Skill Enhancement Courses Earth Sciences (Geology and Geoinformatics)

Name of the Course	Course Code	Name of the Programme	Year of introduction
Economic and Petroleum	GL15106DCE and GL15107DCE	MSc Applied Geology	2001
Engineering Geology	GL15205DCE	MSc Applied Geology	2011
Disaster, Hazard and Risk Assessment	GL15206DCE/GI15205DCE	MSc Applied Geology & MSc Geoinformatics	2015
Geophysical exploration	GL15207DCE	MSc Applied Geology	2012
Mining and Exploration geology	GL15402DCE	MSc Applied Geology	2012
Hydrogeology	GL15302CR	MSc Applied Geology	2011
Hydro informatics	GI 15306CR	MSc Geoinformatics	2015
Natural resource management	GI15306DCE	MSc Geoinformatics	2015
RS in Geosciences	GI15303DCE	MSc Geoinformatics	2015
Application of RS and GIS	GI15105DCE	MSc Geoinformatics	2015
Cartography and geoinformation visualisation	GI15104DCE	MSc Geoinformatics	2015
Remote sensing for urban and regional planning	GI15206DCE	MSc Geoinformatics	2012
Surveying techniques	GI15106DCE	MSc Geoinformatics	2015
Field surveying and GPS	GI15301CR	MSc Geoinformatics	2012
Open source GIS	GI15403DCE	MSc Geoinformatics	2015
Database management system	GI15207DCE	MSc Geoinformatics	2015
Computers and geoinformation management and Applications of Geoinformatiocs	GI15101CR and GI15209GE	MSc Geoinformatics	2015

Syllabus

GL17106DCE: Economic Geology

Unit-I

Ore Geology: Space-time distribution of mineral deposits and global metallogeny with special reference to India. Processes of formation of different mineral deposits. Weathering and Placer deposits. Different types of ore reserves, Mineral economics and its significance. National Mineral Policy

Fluid inclusions: types, assumptions, techniques and limitations.

Unit-II

Fuel Geology: Coal: origin and classification of coal. Macroscopic and microscopic constituents of coal. Geological and geographical distribution of coal deposits in India with emphasis on Gondwana coal fields of India.

Books recommended

Evan, A. M., 1983: Ore Geology and industrial Minerals. Blackwell.
Holson, G. D. and Tiratsoo, E. N., 1985: Introduction Petroleum Geology. Gulf Pub. Houston, Jensen, M. L. and Bateman, A. M., 1981: Economic Mineral Deposits, John Wiley.
Keller, S. E., 1994: Mineral Resources, Economic and the Environment. McMillan College Pub.
Levarson, 1985: Geology of Petroleum. CBS Pub.
Prasad, U., 1996: Economic Geology. CBS Pub. N. Delhi.
Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press.
Sinha, R. K. and Sharma, N. L. 1993: Mineral Economics. Oxford & IBH Pub. Co. Pvt. Ltd.
Stach, E. and Others, 1982: Stach's Text Book of Coal Petrology. Gebruder Borntraeger
Stanton, R. L, 1972: Ore Petrology. Mc-Graw Hill.
Tissot, B. P. and Welte, D. H, 1984: Petroleum Formation and Occurrence. Springer-Verlag.
Outlines of Geophysical Prospecting - A manual for geologists by Ramachandra Rao, M.B., Prasaranga, University of Mysore Mysore 1975.
Exploration Geophysics - An Outline by Bhimasarikaram Y.L.S., Association of Exploration Geophysicists, Osmania University, Hyderabad, 1990.
An introduction to Geophysical Prospecting by Oobrin, M.B. and Savit, C.H., McGraw Hill, New Delhi, 1988.
Applied Geophysics by Telford W.M. Geldart L.P., Sheriff, R.E. and Keys D.A. Oxford and IBH Publishing Co. Pvt., Ltd. New Delhi, 1976.

GL17107DCE: Petroleum Exploration

Unit-I

Source rocks, reservoir rocks and different types of traps. Amount, type and maturation of organic matter. Petroleum and source rock correlation. Locating petroleum prospects based on principles of petroleum generation and migration (geological modeling).
Geophysical methods of Hydrocarbon exploration.

Unit-II

Petroleum basins:Basin studies and basin analysis. Basin classification in plate tectonics. Fundamental types of petroliferous basin; relation between basin type and hydrocarbon richness. Factors favoring hydrocarbon abundance. Petroleum provinces of India and world Case studies of some giant oil fields

Unit-III

Elements of well drilling: Cable-tool drilling, rotary drilling, various types of drilling units. Elements of logging. Electric, radioactive and sonic logs. Nuclear magnetic resonance and dielectric logging Application of logs in petro-physical analysis and facies analysis

Books recommended

Guillemot, J., 1986: Oil and Gas Exploration Techniques. Additions Technip.
Glennie, K. W., 1998: Petroleum Geology of the North Sea. Blackwell Science.
Holson, G. D. and Tiratsoo, E.N., 1985: Introduction Petroleum Geology. Gulf Pub. Houston,
Keller, S. E., 1994: Mineral Resources, Economic and the Environment. McMillan College Pub.
Levarson, 1985: Geology of Petroleum. CBS Pub.

Landon, R. C., 1996: Principles of Petroleum Development Geology. Printice Hall.
North, F. K., 1985: Petroleum Geology. Allen &Unwin
Salley, R. C., 1988. Elements of Petroleum Geology. Academic Press.
Tedesco, S. A., 1995: Surface Geochemistry in Petroleum Exploration. Chapman Hall.
Tissot, B. P. &Welte, D. H., 1984: Petroleum Formation and Occurrence, Springer Verlag.

GL17205DCE: Engineering Geology

Unit-I

Principles of engineering geology: Engineering properties and classification of rocks. Factors affecting engineering properties of rocks. Rock stability tests. Engineering properties of soils. Soil liquefaction and creep. Stress distribution in soils and foundation failures.

Unit-II

Geological considerations for construction of dams, reservoirs, and tunnels Tunnel alignment and transportation routes. Methods of tunneling and various types of tunnel support.
Geological consideration for construction of roads, buildings and bridges

Unit-III

Mass movements with special emphasis on landslides and slope stability. Earthquakes and seismic zones of India. Case history of engineering projects and geological causes for failures of engineering structures and remedial measures

Books recommended:

Arms, K., 1990: Environmental Science. Saunders College Pub.
Bell, F. G., Engineering Properties of Soils and Rocks.
Bell, F. G., 1999: Geological Hazards their assessment, Avoidance & Mitigation. E&FN S. London.
Bell, F. G., 1999: Geological Hazards. Routledge, London.
Bryant, E., 1985: Natural Hazards. Cambridge University Press.
Goodman, R. E., Engineering Geology.
Keller, E. A., 1978: Environmental Geology. Bell and Howell, USA.
Krynine, D. H. and Judd, W.R., 1998: Principles of Engineering Geology. CBS Pub.

GL17206DCE: Disaster, Risk & Hazard Assessment

Unit-I

Principles of Disaster Management: Natural disasters (earthquakes, floods, landslides, GLOFS, avalanches), anthropogenic disasters; hazards, risks and vulnerabilities. Assessment of disaster vulnerability of a location and vulnerable groups. Preparedness and mitigation measures for various disasters. Disaster management with respect to earthquakes, flood and landslides

Unit-II

Remote sensing for disaster management: Satellite remote sensing for disaster management, real time disaster analysis and management, identification of flood prone areas using remote sensing and other ancillary data, post disaster analysis of inundated areas, area estimations, crop loss estimates etc. Forest fire identification and zonation using remote sensing data. Seismic microzonation.

Unit-III

Geoinformatics for disaster assessment: Flood control, drought management, cyclones, avalanches, land use planning,. GPS for early warning system for disasters. GIS for Risk assessment, Recent trends in Geoinformatics for disaster management.

Books recommended:

Aki, K. and P.G. Richards (2002) Quantitative Seismology, University Science Books, Sausalito, CA.

Bolt, B.A. (1992). Inside the Earth, W.H. Freeman, San Francisco.

Building safer cities, 2003.Alcira Kreime, Margaret Arnold,Anee Carlin, New York United Nations Press. Collaborative Decision Making: Perspectives and Challenges,2008,Pascale Zarate, James and James science Publisher.

Iyer, H.M. and K. Hirahara (Eds.) (1993) Seismic Tomography Theory and Practice, Chapman & Hall, New York.

Landslides-Risk reduction. Kyoji Sassa, Paolo Canuti.. 2008, Kluwer Academic Publishers.

Lay, T. and T.C. Wallace (1995) Modern Global Seismology, Academic Press, San Diego.

Natural Hazards and Human-Exacerabated disasters, Edgardo Latrubesse. National University of Colombia. Risk management and Society-Eve Coles, Denis Smith,Steve Tombs,2000

GL17207DCE: Geophysical Exploration

Unit-I

General and Exploration geophysics- Different types of geophysical methods; Gravity, magnetic, Electrical, Seismic, radioactive- their principles and applications. Concepts and Usage of corrections in geophysical data.Role of geophysical data in explaining geodynamical features of the earth.

Unit-I

Geophysical field operations: Different types of surveys, grid and route surveys, profiling and sounding techniques, scales of survey, presentation of geophysical data. Application of Geophysical methods - Regional geophysics, oil and gas geophysics, ore geophysics, groundwater geophysics, engineering geophysics.

Unit-III

Geophysical anomalies: Correction to measured quantities, geophysical, anomaly, regional and residual (local) anomalies, factors controlling anomaly, depth of exploration.

Integrated geophysical methods - Ambiguities in geophysical interpretation, Planning and execution of geophysical surveys.

Books recommended:

Outlines of Geophysical Prospecting - A manual for geologists by Ramachandra Rao, M.B., Prasaranga, University of Mysore Mysore 1975.

Exploration Geophysics - An Outline by Bhimasarikaram Y.L.S., Association of Exploration Geophysicists, Osmania University,Hyderabad, 1990.

An introduction to Geophysical Prospecting by Oobrin, M.B. and Savit, C.H., McGraw Hill, New Delhi, 1988. Applied Geophysics by Telford W.M. Geldart L.P., Sheriff, R.E. and Keys D.A. Oxford and IBH Publishing Co. Pvt., Ltd. New Delhi, 1976.

GL17402CR: Mining & Exploration Geology

UNIT I

Classification of mining methods, introductory geological and economic aspects of mine planning, developmental works for underground mining, mode of entry in mines, drift, crosscuts, winz, raise, ore bin and ore chuites. Surface mining methods; placer mining methods and open pit methods, ground sluicing, hydraulic mining, dredging, drift mining, shovel mining and multi bench, lateral advance mining method, their advantages and disadvantages. Underground mining methods; open stopes mining methods, supported stopes mining methods, shrinkage, cut and fill and square set mining methods, caving methods- top slicing sublevel caving and block caving, their advantages and disadvantages.

UNIT II

Mining supports; support types with their merits and demerits. Stowing methods; subsidence –causes and prevention. Methods of breaking and blasting the rocks, types of explosives used; arrangements of drill holes for blasting in surface and underground mines. Mining atmosphere; ventilation in underground mines, types and arrangements of directing ventilations in underground mining.

UNIT III

Exploration Geology: Concept of Geochemical Prospecting: dispersion, pathfinder elements, geochemical sampling, and geochemical field techniques. Geophysical prospecting: Basic principles, scope and application of geophysical prospecting. Principle, procedure, equipment used and applicability of gravity, magnetic, electrical, seismic and radiometric methods. Aerial geophysical surveys.

Books recommended:

Evan, A. M., 1983: Ore Geology and industrial Minerals. Blackwell.

Holson, G. D. and Tiratsoo, E. N., 1985: Introduction Petroleum Geology. Gulf Pub. Houston,

Jensen, M. L. and Bateman, A. M., 1981: Economic Mineral Deposits, John Wiley.

Keller, S. E., 1994: Mineral Resources, Economic and the Environment. McMillan College Pub.

Levarson, 1985: Geology of Petroleum. CBS Pub.

Prasad, U., 1996: Economic Geology. CBS Pub. N. Delhi.

Selley, R.C., 1998: Elements of Petroleum Geology. Academic Press.

Sinha, R. K. and Sharma, N. L. 1993: Mineral Economics. Oxford & IBH Pub. Co. Pvt. Ltd. Stach,

E. and Others, 1982: Stach's Text Book of Coal Petrology. Gebruder Borntraeger Stanton, R. L, 1972: Ore Petrology. Mc-Graw Hill.

Tissot, B. P. and Welte, D. H, 1984: Petroleum Formation and Occurrence. Springer-Verlag.

GL17302CR: Hydrogeology
Theory

Unit-I
Introduction: Groundwater in the hydrologic cycle. Groundwater table – Groundwater table fluctuations and controlling factors. Subsurface inflow and outflow, recharge and discharge, effluent and influent streams. Elementary theory of groundwater flow: Darcy's law and its range of validity. Steady and unsteady flow. Hydrological properties of aquifers: Porosity and permeability, transmissivity, storage coefficient, their definition and methods of determination. Water table maps and flow net analysis; differential equation for controlling groundwater flow. Well hydraulics: Steady, unsteady and radial flow into a well. Confined and leaky confined and unconfined aquifers. Determination of aquifer characteristics from pump-tests.

Unit-II
Groundwater development: Groundwater exploration methods – geological & geophysical (resistivity, magnetic and seismic) methods. Borehole geophysical logging – electrical, resistivity and SP; Radiation logging – gama, gama-gama, and neutron logging. Cliper and temperature logging. Preparation of strata charts, design of tube well assembly and water well design criteria. Water level development and yield tests, well completion reports. Groundwater modeling techniques, data requirement.

Unit-III
Groundwater basin management methods: Basic ideas of groundwater management. Water logging –causes and remedial measures; artificial recharge. Fresh and saltwater relationship in coastal areas. Quality and geochemistry of water: Groundwater quality analysis – sampling methods, bacteriological, chemical and physical quality. Quality criteria for drinking, irrigation and industrial purposes. Pollution of groundwater. Groundwater and hydro-chemical provinces of India.

GLP17302CR: Practical Hydrogeology
Delineation of hydrological boundaries on water-table contour maps and estimation of permeability. Preparation of isohytal maps, Theissen's polygonal method. Analysis of aquifer performance test data, Thiem's, Theis's and Jacob's method. Design of water well screen and gravel pack on the basis of mechanical analysis data of aquifer material. Analysis of hydrographs and estimation of infiltration capacity. Study of geophysical well logs. Estimation of TDS using resistivity and SP logs. Plotting of groundwater provinces of India.

Books recommended:
Chow, V. T, 1988: Advances in Hydrosciences, McGraw Hill.
Freeze, R. A. & Cherry, J. A., 1979: Ground Water. Prentice Hall.
Fetter, C. W., 1990: Applied Hydrogeology. Merill Publishing.

Karanth, K. R., 1987: Groundwater Assessment-Development and Management. Tata McGraw Hill.
Todd, D. K.., 1980: Groundwater Hydrogeology John Wiley.
Raghunath, N. M., 1982: Ground Water. Wiley Eastern.
Ragunath, H. M., 1997: Hydrology, Principles, Analysis, Design. New Age Pub. Roa, K. L., 1979:
India's Water Wealth, Orient Blackswan.

GI17303CR: HYDROINFORMATICS

Coarse goals

- To assess and manage the water resources vis-a-vis the application of Geoinformatics.
- To learn to develop site specific strategies or plans for water resource management using the Geoinformatics.
- To enable theidentification and management of potential ground water resources.

Unit I: Hydrological Cycle and Processes: Hydrological cycle and processes: precipitation, evaporation, transpiration, interception, infiltration, percolation and groundwater recharge. Hydrometeorology: stream flow and precipitation measurement and Statistical methods for the analysis of stream flow and precipitation data, runoff–flow duration curve, flow mass curve, hydrograph – its components.

Unit II: Remote Sensing for Surface and Ground Water: Remote sensing techniques for water resources assessment: Interpretation of satellite data for water resources, impact of spatial resolution on water resources mapping. Surface water bodies mapping (visual interpretation and digital image processing for mapping irrigation tanks, ponds, reservoirs, lakes etc.).Role of remote sensing for quantifying the hydrological processes.Groundwater exploration using remote sensing and GIS.

Unit III: Geoinformatics for Watershed Management: Watershed characterization and hydrological modelling. Concept of Runoff and overland flow, Factors affecting runoff processes. Watershed factors that affect runoff: size, topography, shape, orientation, aspect, geology, soil interflow and base flow. DEM applications in water resources.Watershed management, planning and conservation principles.Geoinformatics for watershed management.

Unit IV: Snow and Glacier Studies using Geoinformatics: Visible, infrared and microwave remote sensing for snow and glacier studies. Normalized Difference Snow Index (NDSI) and other ratio methods for snow/glacier mapping. Snow hydrology, snowmelt run-off modeling. Glacier inventory (areal extent, depth) Change detection studies of glaciers. Mass balance studies of glaciers using geological, geodetic and hydrological approaches.

References

Hand Book of Applied Hydrology: (Ed) Ven T. Chow Water Resources Engineering: Linsley and Franzin Remote Sensing in Hydrology: E.T. Engman& R.J. Gurney Elementary Hydrology: V. P. Singh.

Principles of Water Resources Planning: Alvin, S. Goodman.

Freshwater Ecology (Concepts and Environmental Applications): Walter K. Dodds Environmental Hydrology: Andy D. Ward and Stanley W. Trimble.

Hydrology and Water Resources Engineering: K. C. Patra Ground Water Hydrology: David Keith Todd.

Snow and Glacier Hydrology: Kayee Brubaker.

Hydroinformatics Tools, 1998.Jiri ,Marasalak, Cedo, Maksimovic, EvzenZaman. Kluwer Academic Publishers.

GI15306DCE: NATURAL RESOURCE MANAGEMENT

Coarse goals

To acquaint the students with the applications and use of Geoinformatics for Natural Resource Conservation and Management.

To impart knowledge about the GIS analytical capabilities to solve environmental Problem.

To equip the students with the know-how about integrated environmental analysis using Geoinformatics.

Fundamentals of Natural Resource Management:

Natural resources: Introduction and classification. Inventory and monitoring major natural resources of Jammu and Kashmir with special reference to water and forests. Ecosystem: concept, types and components. Major biomes of the world: distribution and characteristic features of Forests, Grassland, Tundra, Desert and Marine. Wetlands: Concepts, Ramsar Convention, socio-economic and environmental importance, mapping, inventorying and management.

Climate Change: Process and Consequences:

Basic concepts of climatology, Climate change: introduction, causes & consequences. Green house gases and green house effect. Impacts of climate change on natural resources particularly forest, agriculture and water resources. Energy sources and Climate change. International environmental conventions viz., UNFCCC, UNCBD, UNCCD. Kyoto & Montreal Protocol. Sustainable development of natural resources, concept, principles and limitations. Integrated Environmental analysis. Systems approach to Ecosystem studies.

Remote Sensing of Natural Resources:

Forest Resources Inventory and Management using high and moderate resolution satellite data. Vegetation mapping for change detection studies and biomass estimations. Remote Sensing for Sustainable Agriculture and crop production estimates. Rangelands: spatial and temporal variation in distribution, change detection analysis based on satellite imagery. Mineral wealth of J&K, Application of hyperspectral remote sensing data for mineral

exploration and distinction. Water resources (snow and glaciers): inventorying, change detection studies and glacier retreat.

GIS for Natural Resource Management:

Decision Support Systems for NRM. GIS for modeling land surface processes particularly erosion and hydrological processes. Biodiversity: Monitoring, management and loss. Conservation of biodiversity (with special references to biodiversity pool of J&K). Role of Geoinformatics for management of wildlife reserves, habitat analysis of musk dear, black bear and snow leopard in Jammu and Kashmir. GIS for watershed prioritization. GIS for Wetland restoration.

References:

Alan H. Strahler& Arthur Strahler. Physical Geography. Wiley
Bir Abhimanyu Kumar. Remote Sensing and GIS for Natural Resource Management.
Eastern Book Corporation.
DS Lal. Climatology. Sharda Pustak Bhawan
Frank Oldfield. Environmental Change: Key Issues and Alternative Approaches. Cambridge University Press.
Jasper S Lee. Natural Resources and Environmental Technology. Interstate Publishers M.
Anji Reddy. Remote Sensing and Geographical Information Systems. BS Publications
R.B. Singh. Dynamics of Mountain Geosystems.South Asia Books.
Stanley Aronoff. Remote Sensing for GIS managers. ESRI Press.

GL17303CR: Remote Sensing in Geosciences

Theory

Unit-I

Remote sensing: basic concepts, fundamentals, data sources, Types of scanners and image acquisition: History and scope of remote sensing, concepts of remote sensing, electromagnetic radiations, matter interactions with atmosphere and terrain atmospheric windows, spectral reflectance of vegetation, soils, minerals and rocks. Elements of visual image interpretation. Factors governing image interpretation,verification and validation of RS data (Ground Truthing).

Unit-II

Digital analysis of remote sensing data: Picture element and image statistics, Geometric and Radiometric Distortions, Pre-processing of satellite data (radiometric and geometrical corrections).Image enhancements techniques. Image filtering techniques. Spectral ratios and indices. Digital image classification: Supervised and unsupervised classification. Accuracy assessment: Sources of errors and measurement of map accuracy, kappa coefficient.

Unit-III

Remote sensing applications to geosciences: Earth sciences: Lithology and structure (faults, folds), Environmental: Land use and land cover changes, monitoring erosion, urbanization and deforestation. Survey: cadastral mapping, digital terrain models. Hydrology: hydrological modeling and ground water prospecting.

GLP17303CR: Practical Remote Sensing in Geosciences

Remote Sensing in Geosciences: Tutorial on different modules of image processing software; Import and export of satellite data; Different image and remote sensing data formats; Familiarization with the earth surface features on the images; Preparation of satellite data for analysis like rotate, reflect, subset, layer addition; Pre-processing of satellite data like image registration, geo-correction, filtering, image enhancements, math operations; Image ratios and other remote sensing and geological indices like SAVI; Lithologic, land use/land cover feature identification Familiarization with GIS software systems.

Books recommended:

Burrough, P.A., 2003: Principles of Geographic Information Systems. Oxford University Press.

Campbell, J., 2002: Introduction to Remote Sensing. Guilford Press, New York.

Demers, M. N., 1999: Fundamentals of Geographic Information Systems. John Wiley.

Jensen, J. R., 2004: Remote Sensing of the Environment. Prentice Hall, New Jersey.

John, A. Richards, 1993: Remote Sensing Digital Image Analysis. Springer-Verlag.

John, R. Jensen, 2000: Introductory Digital Image Processing, A Remote Sensing Perspective.

Lillesand, T. M. and Kiefer, R. W., 1987: Remote Sensing in Geology. John Wiley. Prentice Hall,New Jersey. Lillesand, T. M. and Kiefer, R. W., 2002: Remote Sensing and Image Interpretation, J.

Wiley Rees, W. G., 2001: Physical Principles of Remote sensing. Cambridge University Press.

Sabbins, F. F., 1985: Remote Sensing - Principles and Applications. Freeman.

GI17105DCE: APPLICATIONS OF REMOTE SENSING AND GIS

Course Goals

- Familiarize students with the basic and advanced applications of geoinformatics
- Expose students to basic methodologies of remote sensing and GIS for environmental monitoring

Unit I: GIS Applications and Case Studies

Utility mapping using GIS, Wildlife habitat analysis, Land suitability analysis, Geoinformatics for Environmental impact analysis (EIA), Disaster vulnerability analysis (seismic micro zonation, landslide hazard zonation), Geoinformatics for Land information System (LIS).

Unit II: Geospatial Modeling and Applications

Geospatial Modeling: introduction, importance and techniques. Land degradation modeling, watershed prioritization. Hydrological modeling, flood vulnerability zonation.

Environmental modeling: Integrated Environmental analysis and assessment of Carrying Capacity using GIS, Eco-zonation mapping. Crop growth modelling in GIS environment.

Unit III: Remote Sensing Applications

Role of Remote Sensing in Landslide mapping, Flood and Agriculture management/monitoring. Land use/land cover mapping and monitoring, Urbanization (urban land use, urban sprawl). Role of Remote Sensing in Fishery and wildlife application.

Unit IV: Advanced Applications of Remote Sensing

Vegetation applications (Deforestation, Net primary productivity estimation, Leaf area index. Cadastral mapping. Geological applications (lithology, tectonics). Water resources management (snow and glaciers, ground water exploitation) Environmental evaluation and monitoring (wetlands, desertification)

Books recommended:

DeMers, M. N. 2003. Fundamentals of geographic information systems. J. Wiley.

Chrisman, N. 2002. Exploring Geographic Information Systems**,** J W and Sons, New York.

Cracknell, A. P and Hayes, L.W.B. 1993. Introduction to Remote Sensing, Taylor and Francis London. Colwell, R. N. 1983. Manual of remote sensing. American Society of Photogrammetry.

Jensen, John R. 2004. Introductory Digital Image Processing, Prentice Hall.

GI17104DCE: CARTOGRAPHY AND GEOINFORMATION VISUALIZATION

Course Goals

- Expose students to the basic and advanced techniques of digital cartography for visual exploration and presentation of the geo-information data.
- Develop map design, composition and editing skills
- Teach techniques for Integration of thematic, spatial and non-spatial data at various scales

Unit I: Map Making

Maps: Introduction, types of maps, uses of maps. Cartography: analogue and digital cartography, cartographic generalizations. Map composition: map design and layout, map scale, legend, annotations. Coordinate systems, Geoid, shape of earth and datums, Map projections: introduction, properties and aspects of map projections, classification of map projections.

Unit II: Data Sources and Visualization

Data sources for mapping: remote sensing, field observations, GPS, maps and other ancillary data. Survey of India (SOI) map index and National Mapping Policy, Use and users of geo-spatial data, Data products w.r.t land surface processes, disasters, EIA and

geology. DEM, need, methods, data sources and products, Visualization techniques: Visual exploration for different features/surfaces, virtual reality and scenario mapping. Lidar, Stereo-images, Aerial photos and InSAR.

Unit III: Statistical Data Analysis

Measurement Scales: nominal, ordinal, interval, and ratio. Measures of central tendency: mean, median, mode, Measures of Dispersion: range, Variance, standard deviation, coefficient of variation, skewness and kurtosis. Regression and correlation analysis. Basic concepts of time series data analysis.

Unit IV: Data Presentation

Geospatial data dissemination: maps, graphics, animations, multi- media, internet and posters. Quantitative representation of spatial and non-spatial data. Digital and cartographical and scape models. Exaggerations and omissions. Map updating using GPS and Remote Sensing data. Assessing the accuracy of maps.

Books recommended:

Ormeling, F., & Kraak, M. J. 2010. Cartography: Visualization of Geospatial Data. Prentice Hall.

Robinson, Arthur H., JoelL. Morrison, Phillip C. Muehrcke, A. Jon Kimerling, and Stephen C. Guptill 1995. Elements of Cartography, John Wiley and Sons, New York.

Laurini, R., & Thompson, D. 1992. Fundamentals of spatial information systems. Academic press. London.

Longley, Paul A., M.F. Goodchild, D.J. Maguire, and D. W. Rhind 2005. Geographic Information Systems and Science, John Wiley and Sons, New York.

DeMers, Michael N 2008. Fundamentals of geographic information systems, John Wiley & Sons Richard K. Brail, and Richard E. Klosterman 2001. Planning Support Systems: Integrating Geographic Information Systems, Models, and Visualization Tools, ESRI Press.

Lo, C. P. & Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.

GI17207DCE: REMOTE SENSING FOR URBAN AND REGIONAL PLANNING

Coarse goals

- To use different high-resolution satellite data products for urban planning.
- To develop a credible remote sensing and GIS system for urban area related problems.

Unit I: Introduction to Urban Planning

Principles of urban area development and land use planning. Importance of Urban and regional planning. Urbanization trends in Jammu and Kashmir with special reference to the Srinagar and Jammu city centres. Impact of urbanization on different natural resources of Jammu and Kashmir with reference to some case studies. Master planning for urban land use. Unplanned urbanization and resource mis-management.

Unit II: Remote Sensing for Human Settlement Analysis

Urban area identification and interpretation using high and moderate resolution remote sensing data, Various classification systems; Residential area classification; Space use classification system; Urban land use classification systems, interpretation, monitoring and change detection analysis using satellite imagery. Mapping urban land use and urban sprawl with remotely sensed data.

Unit III: Socio-economic GIS

Census operation in India, census data and field observations, Demographic and social patterns, Socio economic and residential area evaluation. Remote sensing for population studies and settlement, slum settlement detection. Updating of population data, Traffic and parking survey with high spatial resolution satellite data, Role of Geoinformatics in Transportation Planning. Geoinformatics for cadastral based land information system.

Unit IV: GIS for Urban Resources and Services Planning

Eco-zonation of ecologically fragile landscapes. Urban facility mapping, Advancement of Geoinformatics in services sector particularly Utilities. Urban land evaluation and suitability analysis, Urban hazards and risk management. Seismic micro zonation of urbanized areas.

Books recommended:

Hashim, N. and Rainis, R. 2003. Urban Ecosystem Studies in Malaysia: A Study of Change. Universal-Publishers.

Branch, M. C. 1971. City Planning and Aerial Information. Cambridge, Harvard Uni. Press.

Burrough, P.A. 1996. Principles of Geographic Information Systems for land resources assessment: Oxford: Clarendon Press.

Demer, Michael, N. 2000. Fundamentals of Geographic Information Systems, John Wiley and Sons, Inc.

GI 17106 DCE: SURVEYING TECHNIQUES

Course Goals:

- To make students understand the importance of surveying in earth sciences
- To make students understand the applications of basic surveying instruments.

Unit I: Basics of Surveying

Introduction to surveying. Key concepts and principles of Surveying. Designing surveys, processing of survey data, Process of Map Making, Data sources for mapping: remote sensing, field observations, GPS, maps and other ancillary data.

Unit II: Sampling and sampling design

Introduction to sampling. Probability sampling; Simple Random sampling, Systematic sampling and Stratified sampling. Methods of computer assisted data collection.

Unit III: Modern survey methods

Modern surveying electronic equipments: digital levels, digital theodolites, EDMs, Total stations; Principles, working and applications; Lasers in surveying, GPS working principles and components.

Unit IV: Remote Sensing and GIS based Surveys

Remote Sensing principles, components as a tool for data generation and mapping; Introduction to modern techniques – Air photographs and Satellite Imagery and their basic properties, concept of GIS and GPS and their components, Types, scales and ground coverage. Advantages of Aerial photographs over conventional on-the-ground observations.

Tutorial

- GPS survey of the University Campus or Dal Lake, Shalimar/Nishat garden.
- Validation of the Satellite based Digital Elevation Model with the GPS data.
- Accuracy assessment of the satellite based land use and land cover data.

Books recommended:

Leick A. 1995. GPS Satellite Surveying, Wiley, Newyork Chicheste Brisbane Toronto Singapore.

Hofmann-Wellenhof B, Lichtenegger H. 2007. GPS Theory and Practice, Springer (5^{th}eds), Wien New York.

Kennedy, M. Ann Arbor, M. I. 2002. Global Positioning System and GIS, CRC Press.

Kraak, M. J., & Ormeling, F. 2003. Cartography: Visualization of geospatial data. Harlow.

Robinson, Arthur H., JoelL. Morrison, Phillip C., Muehrcke A. Jon Kimerling, and Stephen C 1984. Elements of Cartography, John Wiley and Sons, New York.

Lo, C. P. & Yeung, A. K. 2007. Concepts and techniques of geographic information systems, Pearson Prentice Hall.

Laurini, R and Thompson, D. 1992. Fundamentals of spatial information systems,

Academic Press London.

GI17301 CR: FIELD SURVEYAND GNSS

Course goals

- To make students understand the importance of fieldwork and enable them to collect field data on various aspects of earth system.
- To acquire the skills of interpreting, synthesizing and disseminating field data and information.
- To make use of data derived from the field into a GIS.

Unit I: **Introduction to Surveying and Mapping**: Geographic data collection, spatial location and reference. Issues and challenges in geospatial data collection from remote sensing platforms and ground based approach. Historical background in the advancements in surveying. Basic principles of surveying, Type of surveys, (a) Surveying techniques, (b) Procedure of field survey, (c) Collection of data, (d) Error adjustments. Ground truth data format for land cover, wetlands, forests, urban built up and glaciers. NNRMS mapping standards.

Unit II: Digital Field Data Capture Techniques: Traditional Field Equipment: - Theodolite, Abney Level, Plane Table. Application of latest technology instruments like GPS, 3D Laser Scanners, EDM, Total Station for field mapping. Compilation of data: Data quality assessment, Digitizing and the creation of a geospatial database. Data interpretation by integration of field and remotely sensed data.

Unit III: Global Navigation Satellite Systems: Geo-positioning basic concepts. Introduction to GNSS, concept, types and components. Concepts of DGPS, GNSS satellite constellations: Russian, European, GAGAN, IRNSS. GPS accuracy, wave frequencies, error corrections. Ground data collection: spatial and non-spatial data for analysis and modelling, GPS signal interferences, Applications of GPS in resources surveys / mapping, crustal deformation and urban land cover.

GIP17301CR: Practical Field Survey and GPS

- GPS handling and ground data collection through LDM, Camera, measuring tape, etc.
- Accuracy assessment of the satellite based land use and land cover data.
- GPS survey of the University Campus, Dal Lake and Mughal gardens/ public parks.
- Validation of the satellite-based Digital Elevation Models with the GPS data.
- 2 weeks field visit for mapping glaciated terrain, city/town, and tourist resort, whichever feasible.
- Group assignment on any of the above field based observations.

References:

GPS Satellite Surveying, Leick A (1995): 2nd end. Wiley, New yorkChicheste Brisbane Toronto Singapore.

GPS Theory and Practice, Hofmann-Wellenhof B, Lichtenegger H: (2007). Springer (5th eds), Wien New York.

Global Positioning System and GIS, An Introduction, Kennedy, M. Ann Arbor,MI,1996.

Concepts and techniques of Geographic Information System : Lo C.P: Albert. Prentice Hall. Remote Sensing and Image Interpretation, Lillesand, R. M. and R. W. Kiefer, 1994, 3rd Ed. NY: John Wiley and Sons, Inc

GI17403CR: OPEN SOURCES GIS

Course Goals:

- To expose students to free open source platforms for remote sensing and GIS data analysis
- Develop competence among students in the use of geospatial tools available from open source GIS platforms.

Unit I: Geospatial Analysis in QGIS:

QGIS features; menu and toolbars; Map navigation. Vector Analysis: Digitization and Symbology, Geoprocessing-Buffer, Union, Intersect, Clip, Data Import/Export and Querying, On the fly projection. Raster data analysis: Virtual raster, Mosiacing, Terrain analysis, zonal statistics, Projections and transformations. Open street maps. Plugins in QGIS. Map Composition in QGIS.

Unit II: Fundamentals of ILWIS:

Key features of ILWIS. Displaying geographic data in ILWIS, Displaying raster and vector data in ILWIS, Concept of domains in ILWIS. Coordinate systems and georeferencing in ILWIS. Raster and vector data import. Rasterization and vectorization.Resampling, Subset, Resampling and band visualization.

References:

Anita Graser. (2016). Learning QGIS - Third Edition. Packt Publishing, Birmingham UK.

Kurt Menke, Richard Smith Jr., Luigi Pirelli, John Van Hoesen. (2015). Mastering QGIS - Second Edition. Packt Publishing, Birmingham UK.

Jesse Russell, Ronald Cohn. (2012). ILWIS.Book on Demand, Berlin Germany.

GI17204DCE: DBMS AND GEOSPATIAL DATABASES

Coarse goals

- To make an understanding about the working of database management system.
- To define queries in the standard language SQL, stored tables and queries.
- To learn about the aspects of data base design and its applications.

Unit I: Fundamentals of Database Management System

Database concepts. Steps in database design: Prototype model and Waterfall model. Database management system (DBMS): Network DBMS, Hierarchical DBMS, Relational DBMS, Codd's rules, Comparison between these DBMS. Editing and Storing GIS databases. Concept of keys in a database.

Unit II: DBMS Concepts

Theoretical and mathematical understanding of database querying: Relational Algebra. Basics of SQL, data types and constraints in SQL. Data definition language, data manipulation language, data control language in SQL. GIS Data modelling using Entity Relationship Diagrams. Framing the ER models for: Village Information system, Tourist Development Authority, Rural Development, Water Resource Information System.

Unit III: Regional and Global databases I

Global land use datasets. Global ecosystem maps. Datasets related to vegetation: Global forest datasets-AVHRR global forest resource assessment, AVHRR NDVI dataset, Hansen (2013) global forest change database. Global NPP datasets. BALANS land cover data Agriculture datasets-FAOSTAT and its components. Vegetation map of India (Champion and Seth 1968; Roy et al 2015). Harmonized world soil database.

Unit IV: Regional and Global databases II

Global topographic data: GOTOPO, SRTM, ASTER, Carto DEM. GEOnet names server, Gridded population of the world, Global glacier inventories: RGI, WGI, GLIMS. ICIMOD glacier inventory. World lake database. National Wetland Inventory Assessment. Wetland Atlas of Jammu and Kashmir. Web-portals for data download: Bhuvan, Earth Explorer, WebGIS, India-WRIS. Global climate datasets: ECOCLIMATE, WorldClim.

Books recommended:

Elmasri, R., Navathe S. B. 2007. Fundamentals of Database Systems, Pearson Education.

Benynon-Davies, P. 2002. An introduction to Informatics in Organizations. Information Systems: Palgrave (formally Macmillan).
Date, C. J. 2000. An introduction to Database Systems, Reading, M. A. Addison-esley.
Ramakrishnan, R. and Gehrke J. 2003. Database Management Systems, Boston, M. A, McGraw.
Teorey, T.J. 1994. Data base Model Design: The fundamental Principles, San Mateo, CA, Morgan Kaufmann.

GI17101CR: COMPUTERS AND GEOINFORMATION MANAGEMENT

Course Goals

- Develop basic skills and understanding of the computer operations.
- Development of basic computer programming skills.
- Geospatial data handling and management.

Unit I: Programming and Problem Solving in C

Introduction to number systems and conversions. Basic flowcharts with examples. 'C' character set, keywords, data types, constants, variables, Operators: arithmetic, logical, relational, assignment and conditional operators. Expressions and statements in C, Symbolic constants. Basic programs in C. Control statements: If statements, If-Else and Switch-Case statement with examples. Loops in C: While, Do-While and For Loop with examples. Introduction to: Arrays, Structures, Functions and Pointers.

Unit II: Geospatial Data Handling

Ideal computer configuration for satellite data analysis and geospatial modelling. Role of computers in GIS and remote sensing data analysis. Metadata: introduction, importance and standards. Remote sensing data types: Signed, unsigned, float, double, complex. Data compression techniques: Advantages and disadvantages. Data conversion in remote sensing and GIS: Necessity, advantages and disadvantages.

Unit III: Geospatial Data Management

Overview of data management in GIS. Common geospatial data types: Geodatabase, Feature class, Raster, Shapefile, Tables. Basic raster analysis in GIS: Resampling, arithmetic operations, clip. Vector analysis: Fishnet and its applications, designing sampling intensity. Spatial analysis operations: Data extraction and zonal statistics.

Books recommended:

Maguire, D. J. 1989. Computers in Geography, Addison-Wesley Longman Publishing Co.
Mather, P. M. 1991. Computer applications in geography. John Wiley & Sons, Inc.
Drozdek, A. 2001. Elements of data compression. Brooks/Cole Publishing Co.

Jeffrey, A. H., Mary, P. & Fred, R. M. 2002. Modern database management. Prentice Hall, USA. Balagurusamy, E. 2002. Programming in ANSI C. Tata McGraw-Hill Education.

Current review and comparisons of different hardware and software published frequently, particularly for the DOS environment in magazines such as Byte and PC Magazine.

GIP17101CR: PRACTICAL-GEOSPATIAL DATA HANDLING AND MANAGEMENT

- Computers: Handling and maintenance
- Hands on MS Office (MS Word, MS Excel, MS Power point)
- Control statements: If, If-Else and Switch-statements.
- Loops: While, Do-While and For Loops,
- Data conversions: Basic import and export operations in GIS
- Data management schemes/methods in GIS