Department of Geoinformatics

M. Phil. / Ph. D. Entrance Test Syllabus for Geoinformatics

Note: The subject-wise detailed syllabus for Entrance Test admission to IPhD Geoinformatics course in the university of Kashmir is outlined under the following 10 units. 80 MCQ questions (Part-II 30 questions + Part-III 50 questions) shall be set from the entire syllabus for the Entrance Examination. Part-II questions are relatively easier than the Part-III MCQ questions

UNIT: I: Computers and Geoinformation Management:

Flowcharts and algorithms, translators, interpreters, compilers, assemblers and editors. number system. 'C' character set, Identifiers and key words, data types, constants, variables, operators, expressions, statements, symbolic constants, library functions.Control statements: If statements, If - Else, Nested if statements, Loops: While Loops, Do- While Loops, For Loop, Switch-Case statements, Functions: Defining Functions, Accessing a Function, Passing Arguments to a Function. Arrays: Defining an Array, Processing an Array, Pointers, Meta data: introduction, importance, and standards. RS data types: Signed, unsigned, integer, float, double, complex, data compression techniques; their advantages and disadvantages, data conversion in RS/GIS, data mining and warehousing, Networking and data sharing, Web-based GIS, Expert systems, Decision support system (DSS).

Unit II: Cartography and Geoinformation Visualization

Types and uses of maps, analogue and digital cartography, elements of map composition. Coordinate systems, Geoid, shape of earth and datums, properties and classification of map projections, data sources for mapping, use and users of geo-spatial data, Data products w.r.t land surface processes, disasters, EIA and geology, data visualization techniques, virtual reality and scenario mapping, coefficient of variation, skewness, kurtosis, regression and correlation analysis, basic concepts of time series data analysis, Quantitative representation of spatial and non-spatial data, geospatial data dissemination methods. Misuse of maps: exaggerations and omissions. Map updating using GPS and remote sensing data, assessing the accuracy of maps.

UNIT III: Fundamentals of Remote Sensing:

Typical Remote Sensing system and its components, sensor resolution (Spatial, spectral, temporal), Electromagnetic radiation (EMR) and Electromagnetic Spectrum (EMS): radiation laws, sources of electromagnetic radiation, theories of electromagnetic radiation, atmospheric windows. Interactions of EMR with atmosphere, interaction of EMR with earth's surface features; vegetation, water, and soils. Spectral signatures, elements of visual image interpretation, factors governing the interpretability of satellite

data, characteristics of aerial photographs, measurement of scale and height, sensors for stereo-imaging (ASTER), use of ancillary information for satellite data interpretation, Ground truth methods, digital data storage formats (BSQ, BIL and BIP), use of statistics in DIP, Pre-processing of satellite data, FCC and TCC, Image enhancement techniques, applications of remote sensing in disaster management; agriculture (crop acreage estimation, cropping monitoring), LULC mapping and monitoring, fishery and wildlife, urbanization.

Unit IV: Geographic Information System

Components of GIS, types of GIS. concept of data, information, knowledge and intelligence, Geographic data sources, integration of spatial and non-spatial data, concept and applications of Topology in GIS, GIS data models, advantages and disadvantages of raster and vector data models, issue related to data model conversation. Data input methods, data quality, data errors, data editing, spatial data infrastructure, vector and raster data analysis methods, network analysis: concept and applications, utility mapping using GIS, Wild life habitat analysis, land suitability analysis, geoinformatics for Environmental impact analysis, disaster vulnerability analysis, land information System.

Unit V: Microwave Remote Sensing:

Synthetic Aperture Radar (SAR). Advantages/disadvantages of radar remote sensing vis-à-vis optical remote sensing, SAR viewing geometry: slant range, ground range, azimuth, look angle, incidence angle and local incidence angle, backscattering coefficient and sigma naught expression, radar equation for point and distributed targets, radar penetration, polarization, Dielectric constant, SAR dependence on dielectric constant and roughness w.r.t. angle and frequency, definition and causes of speckle in SAR images, multi-looking, speckle removal methods; topographic influences on radar imaging, methods for minimizing topographic influences on SAR images, reflectivity of earth's features, some common modeling approaches like discrete, continuous, cloud model and MIMICS model concepts, scattering mechanisms of SAR with volume. Interferometry: concept and applications, Polarimetry: Definition and scope, applications of SAR for Soil moisture estimation, snow and glacier studies, disaster management, crustal deformation, woody biomass, crop growth monitoring

UNIT VI: Advanced Image Processing:

Active, passive, imaging and non-imaging remote sensing, remote sensing in 21st century. geophysical remote sensing and its applications. Overview and applications of hyper-spectral and thermal remote sensing, integration of multi-sensor data, high pass filter, low pass filters, density slicing, edge enhancement and detection filters, image indices (VI, NDVI, PVI, SAVI), principal component analysis (PCA), supervised and unsupervised image classification, training samples, classification algorithms: maximum likelihood, mean distance to means, parallel piped, Mahalanobis, Knowledge based classifier, Neural networks and fuzzy logic, classification accuracy methodology, applications of remote sensing to vegetation (Deforestation, NPP estimation, LIA), cadastral mapping,

lithological mapping, snow and glacier studies, ground water exploitation and desertification

Unit VII: Advanced GIS:

Emerging tends and scope of Geoinformatics, relationship between Geoinformatics, Information Technology and Space Technology, data standards, scale issues in RS and GIS, GIS design and implementation, enterprise GIS, Socio-economic GIS, integration and application of socio-economic and environmental data, fundamentals of multi-criteria analysis, geographic data sampling methods, interpolation methods and applications of interpolation, concept and types of surfaces and application of surface mapping, methods of development, and applications of DEM, geospatial modeling for land degradation, watershed prioritization, hydrological modeling, flood vulnerability zonation, Integrated Environmental analysis and assessment of Carrying Capacity using GIS, Eco-zonation mapping, Crop growth modeling in GIS environment.

Unit VII: Field survey, Geodesy and GPS:

Geographic data collection, importance of spatial location, development of global surveying techniques, geoinformation techniques for the storage and analysis of the spatial data, designing database structure for GPS geospatial data, application of latest technology instruments like GPS, field spectrometers to validate field mapping. data quality assessment, concept, types, and components of GPS, GPS satellite constellation including US, Russian and European. Geo-positioning basic concepts, GPS accuracy, wave frequencies, error corrections, GPS signal interferences, applications of GPS in resources surveys, mapping, crustal deformation and navigation, origin, structure and evolution of planet earth, endogenic and exogenic earth processes, basic principles of geophysical survey design and interpretation, including gravity, magnetic, electric, electromagnetic and seismic methods, Geophysical properties of geological materials, interpretation of geophysical data for geospatial applications.

Unit IX: Database Management System:

Database concepts, database development, implementation and design, database management systems (DBMS): Network DBMS, Hierarchical DBMS, Relational DBMS, Object oriented DBMS, storing of GIS databases, importance of editing GIS databases, theoretical and mathematical understanding of database querying, database querying using SQL (MS Acess/ Oracle), GIS database application development, object-oriented programming language, GIS database object models. Object-oriented software development (domain analysis, user requirement analysis, design models). Principles of user interface design (windows-based user interface design), global databases and their applications; land use, forest, agriculture, NPP datasets, Seeps database, topographic databases like GTOPO, SRTM and ASTER, gridded population of the world.

Unit X: Geostatistics and Geospatial Modeling:

Use of statistics in interpreting multi-dimensional satellite data, concept of estimation and simulation in geospatial modeling, overview of spatial statistics, autocorrelation principles, variogram analysis, applications of variogram analysis for soil moisture and forest structure, scatter plots and data redundant analysis for multi-dimensional satellite data, correlation in multivariate data, time series analysis and representation, applications of time series analysis for feature extract from the multi-temporal satellite data for soil moisture, vegetation analysis and disaster management.

General modeling approaches, knowledge driven models, model validation techniques, model input parameters for hydrological and erosion models, role of remote sensing and GIS in land surface process modeling, agent modeling, concepts on modeling the historical and futuristic land cover changes, assessing the impacts of climate change on water resources and agriculture**,** geospatial modeling case studies for solid waste management, disaster vulnerability and risk assessment, Air quality modeling and assessing its impacts on human health using GIS