Course title: **Geographic Information Systems and Remote Sensing**  Full Marks: 100

Course No: Geo.Ed. 428 Pass Marks: 35

Nature of the course: Theory (50 %) and Practical (50 %) Periods per week: 9

Level: B.Ed. Total Periods: 225

Year: Second [Th.75hrs + (Pr. 75 lab) [1 lab =2 hrs)]

1. **Course Description**

This is a specialization course designed for the students of Four Year B. Ed. Program. This course is designed to orient the students to the geo information technology applied in geography. It aims to provide them mainly with a comprehensive knowledge of spatial dimension of geographical data, geo-information techniques and technology application in the teaching geographical problems. Geographical Information System (GIS) Remote Sensing (RS) and Global Positioning Systems (GPS) are three fundamental aspects of geo-information technologies which are included in this course. The main objective of the course is to provide fundamental concepts of spatial information and its acquisition, handling, analysis and interpretation techniques. This course offers students having geography major and also as a minor to other subject majors.

1. **General Objectives**

The general objectives of this course are as follows:

* enable students to understand the fundamental concept of geographical data and its spatial dimension,
* familiarize students in technical knowledge and skills to handle geographical data that can be used in the academic/empirical research and application in the future career
* develop capacity of the students to solve the real world problem on the basis of handling geospatial information

**3. Specific Objectives and contents**

|  |  |
| --- | --- |
| **Specific objectives** | **Unit 1.Fundamental concepts of geographical data and their elements**  **(20)** |
| * Discuss the meaning and definition of geographical data * Describe the spatial elements of geographical data * Provide the concept of entities of geographical data * Discuss about the typologies and hierarchies of the geographical data * Provide the concept of site, situation and association of geographical data | * 1. Meaning and definition of geographical data   2. Typologies of geographical data (spatial, attribute, formal, functional, continuous, discrete)   3. Sources of geographical data (map, satellite imageries, panoramic photographs, aerial photographs, GPS, Total Station/Digital Theodolite, open source digital data)   4. Spatial elements of geographical data (dimensionality, continuity, proximity and separation)   5. Entities of geographical data (objects, areas, phenomena, records, by-laws)   6. Hierarchies of geographical data (global, regional, local)   7. Properties of geographical data (core, periphery, boundary)   8. Site, situation and association of geographical data (global, local, separate, continuum, close, island) |
| * Discuss the sources of geographical data * Describe map and maps typology * Provide the knowledge about various forms of hardcopy maps * Discuss on imageries, types and their sources * Introduce the global positioning system (GPS) * Provide knowledge on open source digital data * Introduce the attribute data and their sources | **Unit 2. Sources of Geographical Data (15)** |
| * 1. Sources of geographical (spatial) data      1. Map and maps typology * analog map (large and small scale map) * digital map * general map * thematic map   + 1. Forms of hardcopy (analog) maps * Globe * Atlas * Wall map * Toposheet * Imageries * Choropleth maps * Isopleth * Photographs (Panoramic, Aerial, Digital)   + 1. Imageries * Satellite imageries * Typology of satellite imageries * Panchromatic * Multispectral   + 1. Global Positioning System (GPS) * Handheld GPS * Differential GPS   + 1. Open sources digital data * Google earth imageries * Other online data, maps and imageries   1. Sources of geographical (attribute) data      1. Secondary (desktop review)      2. Primary (field survey) |
| * Introduce the elements of maps * Provide the cartographic information and conventional signs of a map * Introduce the discrete and continuous geographical objects/features * Provide the knowledge on geographical data layers | **Unit 3. Concept of Cartographic Elements, Map Reading and Data Layer (15)** |
| * 1. Elements of map * Title * Scale (length and area measurement) * legend * north * grid (graticule or latitude and longitude- Degree Minute Second (DMS)/projection) * map body * text note   1. Cartographic information * Symbology * Point symbols * Color and color graduation * Shading (hatchures) * Line, line thickness and symbols * Text font, size, alignments   1. Conventional signs   2. Types of geographical objects/features * Point * Line * Polygon/Area/patch   1. Types of continuous data * Grid/ cell/ pixel * Digital number (DN) representation   1. Understating geographical data layers   Point feature (house, school, temples, spot height, springs, ponds etc)  Line feature (contours, river, road, telephone line, electricity line etc)  Area (Land use/cover, lake, large rivers) |
| * Highlight the geographical matters based on location of space * Discuss the location and spatial questions * Provide the concept of spatial organization of geographical data * Discuss on spatial structure and process of geographical data * Focus the geographical matter with relevant stories of object location, flow and use | **Unit 4. Geography matters (5)** |
| * 1. The spatial site and association of geographical data * Relative space * Absolute space   1. Location and spatial questions * Location (what ?) * Conditions, (where ?) * Trends (when?) * Patterns (how?) * Models (why?)   1. Concept of spatial organizations of geographical data (school, temples, village boundary, nation boundary, road, river, elevation zones etc.)   2. Spatial structure and process (different level of school location, land use and cover distribution, distribution of house and households, caste/ethnic groups, economic class)   3. Stories of geographical chain |
| * Introduce Geographical Information System (GIS) and its software environment * Provide knowledge on data types, sources and structure | **Unit 5. Geographic Information System (GIS) as a language to understand geographical objects, area and phenomenon (10)** |
| * 1. Definition of GIS   2. Components of GIS   3. Types of GIS Data and their sources   4. Types of GIS data models/structure (vector, raster, table, by-laws) |
| * Provide the GIS software (ArcGIS/QGIS) handling techniques for data entry/input, management/manipulation * Introduce geo-processing steps in computer based GIS software * Deliver skills of map design, and printing | **Unit 6. Handling GIS data (practical session with theoretical concept)**  **(60)** |
| * 1. Concept of data entry and their procedures      1. screen digitization      2. run-length coding      3. quad tree      4. chain code      5. attribute table construction   2. Concept of data management and manipulation (map projection and transformation) * Concept of datum - World Geodetic System (WGS), and Nepal Nagarkot. * Defining datum * Concept of map projection – Universal Transverse Mercator (UTM) system. * Projection and Transformation of map   1. Concept of geo-processing and spatial analysis      + Selection,      + Clip,      + Dissolve      + Proximity      + Overlay   2. Concept of map design and printing |
| * Introduce remote sensing (RS) and its imaging system * Provide the concept of platform and sensor sensing system * Give the knowledge of scale in remote sensing data | **Unit 7. Fundamentals of Remote Sensing (10)** |
| * 1. The meaning, nature and types   2. Concept of panoramic photographs, aerial photographs , and satellite imageries   3. Concept of platform and sensor sensing system   4. Concept of scale in remote sensing data |
| * Provide the concept of object identification through the visual interpretation of aerial photographs * Introduce the multispectral satellite imageries * Deliver skills of interpretation of satellite imageries * Provide the skill of map overlay of two deferent years | **Unit 8. Visual Interpretation of remote sensing data (Practical session with theoretical concept) (50)** |
| * 1. Concept of object identification in the aerial photographs * Aerial photo interpretation by visually * Preparation of a land use map   1. Concept of multiband satellite imageries * Interpretation of multispectral imageries visually * Preparation of a land use map   1. Overlay of land use map of two successive years by using software/tracing paper map |
| * Discuss on the concept of GPS and its functionality * Provide the skill of what where mapping using GPS * Collect location-based school data * Provide skill on handling GIS software and school data sheet and linking of both * Provide skill of report preparation, printing and presentation | **Unit 9. Spatial Learning for School Mapping (practical session) (40)** |
| * 1. Concept of Global Positioning System and its functionality   2. What where mapping by using GPS   3. Location based school data preparation   4. School data handling by using GIS software and linking location and flash report   5. Map design by using reference data of a project area   6. Preparation a report of school mapping using map and flash report data   7. Report printing and presentation |

*Note: The figures in the parentheses indicate the approximate periods for the respective units.*

**4. Instructional Techniques**

Two types of instructional techniques have been recommended. The first group comprises common techniques applicable to most of the unit. The second group includes instructional techniques to be applied to teach specific unit.

**4.1 General Instructional Techniques**

* Lecture, discussion, question-answer, student interaction, paper preparation and presentation by the students in selected topics. 50 % of the total time allotted is on the theoretical concept, assumptions and principle available in the textbooks and reference books given in the end section of this syllabus. The list of the text and reference materials can also be collected by the instructor in accordance with the need and contemporary development of the discipline from www and other reference.
* Practical sections - have been separated into three different sections i.e. GIS, Image interpretation and GPS allocated 50 % time in total.
* Practical section of GIS is basically concentrated in handling/operating in computer based GIS software. Use of GIS software (preferably ESRI products, ArcGIS, latest release in the market because the software is in common use in the country) is recommended. Besides this, open source software (preferably the Quantum GIS -QGIS) can be used to give the concept to the students. The selection can be made by the subject instructor and availability of resource and skill.
* For the understanding of the concept of image processing, visual interpretation of aerial photographs and Multispectral Imageries of the multi band sensors can be used. Being introductory level of understanding tracing paper can use. For the basic ideas of Digital Image Processing (DIP) ArcGIS image classification command needs to be used.
* For the GPS, a hand-held GPS device has to be used for the acquisition of geographical standpoint of the object location from the real world.
* Group work on geographical issues published in the journals and magazines and present reports in class room.
* Being a practical nature of the syllabus content teaching will follow by the hands-on exercise using visual mapping techniques as well as computer-based software techniques
* Preparation of charts and diagrams associated with various types of school data

**4.1 Specific Instructional Techniques**

|  |  |
| --- | --- |
| **Unit** | **Instruction methods** |
| I | * Description can be made with the help of maps, photograph and charts and make clear the concept of geographical data and their elements. * A set of different types of maps (i.e. physical, political, regional with various scales can be used as the teaching materials. |
| II | * Displaying of map and map typology can be made by using different types of maps * Wall map, globe, atlas, satellite imageries, photographs, google earth data and other open source data need the teaching materials to make clear the concept of sources of geographical data |
| III | * Displaying topo-sheet maps prepared by the Department of Survey Government of Nepal and discussion on cartographic elements of a map * Presentation of geographical data layers by giving the examples. |
| IV | * Discussion on geographical matters based on the examples of geographical objects, their site, situation and association. Examples can be cited from the hierarchies of different schools, their location and the number of students in each school. Some students coming from faraway and some are from the closer distance. Thought provoking discussion can be conducted on the location and spatial geographical matters. * Real time-based stories telling and coinciding geographical chain by giving examples like (tea plantation and a cup of tea - production plot/garden, weather/climate, soils, labor, fertilizer, processing, packing, transportation, marketing, cooking, and end user i.e. a cup of tea). |
| V | * Discussion on the concept of spatial thinking, definition of GIS, its functional components, data types and data model. Defferent text books about GIS can be used for the discussion. |
| VI | * This unit is about the hands-on exercise based on GIS software. ArcGIS (ESRI) professional software or Quantum GIS (Open source GIS) can be used to cover the hands-on GIS practice. Digital data for the exercise can be used from the nearby area of the location of institution. * Hands-on exercise will produce the final maps and report which will be the deliverables of the students for their evaluation. |
| VII | * Discussion about the remote sensing concept and theories will be based on the textbook. * Examples of the imageries can be visualized from the google earth imageries and also from the satellite data archives, free available in the website. |
| VIII | * Hands-on exercise about the remote sensing data interpretation will be carried out from the visual interpretation or digital interpretation of imageries by using Lwis 0r Edras Imagine softwares. * Aerial photographs, printed copy of color photographs, black and white photographs, panchromatic satellite imageries and multispectral imageries, tracing paper, pencil and color pencils can be used to make the visual interpretation of the geographical objects acquired by the sensor sensing system i.e. Camera, sensors), * Screen digitization in the PC can be used. * Deliverables of the hands-on exercise are interpreted map and its report in hardcopy form. |
| IX | * Hands-on exercise on integrating the location based school data (GPS) with the thematic tables prepared in the form of flash report. * School mapping exercise with real project basis. * Preparing a report, printing and presentation |

**5. Evaluation**

The students will be evaluated on the basis of the written test, practical test, classroom participation, presentation of reports and other classroom activities. But the score obtained will be used only for the feedback purposes. The performance of the students will be evaluated by the annual examination to be held by the Office of the Controller of Examinations.

**5.1 External examination** (theory)

The course contains both theory and practical. The final examination covers 50 percent theory (written examination) and 50 percent practical (Laboratory work). Both modes of examination need to pass independently, but percentage will be counted together. The types and number of questions to be included in the final paper are as follows:

|  |  |  |
| --- | --- | --- |
| 1. | Objective type question (Multiple choice 10x1 point) | 10 points |
| 2. | Short answer subjective questions (6 questions with 2 or x 5 points) | 30 points |
| 3. | Long answer subjective questions (1 questions with 1 or x 10 points) | 10 points |
| ***Total*** |  | ***50 points*** |

**5.2 Evaluation Scheme for external examination** (practical) - 50 points

1. Examination (Written, Viva-voce, Observation) 15 + 15 + 5 = 35
2. Construction of teaching learning resources using computer skills / models and charts construction/ collection of materials/ and Record book 15

***Students need to acquire minimum pass mark in each component (5.1 and 5.2) individually for the completion of the course.***

**6. Recommended Books and References**

**Recommended Books**

Books:

>]i7, a;Gt / cGo -;g\ @))%\_= *Ef}fuf]lns ;"rgf k|0ffnLM Ps kl/ro– Ef}fuf]lns ;"rgf k|0ffnLsf] kl/rofTds cjwf/0ff tyf Jojxfl/s cEof;* (GIS for Beginners) = nlntk'/M cGt/f{li6«o PsLs[t kj{tLo ljsf; s]Gb (ICIMOD), ICIMOD, 2001. GIS for Beginners, Kathmandu: ICIMOD. (UNIT I, IV, V, VII, VIII, IX)

Burrough, P. A. (1986). Principles of Geographical Information System of Land Resources Assessment. UK: Oxford University Press. (Unit VI)

# Lillisand, T. Keifer, R. W. and Chipman, J. (2015). Remote Sensing and Image Interpretation. New York: John Willy E-Sons, Ink ( 7th edition). (Unit VII, VIII)

National Research Council, (2006), Learning to Think Spatially: GIS as a Support System in the K-12 Curriculum, (Committee on the Support for the Thinking Spatially: The Incorporation of Geographic Information Science Across the K-12 Curriculum, Committee on Geography). National Academies Press online (Unit I)

Kff}8]n, s[i0f k|;fb, -@)^\*\_*:yfgLo ljsf;df ef}uf]lns ;"rgf k|0ffnL*(Geographic Information Systems in Local Development) Kathmandu: Nepal GIS Society ((Unit, I, II, III, IV, V, VI)

Singh R. L. (1979). Elements of Practical Geography. New Delhi: Kalyani Publishers (Unit I, II, III)

**References**

* Aronoff, S. (1989). Geographical Information System: A Management Perspective. Ottawa: WDL Publications.
* Avery, Thomas Eugene, Berlin, Graydon Lennis, 1985. Fundamentals of Remote Sensing and Airphoto Interpretation. NewYork, Macmillan Publishing Company
* Chrisman, N., 1997. Exploring Geographic Information Systems. New York: John Wiley and Sons, Inc
* Deby, R. A. (ed.) (2000). Principles of Geographical Information System. Enscheda: The International Institute of Aerospace Survey and Earth Sciences.
* DeMers, M. N., 1997. Fundamentals of Geographic Information Systems. New York: John Wiley and Sons, Inc
* Donna J. Peuquet and Marble F. Duane (eds.) (1990). Introductory Reading in GISs. New York. Taylor and Francis.
* ERDAS, (2003). Leica Geosystem, GIS and Mapping LCC. ERDAS Field GuideTM. Atlanta.
* ESRI, (2005). ArcGIS® 9.x, Getting Started With ArcGIS®. Redland: ESRI
* GIS Nepal bulletin of Nepal GIS Society, Jawalakhel Lalitpur, (Various Issues)
* JARS. (1996). Remote Sensing Notes. Japan Association of Remote Sensing.
* Ormsby, T. and Others (2004). Getting to Know ArcGIS Destop. New York : ESRI Press USA.
* Poudel, Krishna P., (2010) Geographic Information Science and Technology: Building Concepts in Nepalese Perspectives. Kathmandu: Nepal GIS Society.