques in Geo Informatics IV

Course Objectives:

1. To define the basics of computer programming in Python.
2. To explain techniques of file handling in Python.
3. To develop understanding of GIS data processing using Python libraries
4. To associate spatial data with python modules
5. To compare between the functioning of OSR and pyproj
6. To assess spatial data with the help of python codes and map algebra

Course Outcome:

1. CO 1: Learners will be able to define the basics of computer programming in Python (Level : Knowledge)
2. CO 2: Learners will be able to explain techniques of file handling in Python (Level : Comprehension)
3. CO 3: Learners will be able to develop understanding of GIS data processing using Python libraries (Level : Application)
4. CO 4: Learners will be able to associate spatial data with python modules (Level : Analysis)
5. CO 5: Learners will be able to compare between the functioning of OSR and pyproj (Level : Synthesis)
6. CO 6: Learners will be able to assess spatial data with the help of python codes and map algebra (Level : Evaluation)

Unit 1: Functions, Modules and File Handling: **20 Lectures**

1.1 Implement functions with parameters and return values.
1.2 Implement recursive functions.
1.3 Write a python program to read/write data from/to a file
1.4 Working with Modules

Unit 2: Vector Data Processing Using Python **20 Lectures**

2.1 Reading and writing vector data with OGR
2.2 Filtering data with OGR
2.3 Manipulating geometries with OGR

2.4 Using OSR and pyproj

Unit 3: Raster Data Processing Using Python **20 Lectures**

3.1 Reading writing and resampling raster data with GDAL
3.2 Working with raster data
3.3 Implement Histograms
3.4 Map algebra with NumPy and SciPy

References:

11. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
12. Michael Dawson, Python Programming for the Absolute Beginner, Paperback, Second Edition, Published November 8th, 2005 by Course Technology PTR
13. James Payne, Beginning Python: Using Python 2.6 and Python 3, Wiley India, 2010
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15. ChrisGarrard.GeoprocessingwithPython."ManningPublications",2016.
16. FabrizioRoman. LearningPython ,2015PacktPublishing,Birmingham-Mumbai
17. QGIS Community. Pyqgisdevelopercookbook.http://docs.qgis.org/2.14/pdf/ en/QGIS-2.14-PyQGISDeveloperCookbook-en.pdf, accessed25-Feb-2017.
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21. ErikWestra.(20130:PythonGeospatialDevelopment,SecondEdition,PacktPublishing