UNIVERSITY OF THE PUNJAB

NOTIFICATION

It is hereby notified that the Syndicate at its meeting held on 27-07-2023 has approved the recommendations of the Academic Council made at its meeting dated 24-05-2023 regarding approval of the Revised Syllabi and Courses of Reading for M.Phil Geomatics under Semester System at the College of Earth and Environmental Sciences w.e.f. the Academic Session, 2021 and onward.

The Revised Syllabi and Courses of Reading for M.Phil Geomatics under Semester System is attached herewith as Annexure 'A'.

Sd/-
REGISTRAR

Admin. Block,
Quaid-i-Azam Campus,
Lahore.

No. D/ 7663 /Acad. **Dated: 11 – 10 /2023.**

Copy of the above is forwarded to the following for information and further necessary action: -

1. Dean, Faculty of Geo Sciences.
2. Principal, College of Earth and Environmental Sciences.
3. Controller of Examinations
4. Director, IT for placement at the website
5. Admin Officer (Statutes)
6. Secretary to the Vice-Chancellor.
7. PS to the Registrar.
8. Assistant Syllabus.

Assistant Registrar (Academic)
for Registrar

COLLEGE OF EARTH AND ENVIRONMENTAL SCIENCES
UNIVERSITY OF THE PUNJAB, LAHORE

Approval of Revised Courses & Syllabi for M.Phil. in Geomatics

The curriculum and courses for M.Phil. in Geomatics were approved from various statutory bodies of the University of the Punjab in the year 2011. Presently College of Earth and Environmental Sciences intends to revise the courses & syllabi keeping in view the advancements in the field of Geomatics. Most of the courses have been designed according the latest trends of the subject that can provide an interest to the students and later help them for competing in the job market.

Program Title: **02 Year M. Phil. Degree in Geomatics**

Department: **College of Earth and Environmental Sciences**

Faculty: **Geo-Sciences**

1. Department Mission

Our mission is to address the issues regarding environmental sciences using modern Geospatial techniques. The basic goal is to develop new technologies related to Geomatics and Environmental Sciences. As Geomatics, Environmental sciences, Occupational health and safety Hydrology and Tourism & Hotel Management are professional degrees, the College seeks to provide education and training in the multiple dimensions of contemporary Environmental issues toward developing solution for a more sustainable future.

2. Introduction

Keeping in view the importance and the growing demands for training manpower in the emerging discipline, the College of Earth and Environmental Sciences has been established in the University of the Punjab in 2005. The new building of the College was completed in November 2008, featuring spacious rooms, moderately equipped laboratories, a library and large grounds.

College of Earth and Environmental Sciences provides a learning educational environment to students with the opportunities to acquire knowledge and skill to build a successful career and become an integral part of the community. Students will study different subjects related to

Geomatics i.e., cartography, advanced spatial analysis, applications of geomatics in environmental sciences, geospatial applications for climate change, environmental management, air pollution modelling, population dynamics, ecosystems, urbanization etc. Provision of high-quality education is the integral part of the college to produce graduate s of international standard. Furthermore, ethical and moral standards developing leadership capabilities and professionalism are the main goals of the college.

3. Program Introduction

As M.Phil. Geomatics is a professional degree, the degree is expected to provide education and training in the multiple dimensions of contemporary geospatial sciences toward developing solution for a more sustainable future. Our overriding objective is to provide the next generation of national and international leaders with the knowledge, skills and experience needed to advance policy and decision making, formulate effective solution to enhance Geomatics goals, and meet the challenges and opportunities of Geomatics applications in various fields, in way that provide broad, sustainable, resilient and equitable advances for human well-being in a complex and interdependent world,

4. Program Objectives

1. To establish the foundations and concepts of modern Geomatics techniques and their applications in various physical and social fields.
2. To equip students with professional skills to be demonstrated in teaching, research and Geospatial industry.
3. Graduates will be capable to cultivate and present client-driven Geomatics solutions and demands.
4. To train the students in problem solving skills that employ their understanding of theories, ideas, and concepts as well as their mastery of geospatial information science software and hardware.

In order for our program to remain preeminent our key goals are:

5. Market Need / Rationale of the Program

As Geomatics degree equips you with skills and knowledge for a variety of jobs in many areas including forest management, urban development, irrigation monitoring & management, agriculture resource estimation, flood monitoring & management, DAM sites selection, mineral resource assessment etc.

Moreover, urbanization, climate change, habitat loss assessment, water and air pollution modelling, species distribution assessment, water resources monitoring & management, and the availability of data are among the many major dilemmas our society faces each day. These complex problems cause environmental limits against economic development, diverse cultures, ethics, values, and social stability, and therefore require an understanding of science, policy, society, history, and economics in order to address problems realistically and effectively. Geomaticians must use integrated and holistic approaches to understand and find sustainable solutions to these problems. Graduates of the Geomatics degree are well prepared for a variety of sustainable careers including consulting, research, policy, and outreach, or further graduate work in a doctoral program.

Potential employer:

- Space and Upper Atmosphere Research Commission (SUPARCO)
- National Engineering Services Pakistan (NESPAK)
- Ministry of Climate Change
- Pakistan Army, Air force and Navy
- Worldwide Fund for Nature (WWF)
- The Urban Unit
- Planning & Development Department of Provinces
- Mines & Minerals Department
- Agriculture Department
- Irrigation Department
- Forest Conservation Department
- MM Pakistan
- Transport Department
- Lahore Development Authority
- Water & Sanitation Authority (WASA)
- Lahore Waste Management Company (LWMC)

- Survey of Pakistan (SoP)
- PTCL, WARID, TELENOR and other Telecom sectors
- WAPDA

6. Admission Eligibility Criteria

- B.S. Applied Geology, M.Sc. Applied Geology, M.Sc. Seismology, B.S. Remote Sensing and GIS, B.S. Computer Science, M.Sc. Computer Science B.Sc. Engg. (Civil, Environmental and Geological), B.S. Environmental Science, M.Sc. Environmental Sciences, B.S. Geography, M.Sc. Geography, B.S. Space Science, M.Sc. Space Science, M.Sc. Soil Science or equivalent to all these.

- No third division in the whole career.

- CGPA on a scale other than 4.00 will be converted accordingly.

7. Duration of the Program

Total duration of the program will be 02 year and number of courses taught in M. Phil. degree in Geomatics will be 30 credit hours total with 04 semesters varied by 6-12 credit hrs in each semester. There shall be following 3 categories of courses offered to the students according to HEC standardized format/Scheme of studies.

8. Categorization of Courses as per HEC Recommendation and Difference

Semester	Courses	Category (Credit Hours)					
		Core Courses	**Basic Courses**	**Major Electives**	**Minor Electives**	**Any Other/Thesis**	**Semester Load**
1st	8	3		9	-		12
2nd	7	3		9	-		12
3rd and 4th						6	6
HEC Guidelines		18		6	6		30
Difference HEC & PU							

9. Scheme of Studies / Semester –Wise Workload

FIRST SEMESTER*:* **(*12 Credit Hours)***

Sr. No.	Course Code	Course Title	Course type	Pre-requisite	Credit Hours
		CORE-COURSES ***(03 credit hours core-courses will be offered in 1st semester)***			
1.	GMT-501	INTEGRATION OF REMOTE SENSING, GIS, GPS and SURVEYING (CORE-COURSE)	Core-Course	As per the eligibility requirement of the program	02+01
		ELECTIVE COURSES ***(02 Elective courses of 06 credit hours will be offered in 1st semester)***			
2.	GMT-502	INTRODUCTION TO AERIAL PHOTOGRAPHY AND CARTOGRAPHY	Elective Course	As per the eligibility requirement of the program	02+01
3.	GMT-503	GEODESY & SURVEYING	Elective Course	As per the eligibility requirement of the program	02+01
4.	GMT-504	COMPUTER CARTOGRAPHY: PRINCIPLES AND DESIGN	Elective Course	As per the eligibility requirement of the program	02+01
5.	GMT-505	AIRBORNE SENSORS AND INSTRUMENTATION	Elective Course	As per the eligibility requirement of the program	02+01
6.	GMT-506	GIS PROBLEM SOLVING AND SPATIAL MODELING	Elective Course	As per the eligibility requirement of the program	02+01
7.	GMT-507	REMOTE SENSING OF LANDSCAPE DYNAMICS	Elective Course	As per the eligibility requirement of the program	02+01
8.	GMT-508	WEB GIS DEVELOPMENT	Elective Course	As per the eligibility requirement of the program	02+01

SECOND SEMESTER **(*12 Credit Hours)***

Sr. No.	Course Code	Course Title	Course type	Pre-requisite	Credit Hours
		CORE-COURSES ***(03 credit hours core-courses will be offered in 2nd Semester)***			
1.	GMT-509	RESEARCH METHODOLOGY IN GEOMATICS (CORE-COURSE)	Core-Course	As per the eligibility requirement of the program	03
		ELECTIVE COURSES (02 Elective courses of 06 credit hours will be offered in 2nd Semester)			
2.	GMT-510	GEOMATICS: BIG SPATIAL DATA ANALYSIS	Elective Course	As per the eligibility requirement of the program	02+01
3.	GMT-511	IMAGE INTERPRETATION AND PHOTOGRAMMETRY	Elective Course	As per the eligibility requirement of the program	02+01
4.	GMT-512	ADVANCED TOPICS IN GEOINFORMATICS	Elective Course	As per the eligibility requirement of the program	02+01
5.	GMT-513	ENVIRONMENTAL MODELLING	Elective Course	As per the eligibility requirement of the program	02+01
6.	GMT-514	REMOTE SENSING AND GIS IN GEO SCIENCES	Elective Course	As per the eligibility requirement of the program	02+01
7.	GMT-515	DATABASES AND ADVANCED WEB GIS	Elective Course	As per the eligibility requirement of the program	02+01

3rd & 4th Semester (Thesis): **(*06 Credit Hours)***

Sr. No.	Course Code	Course Title	Credit Hours
THRID & FOURTH SEMESTER			
1.	GMT- 601	Thesis (Based on Original Research)	06

10. Award of Degree

02 Year M. Phil degree will be awarded on the successful completion of courses & syllabi and research thesis with minimum required CGPA 2.5/4.00.

11. NOC from Professional Councils (if applicable)

Not Applicable

12. Faculty Strength

Degree	Name of Faculty Member	Area / Specialization	Total
PhD	1. Prof. Dr. Sajid Rashid Ahmad	Earth and Environmental Sciences, Climate Change, Remote Sensing & GIS	11
	2. Prof. Dr. Irfan Ahmad Shaikh	Industrial wastewater treatment	
	3. Prof. Dr. Nadia Jamil	Analytical / Environmental Chemistry	
	4. Dr. Abdul Qadir	Environmental Biology	
	5. Dr. Yumna Sadef	Environmental Sciences	
	6. Dr. Muzaffar Majid Ch.	Environmental Geology	
	7. Dr. Azhar Ali	Water and Wastewater Treatment, Health & Safety	
	8. Dr. Sana Ashraf	Biotechnology Bioremediation and Env. Microbiology	
	9. Dr. Naeem Akhtar Abbasi	Environmental Toxicology	
	10. Dr. Muhammad Bilal Shakoor	Water and Wastewater Treatment and Quality Assessment	
	11. Dr. Mehwish Mumtaz	Environmental Engineering / Toxicology	
MS / M.Phil.	12. Ms. Anum Tariq	Urban Ecology, Environmental Sciences	01

13. Present Student Teacher Ration in the Department

12:19 1:1

First Semester

GMT-501 **Integration 0f Remote Sensing, GIS, GPS and Surveying (THEORY) (02 Credit Hrs)**
PRE-REQUISITE: **M.Sc. /BS in allied disciplines**

Learning Outcomes

In this course students will get knowledge about;

- GIS editing functions, data sources
- Different data processing techniques
- Spatial models being used for environmental studies
- Advanced surveying techniques

Contents

This course provides an overview of GIS applications, the fundamentals of GIS map projections, measurement levels for geographical data, data sources, data processing, data models, geographic data structures, and GIS editing functions and analysis; spatial data characteristics, raster and vector data structures, and digital map creation, definition and classification of surveying, principals, basic measurements, basic instruments applications, various spatial interpolation methods and surveying applications.

Theory

Unit-1 Map Projections and Data sources

1.1 Fundamentals of GIS & Remote Sensing
1.2 Map projections
1.3 Geographic Datasets
1.4 Primary and Secondary Data sources

Unit-2 Data collection and Processing

2.1 Freely Available Spatial Data Platforms
2.2 Online sources Data Acquisition
2.3 Data processing and rectification

Unit-3 Integration of Spatial Datasets

3.1 Spatial and non-spatial data linkage
3.2 Data Transformations
3.3 Spatial databases

Unit-4 Surveying Techniques

4.1 Introduction to different surveying Equipment
4.2 Surveying techniques
4.3 Survey Data collection methods
4.4 Processing of Survey Data

Unit-5 Data Models

5.1 Raster and Vector datasets
5.2 Vector and Raster Data surfaces
5.3 Interpolation Methods

Unit-6 Digital Cartography

6.1 History of Cerography
6.2 Advancement in Cartography
6.3 Map Types & Map Indexing
6.4 Map Indexing

TEACHING-LEARNING STRATEGIES

- Lecture-based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is a continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments, and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes, etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Camacho-Lara, S., Madry, S., & Pelton, J. N. (2017). United States Meteorological Satellite Program. *Handbook of Satellite Applications, 2nd edn. Springer Press, Basel*, 1185.
2. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). *Remote sensing and image interpretation*. John Wiley & Sons.
3. Ramasamy, S. (Ed.). (2006). *Geomatics in Tsunami*. New India Publishing.
4. Jensen, J. R. (2005). *Introductory digital image processinga remote sensing perspective* (No. 621.3678 J4/2005).
5. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographic information systems and science*. John Wiley & Sons.
6. Coburn C Timothy and Yarus M. Jeffrey., (2000). *Geographic Information Systems in Petroleum Exploration and Development* (AAPG Computer Applications in Geology, No. 4), American Association of Petroleum Geologists.

Assorted Research Papers / Further Reading: As suggested by the instructor.

GMT-501 Integration 0f Remote Sensing, GIS, GPS and Surveying (Practical) (01 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Course Learning Outcomes

Students will get practical expertise on;

- GIS editing functions, data sources
- Different data processing techniques
- Spatial models being used for environmental studies
- Surveying equipment i.e., GPS, DGPS and Total station etc.

Contents

This course provides practical knowledge about GIS map projections, measurement levels for geographical data, data sources, data processing, data models, geographic data structures, and GIS editing functions and analysis; spatial data characteristics, raster and vector data structures, and digital map creation, surveying, principals, basic measurements, basic instruments applications, various spatial interpolation methods and surveying applications.

Practical

Unit-1 Map Projections and Data sources

1.1 USGS earth explorer
1.2 FEWS datasets
1.3 Spatial DATA Catalo

Unit-2 Data collection and Processing

2.1 Digital Elevation Models (ASTER, SRTM, ALOS)
2.2 Landsat and Sentinel imagery
2.3 Data processing and rectification

Unit-3 Data Models

3.1 IDW, Kriging, Spline techniques
3.2 Triangulated irregular network, Thiessen polygon
3.3 Grid Structures

Unit-4 Digital Cartography

4.1 Map annotation and Indexing
4.2 Map basic and advance elements
4.3 Large and small scales
4.4 Map customization

TEACHING-LEARNING STRATEGIES

- Lecture-based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Pelton, J. N., Madry, S., & Camacho-Lara, S. (Eds.). (2017). *Handbook of satellite applications*. New York: Springer.
2. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). *Remote sensing and image interpretation*. John Wiley & Sons.
3. Ramasamy, S. (Ed.). (2006). *Geomatics in Tsunami*. New India Publishing.
4. Jensen, J. R. (2005). *Introductory digital image processinga remote sensing perspective* (No. 621.3678 J4/2005).
5. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographic information systems and science*. John Wiley & Sons.
6. Coburn C Timothy and Yarus M. Jeffrey., (2000). Geographic Information Systems in Petroleum Exploration and Development (AAPG Computer Applications in Geology, No. 4), American Association of Petroleum Geologists.

Assorted Research Papers / Further Reading: As suggested by the instructor.

GMT-502 Introduction to Aerial Photography and Cartography (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Course Learning Outcomes

Students will learn;

- Data collection mechanism of aerial photographs
- Different digital cartography techniques
- Advanced approaches (i.e., aerial photographs) of spatial data collection and map designing.

Contents

This course provides the knowledge about the aerial photography and different cartography techniques.

Theory

Unit-1 Cartography theory and design

1.1 Basic concepts involved in cartographic theory and design
1.2 Basic cartography principles
1.3 Data transformation in cartography

Unit-2 Map Projections

2.1 Geographic coordinate system basics
2.2 Basic map projection types
2.3 UTM grid systems

Unit-3 Spatial Interpolations and Mapping

3.1 Methods in Spatial Interpolation
3.2 Thematic mapping
3.3 Topographic maps

Unit-4 Fundamentals of Aerial Photography

4.1 Introduction to aerial photography
4.2 Spectral properties of remotely sensed data
4.3 Basics aerial imagery properties

Unit-5 Photogrammetry

5.1 Basics of photogrammetry
5.2 Active and passive sensor data properties
5.3 Processing of aerial photos

Unit-6 Photo-Interpretation

6.1 Basics of visual photo-interpretation
6.2 Extracting spectral signatures from aerial photos
6.3 Techniques in photo-interpretation

TEACHING-LEARNING STRATEGIES

- Lecture-based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework

- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Valavanis, K. P., & Vachtsevanos, G. J. (Eds.). (2015). *Handbook of unmanned aerial vehicles* (Vol. 2077). Dordrecht: Springer Netherlands.
2. Paine, D. P., & Kiser, J. D. (2012). *Aerial photography and image interpretation*. John Wiley & Sons.
3. Aber, J. S., Marzolff, I., & Ries, J. (2010). *Small-format aerial photography: Principles, techniques and geoscience applications*. Elsevier.
4. Avtar, R., & Watanabe, T. (Eds.). (2020). *Unmanned aerial vehicle: Applications in agriculture and environment*. Springer International Publishing.
5. Morgan, D., & Falkner, E. (2001). *Aerial mapping: methods and applications*. CRC press.

Further Reading: As suggested by the Instructor.

GMT-502 Introduction to Aerial Photography and Cartography (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Course Learning Outcomes

Students will be able to get practical knowledge on;

- Data collection mechanism of aerial photographs
- Different techniques of cartography
- Advanced approaches (i.e., aerial photographs) of spatial data collection and map designing.

Contents

This course provides the knowledge about the aerial photography and of cartography techniques.

Practical

Unit-1 Cartography theory and design

1.1 Basic Layout design
1.2 Using templates in cartographic software
1.3 Importing cartographic data

Unit-2 Map Projections

2.1 Projecting raster and vector data
2.2 Reprojection of cartographic datasets
2.3 Modifying projections in cartography software

Unit-3 Spatial Interpolations and Mapping

1.1 IDW, Kriging, Spline techniques
1.2 Generating contours and applying hill-shades
1.3 Choropleth and chorochromatic mapping in cartography software

Unit-4 Fundamentals of Aerial Photography

4.1 Exploring aerial imagery in software
4.2 Spectral enhancement of aerial photos
4.3 Pre-processing of aerial photos

Unit-5 Photogrammetry

5.1 Filtering an aerial photo
5.2 Noise removing from aerial photo
5.3 Extracting spectral information from aerial photos

Unit-6 Photo-Interpretation

6.1 Extracting spectral signatures from aerial photo
6.2 Visual interpretation of aerial photos
6.3 Classifying an aerial photo

TEACHING-LEARNING STRATEGIES

- Lecture-based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,

- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Avtar, R., & Watanabe, T. (Eds.). (2020). *Unmanned aerial vehicle: Applications in agriculture and environment*. Springer International Publishing.
2. Valavanis, K. P., & Vachtsevanos, G. J. (Eds.). (2015). *Handbook of unmanned aerial vehicles* (Vol. 2077). Dordrecht: Springer Netherlands.
3. Paine, D. P., & Kiser, J. D. (2012). *Aerial photography and image interpretation*. John Wiley & Sons.
4. Aber, J. S., Marzolff, I., & Ries, J. (2010). *Small-format aerial photography: Principles, techniques and geoscience applications*. Elsevier.
5. Morgan, D., & Falkner, E. (2001). *Aerial mapping: methods and applications*. CRC press.

GMT-503 GEODESY AND SURVEYING (THEORY) (02 Credit Hrs)
Pre-requisite: M.Sc./ BS in allied disciplines

Learning Outcomes

It is expected that after the completion of this course students have knowledge about;

- Different survey equipment
- Various surveying techniques
- Processing, rectification and manipulation of data

Contents

Introduction to Geomatics, Introduction of Geodesy, Coordinate and Projection Systems, Geodetic and plan survey, Levelling (Theory, methods and equipment, field procedures and calculations), Distance Measurements (Methods, EDM and total station), Azimuths, Angles and Bearings, Establishment of Survey Control Network (horizontal control, vertical control, Traverse introduction, types, Theory of errors in measurements (Types of errors, precision and accuracy, error propagation), Topographic survey (methods, applications), Survey data Processing, various spatial interpolation methods.

Introduction to Geodesy
1.1 Foundations of geodesy
1.2 Coordinate systems
1.3 Projections

Unit-2 Geodetic surveys

2.1 Surveys theory
2.2 Survey methods
2.3 Survey equipment

Unit-3 Survey Data processing

3.1 Field data procedures
3.2 Data calculations
3.3 Distance and angle measurements

Unit-4 Establishment of Survey Control Network

4.1 Horizontal and vertical control
4.2 Traverse introduction

Unit-5 Topographic surveys

5.1 Types of Errors
5.2 Precision and Accuracy
5.3 Error Propagation

Unit-6 Environmental Models

6.1 Methods and application
6.2 Survey data Processing
6.3 Various spatial interpolation methods

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behaviors, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Konecny, G. (2019). *Geoinformation: remote sensing, photogrammetry and geographical information systems*. cRc Press.
2. Solimini, D. (2016). *Understanding Earth Observation*. Springer
3. Ogundare, J. O. (2015). *Precision surveying: the principles and geomatics practice*. John Wiley & Sons.
4. Taniguchi, E., & Thompson, R. G. (Eds.). (2014). *City logistics: Mapping the future*. CRC Press.
5. Richards, J. A. (2009). *Remote sensing with imaging radar* (Vol. 1). Berlin: Springer.
6. Ghilani, C. D., Wolf, P. R., & Gidudu, A. (2008). *Elementary surveying: An introduction to geomatics*. Upper Saddle River: Pearson Prentice Hall.

GMT-503 **GEODESY AND SURVEYING (PRACTICAL) (01 Credit Hr)**

Pre-requisite: M.Sc./ BS in allied disciplines

Learning Outcomes

It is expected that after the completion of this course the students will be able to;

- Use and handle the different survey equipment
- Data collection by using different surveying techniques
- Process and rectify collected data

Contents

Introduction to Geomatics, Introduction of Geodesy, Coordinate and Projection Systems, Geodetic and plan survey, Levelling (Theory, methods and equipment, field procedures and calculations), Distance Measurements (Methods, EDM and total station), Azimuths, Angles and Bearings, Establishment of Survey Control Network (horizontal control, vertical control, Traverse introduction, types, Theory of errors in measurements (Types of errors, precision and accuracy, error propagation), Topographic survey (methods, applications), Survey data Processing, various spatial interpolation methods.

Unit-1Formation of Coordinates

1.1 Measurements on Globe
1.2 Geographic and Projected Coordinates

Unit-2 Survey Equipment usage

2.1 Total Station
2.2 GPS & DGPS
2.3 Drone

Unit-3 Measurements

3.1 Benchmarking
3.2 Distance and Angles
3.3 Precise location
3.4 Correction of errors

Unit-4 Drone Data Collection

4.1 Ortho Imagery
4.2 Mosaicing of imagery tiles
4.3 DEM Generation
4.4 Multispectral imagery

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

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3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Konecny, G. (2019). *Geoinformation: remote sensing, photogrammetry and geographical information systems*. cRc Press.
2. Solimini, D. (2016). *Understanding Earth Observation*. Springer
3. Ogundare, J. O. (2015). *Precision surveying: the principles and geomatics practice*. John Wiley & Sons.
4. Taniguchi, E., & Thompson, R. G. (Eds.). (2014). *City logistics: Mapping the future*. CRC Press.
5. Richards, J. A. (2009). *Remote sensing with imaging radar* (Vol. 1). Berlin: Springer.
6. Ghilani, C. D., Wolf, P. R., & Gidudu, A. (2008). *Elementary surveying: An introduction to geomatics*. Upper Saddle River: Pearson Prentice Hall.

GMT-504 COMPUTER CARTOGRAPHY: PRINCIPLES AND DESIGN (THEORY) (02 Credit Hrs)
PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- This course provides the understanding about the advancements in cartography and digital cartography.
- This course also includes the exposure about the digital cartography and its applications.

Contents

Students will get the knowledge about the modern era techniques used in digital cartography.

Unit-1 Cartographic Data

1.1 Compilation of cartographic data
1.2 Displaying cartographic data
1.3 Spatial referencing of cartographic data

Unit-2 Coordinate Systems and Projections

2.1 Introduction to Geographic coordinate system
2.2 Introduction to Map Projections
2.3 Introduction to Projected coordinate system

Unit-3 Quantitative Data

3.1 Managing quantitative data
3.2 Classifying quantitative data
3.3 Mapping quantitative data

Unit-4 Elevation Data Representation

4.1 Introduction to 3D data
4.2 Contour and other terrain analysis
4.3 Displaying 3D data

Unit-5 Cartographic Data Compilation

5.1 Sources of cartographic data
5.2 Accessing and downloading data from various sources
5.3 Compiling and ordering retrieved data

Unit-6 Map Production

6.1 Principles of cartographic design
6.2 Production of effective maps
6.3 Exporting principles of maps

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behaviour,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
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3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Field, K., (2018). Cartography, ISBN: 9781589485020, ESRI Press Books.
2. Field, K., (2018), The Definitive Guide to Making Maps, Esri Press. ISBN: 1589484398, 9781589484399.
3. Price, M., (2018). Mastering ArcGIS, 8th Ed. McGraw-Hill Education.
4. Foody, G., See, L., Fritz, S., Mooney, P., Olteanu-Raimond, A.,Fonte, C, C.Antoniou, Y., (2017), Mapping and the Citizen Sensor, Ubiquity press, ISBN 978-1-911529-16-3.
5. Wilson, M, W., (2017).New Lines: Critical GIS and the Trouble of the Map, University of Minnesota Press, ISBN: 0816698538, 9780816698530.
6. Rankin, W., (2016).After the Map: Cartography, Navigation, and the Transformation of Territory in the Twentieth Century, University of Chicago Press. ISBN: 022633936X, 9780226339368.

GMT-504 COMPUTER CARTOGRAPHY: PRINCIPLES AND DESIGN (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- This course provides the practical expertise on the techniques being used in cartography and digital cartography.
- This course also includes the practical exposure about the digital cartography and its applications.

Contents

Students will get the knowledge about the modern era techniques used in digital cartography.

Unit-1 Cartographic Data

1.1 Cartographic data folder management
1.2 Displaying cartographic data
1.3 Georeferencing of cartographic data for vector and raster

Unit-2 Coordinate Systems and Projections

2.1 Assigning projected and geographic coordinate system
2.2 Editing and modifying projection attributes
2.3 Projecting and reprojecting spatial data

Unit-3 Quantitative Data

3.1 Quantitative data map design principles
3.2 Methods of quantitative data classification
3.3 Handling quantitative data in cartography software

Unit-4 Elevation Data Representation

4.1 Managing 3D data and its attributes
4.2 Methods of extracting topographic information from DEM
4.3 3D map designing

Unit-5 Cartographic Data Compilation

5.1 Advantages of digital cartography over manual approaches
5.2 Downloading cartographic data from different online sources
5.3 Cartographic data conversions

Unit-6 Map Production

6.1 Concept of different map formats
6.2 Page size and other map properties
6.3 Data-driven mapping

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
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- hands-on-activities,
- Short tests, quizzes etc.

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2. Field, K., (2018), The Definitive Guide to Making Maps, Esri Press. ISBN: 1589484398, 9781589484399.
3. Price, M., (2018). Mastering ArcGIS, 8th Ed. McGraw-Hill Education.
4. Foody, G., See, L., Fritz, S., Mooney, P., Olteanu-Raimond, A.,Fonte, C, C.Antoniou, Y., (2017), Mapping and the Citizen Sensor, Ubiquity press, ISBN 978-1-911529-16-3.
5. Wilson, M, W., (2017).New Lines: Critical GIS and the Trouble of the Map, University of Minnesota Press, ISBN: 0816698538, 9780816698530.
6. Rankin, W., (2016).After the Map: Cartography, Navigation, and the Transformation of Territory in the Twentieth Century, University of Chicago Press. ISBN: 022633936X, 9780226339368.

GMT-505 AIRBORNE SENSORS AND INSTRUMENTATION (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- This course provides the understanding about the significance of airborne Remote sensing techniques for spatial data collection.
- Course also includes the knowledge about the data collected by aerial borne platforms and further processing and interpretation techniques will also be covered in this course.

Contents

Students will be familiar about the different airborne sensors working principle, data collection methods, data processing and rectification.

Unit-1 Airborne Remote Sensing

1.1 Introduction to airborne remote sensing
1.2 Theoretical issues associated with airborne remote sensing
1.3 Airborne remote sensing for precision mapping

Unit-2 Remote Sensing Sensors

2.1 Active remote sensing sensors
2.2 Passive remote sensing sensors
2.3 Comparison of active and passive sensors

Unit-3 Working with LiDAR

3.1 Introduction to LiDAR
3.2 Basics of LiDAR data
3.3 Point-cloud data

Unit-4 Working with RADAR

4.1 Introduction to RADAR
4.2 Basics of RADAR data
4.3 Processing RADAR data

Unit-5 Working with SAR

5.1 Introduction to Synthetic Aperture Radar (SAR)
5.2 Basics of SAR data
5.3 Processing SAR data

Unit-6 Fundamentals of Hyperspectral Data

6.1 Introduction to Hyperspectral data
6.2 Basics of Hyperspectral data
6.3 Processing Hyperspectral data

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Guyer, J.P., (2018). An Introduction to Airborne and Remote Sensing Methods for Geophysical (Second Edition), The Clubhouse Press, EL Macero California.
2. Petrie, G., & Smillie, K. (2008, July). Airborne digital imaging sensors and systems. In Advances in Photogrammetry, *Remote Sensing and Spatial Information Sciences*: 2008 ISPRS Congress Book (pp. 63-80). CRC Press.
3. Jensen, J.R.,(2007). Remote Sensing of Environment: and Earth Resources Perspective, Second Edition, Prentice Hall, Toronto, Canada
4. Jensen, J.R., (2005). Introductory Digital Image Processing: A Remote Sensing Perspective. Third Edition. Prentice Hall, Toronto, Canada.
5. Mather, P.M.,(2004). Computer Processing of Remotely-sensed Images, 3rd Ed. John Wiley & Sons Canada, 442pp.
6. Lillesand, T.M., and Kiefer, R.W., (2003), Remote Sensing and Image Interpretation (Fifth Edition), John Wiley & Sons, Canada, 784pp.

GMT-505 AIRBORNE SENSORS AND INSTRUMENTATION (PRACITCAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Practical

Course Learning Outcomes

- This course provides the hands-on activities regarding airborne Remote sensing techniques for spatial data collection.
- This course also includes the practical labs on the data collected by aerial borne platforms and further processing and interpretation of these images will be done.

Contents

Students will be familiar about the different airborne sensors' techniques and their working principle

Unit-1 Airborne Remote Sensing

1.1 Accessing airborne data
1.2 Properties of airborne data
1.3 Processing airborne data

Unit-2 Remote Sensing Sensors

2.1 Digital properties of active sensor data
2.2 Digital properties of passive sensor data
2.3 Applications of passive and active sensor data

Unit-3 Working with LiDAR

3.1 Accessing LiDAR data
3.2 Displaying LiDAR data in remote sensing software
3.3 Processing point-cloud data

Unit-4 Working with RADAR

4.1 Accessing RADAR data
4.2 Displaying RADAR data in remote sensing software
4.3 Retrieving information from RADAR data

Unit-5 Working with SAR

5.1 Accessing SAR data
5.2 Displaying SAR data in remote sensing software
5.3 Retrieving information from SAR data

Unit-6 Fundamentals of Hyperspectral Data

6.1 Accessing Hyperspectral data
6.2 Displaying Hyperspectral data in remote sensing software
6.3 Retrieving information from Hyperspectral data

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion

- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Campbell, J.B., (2002). Introduction to Remote Sensing (Third Edition), The Guilford Press, 621pp.
2. Guyer, J.P., (2018). An Introduction to Airborne and Remote Sensing Methods for Geophysical (Second Edition), The Clubhouse Press, EL Macero California.
3. Jensen, J.R.,(2007). Remote Sensing of Environment: and Earth Resources Perspective, Second Edition, Prentice Hall, Toronto, Canada
4. Jensen, J.R., (2005). Introductory Digital Image Processing: A Remote Sensing Perspective. Third Edition. Prentice Hall, Toronto, Canada.
5. Lillesand, T.M., and Kiefer, R.W., (2003), Remote Sensing and Image Interpretation (Fifth Edition), John Wiley & Sons, Canada, 784pp.
6. Mather, P.M.,(2004). Computer Processing of Remotely-sensed Images, 3rd Ed. John Wiley & Sons Canada, 442pp.

GMT-506 GIS PROBLEM SOLVING AND SPATIAL MODELING (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

In this course students will be able to;

- Use latest spatial analysis techniques
- Develop various spatial models and understand their utilization for different fields

Contents

This course comprises the different advanced spatial analysis for decision making purposes. Moreover, this course addresses the spatial modelling significance and advantages over conventional methods.

Unit-1 GIS Data Utilization

1.1 Utilization of numerical data
1.2 Utilization of Spatial data
1.3 Utilization of Digital Elevation Models

Unit-2 GIS Data Integration

2.1 Concepts behind GIS Data Integration
2.2 Introduction to Network analysis
2.3 Spatial statistics

Unit-3 Spatial Modelling

3.1 Fundamentals of Spatial Modelling
3.2 Prerequisites of Spatial Modelling
3.3 Developing a Spatial Model

Unit-4 Spatial Interpolations

4.1 Methods of Spatial Interpolations
4.2 Exact and Inexact Spatial Interpolations
4.3 Data requirements for Spatial Interpolations

Unit-5 Spatial Algorithms

5.1 Basics of Spatial Algorithms
5.2 Spatial and Non-spatial Queries
5.3 Applying Spatial Algorithms on Data

Unit-6 Spatial Decision Support System (SDSS)

6.1 Concept of SDSS
6.2 Defining objectives for SDSS
6.3 Executing SDSS

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Lombard, J, R., Stern, E. and Clarke, G., (2017). Applied Spatial Modelling and Planning. Routledge Taylor & Francis Group, London and New York.
2. Hall, G. Brent and Yeung, A., (2007). Spatial Database Systems: design, implementation and project management, Springer: Dordecht, The Netherlands.
3. Hegarty, M., & Waller, D. A. (2005). Individual differences in spatial abilities. Cambridge University Press.
4. Coburn C Timothy and Yarus M. Jeffrey., (2000). Geographic Information Systems in Petroleum Exploration and Development (AAPG Computer Applications in Geology, No. 4), American Association of Petroleum Geologists.
5. Aronoff, S., (1989). Geographic Information Systems: A management Perspective. WDL Publications, Ottawa.

GMT-506 GIS PROBLEM SOLVING AND SPATIAL MODELING (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- This course capitalizes the student's practical expertise about advanced spatial analysis
- Students will be able to develop various spatial models and understand their utilization for different fields

Contents

This course comprises the different advanced spatial analysis for decision making purposes. Moreover, this course addresses the spatial modelling significance and advantages over conventional methods.

Unit-1 GIS Data Utilization

1.1 Displaying numerical data in GIS
1.2 Displaying DEM in GIS
1.3 Processing DEMs in GIS

Unit-2 GIS Data Integration

2.1 Spatial Topology Concepts and Application
2.2 Developing a Network Dataset
2.3 Integrating Spatial data in GIS software

Unit-3 Spatial Modelling

3.1 Creating a model in GIS
3.2 Designing and saving models in GIS
3.3 Executing and sharing models in GIS

Unit-4 Spatial Interpolations

4.1 Applying interpolations on GIS data
4.2 Kriging, IDW, Topo to raster and spline applications
4.3 Comparing results of different interpolations

Unit-5 Spatial Algorithms

5.1 How to develop a spatial algorithm in GIS
5.2 Applying spatial and nonspatial queries on GIS data
5.3 Applying Spatial Algorithms on Data

Unit-6 Spatial Decision Support System (SDSS)

6.1 Creating a SDSS in GIS
6.2 Executing a SDSS in GIS
6.3 Creating a SDSS tool in GIS

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

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- homework
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- Short tests, quizzes etc.

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3. Hegarty, M., & Waller, D. A. (2005). Individual differences in spatial abilities. Cambridge University Press.
4. Coburn C Timothy and Yarus M. Jeffrey., (2000). Geographic Information Systems in Petroleum Exploration and Development (AAPG Computer Applications in Geology, No. 4), American Association of Petroleum Geologists.
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GMT-507 REMOTE SENSING OF LANDSCAPE DYNAMICS (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- Students will get in depth knowledge about the significance of remote sensing in different data collection techniques being used for landscape dynamics.
- This course will strengthen the students in resolving the issues related to various landscape dynamics using Geospatial techniques

Contents

This course provides the knowledge of Remote sensing applications in quantitative analysis of geomorphic processes and examines the surface processes in the sculpting of earth's surface. This course covers the practical labs on the knowledge of remote sensing applications in geomorphic processes and examines the interaction of climate and tectonics.

Unit-1 Landscape Mechanics

1.1 Quantitative introduction to mechanics of fluvial,
1.2 Quantitative introduction to hill slope
1.3 Quantitative introduction to glacial processes

Unit-2 Essentials of Weathering

2.1 Types of Weathering
2.2 Soil formation and runoff
2.3 Slope stability

Unit-3 Sedimentation

3.1 Sediment transport
3.2 River morphology
3.3 Glacial erosion

Unit-4 Landscape Systems Responses

4.1 Landscape systems responses to climatic change
4.2 Landscape systems responses to tectonic forcing
4.3 Landscape systems responses to global warming

Unit-5 Glaciation and Geological Processes

5.1 Glaciation and sea level change
5.2 Uplift and subsidence
5.3 Post-glacial Isostatic rebound

Unit-6 Geomorphic Phenomenon

6.1 Landform shaping
6.2 Characterization of landform changes
6.3 Monitoring landscapes with remote sensing

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Teresa, M., Olmedo, C., Paegelow, M., Mas, J. and Escobar, F. (2018). Geomatic Approaches for Modeling Land Change Scenarios, Springer, ISBN 978-3-319-60801-3.
2. Recardo, L, D. and Robert Frohn, R, C. (2017). Remote Sensing for Landscape Ecology: New Metric IndicatorsPublished, CRC Press.
3. Fu, B. and Jones, B, K. (2013). Landscape Ecology for Sustainable Environment and Culture, Springer Science & Business Media, ISBN:9400765304, 9789400765306
4. Burbank, D, W. and Anderson, R, S. (2012). Tectonic geomorphology, John Wiley & Sons, ISBN:1444345044, 9781444345049.
5. Gupta, R, R. (1990). Remote sensing Geology, ISBN:978-3-662-05283-9

GMT-507 REMOTE SENSING OF LANDSCAPE DYNAMICS (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

Students will get practical knowledge about different GIS and Remote sensing technologies in resolving issues related to various landscape dynamics.

Contents

This course provides the knowledge of Remote sensing applications in quantitative analysis of geomorphic processes and examines the surface processes in the sculpting of earth's surface. This course covers the practical labs on the knowledge of remote sensing applications in geomorphic processes and examines the interaction of climate and tectonics.

Unit-1 Landscape Mechanics

1.1 Identifying fluvial landforms on satellite imagery
1.2 Creating hillslopes from DEMs
1.3 Monitoring glaciation with remote sensing data

Unit-2 Essentials of Weathering

2.1 Identification of weathering from satellite imagery
2.2 Soil data acquisition
2.3 Slope analysis in remote sensing

Unit-3 Sedimentation

3.1 Hydrological modelling in remote sensing
3.2 Erosion assessment using satellite data

Unit-4 Landscape Systems Responses

4.1 Accessing climate data from online sources
4.2 Accessing biophysical data from online sources

Unit-5 Glaciation and Geological Processes

5.1 Microwave remote sensing basics
5.2 Monitoring subsurface processes through microwave remote sensing

Unit-6 Geomorphic Phenomenon

6.1 Identification of landform patterns on satellite imagery
6.2 Monitoring landscapes with remote sensing with temporal information

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

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- attendance, assignments and presentation,
- homework
- attitude and behaviour,
- hands-on-activities,
- Short tests, quizzes etc.

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2. Recardo, L, D. and Robert Frohn, R, C. (2017). Remote Sensing for Landscape Ecology: New Metric IndicatorsPublished, CRC Press.
3. Fu, B. and Jones, B, K. (2013). Landscape Ecology for Sustainable Environment and Culture, Springer Science & Business Media, ISBN:9400765304, 9789400765306
4. Burbank, D, W. and Anderson, R, S. (2012). Tectonic geomorphology, John Wiley & Sons, ISBN:1444345044, 9781444345049.
5. Gupta, R, R. (1990). Remote sensing Geology, ISBN:978-3-662-05283-9

GMT-508 WEB GIS DEVELOPMENT (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

In this course students will get knowledge about;

- Tools and algorithms used in web development
- Designing the websites for spatial data purposes
- Spatial data requirements for Web GIS

Contents

This course provides the knowledge about Web GIS and its utilization as an enterprise GIS for corporate sectors. This course also provides the practical expertise to publish the spatial datasets online.

Unit-1 Prerequisites of WebGIS

1.1 Introduction to Geo-Spatial Data
1.2 Introduction to spatial and nonspatial data
1.3 Introduction to Desktop

Unit-2 Introduction to WebGIS

2.1 Distributed and Web GIS
2.2 Web GIS implementation Challenges
2.3 Web GIS implementation Solutions

Unit-3 Basics of Web Development

3.1 Basic knowledge of HTML
3.2 Basic knowledge of CSS
3.3 Basic knowledge of PHP/JavaScript

Unit-4 Databases

4.1 Single user Database
4.2 Multiuser Database
4.3 Enterprise GIS

Unit-5 WebGIS Application

5.1 WebGIS application Development
5.2 GIS Application Physical Implementation

Unit-6 WebGIS Integration

6.1 Introduction to GML Geometry
6.2 Introduction to GIS Application Integration with other available systems
6.3 Presentation based on basic Web GIS application

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizze

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Fu, P., (2018). Getting to Know Web GIS, 3rd ed. Esri Press, 2018, ISBN: 1589485211, 9781589485211.
2. Foody, G., See, L., Fritz, S., Mooney, P., Olteanu-Raimond, A., Fonte, C, C. and Antoniou, V., (2017). Mapping and the Citizen Sensor, Ubiquity press, ISBN 978-1-911529-16-3
3. Tiwari, A. and Jain, K., (2017). Concepts and Applications of Web GIS, Nova Science Publishers, ISBN: 9781536127799.
4. Li, S.,DragicevicS. and Veenendaal, B., (2011). Advances in Web-based GIS, Mapping Services and Applications, CRC Press, 2011, ISBN: 0415890810, 9780415890816.

GMT-508 WEB GIS DEVELOPMENT (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

Students will get Practical Expertise on;

- Utilization of various algorithms in spatial databases development
- Architecture and design of web GIS
- Publishing and Dashboard development

Contents

This course provides the knowledge about Web GIS and its utilization as an enterprise GIS for corporate sectors. This course also provides the practical expertise to publish the spatial datasets online.

Unit-1 Prerequisites of WebGIS

1.1 Introduction to Geo-Spatial Data
1.2 Introduction to spatial and nonspatial data
1.3 Introduction to Desktop

Unit-2 Introduction to WebGIS

2.1 Distributed and Web GIS
2.2 Web GIS implementation Challenges
2.3 Web GIS implementation Solutions

Unit-3 Basics of Web Development

3.1 Basic knowledge of HTML
3.2 Basic knowledge of CSS
3.3 Basic knowledge of PHP/JavaScript

Unit-4 Databases

4.1 Single user Database
4.2 Multiuser Database
4.3 Enterprise GIS

Unit-5 WebGIS Application

5.1 WebGIS application Development
5.2 GIS Application Physical Implementation

Unit-6 WebGIS Integration

6.1 Introduction to GML Geometry
6.2 Introduction to GIS Application Integration with other available systems
6.3 Presentation based on basic Web GIS application

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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- Short tests, quizzes etc.

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SECOND SEMESTER

GMT-509 RESEARCH METHODOLOGY IN GEOMATICS (THEORY) (03 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- The student will be able to identify a research problem, collect data, and interpret it in a scientific manner in the form of a thesis.
- The course will provide participants with an introduction to the knowledge and skills necessary to develop a research proposal and subsequently to conduct a research study using Geomatics tools.
- It will help to develop research abilities in the activities of research design and practice to develop skills reading research papers and in writing reviews with critical thinking skills and to evaluate a range of available literature.

Contents

Background and philosophy of research: concept of research, types of research, elements of research. Types of data for research. Various stages of research, research methods and methodology. Research proposal, selection of a research topic and problems, literature survey, reference collection, hypothesis, mode of approach, actual investigation, results and conclusion, presenting an oral scientific seminar, writing a report, research paper and thesis, Layout of a research report, PhD thesis dissertation. Plagiarism and its professional consequences.

Unit-1 Research Fundamentals

1.1 Types of Research
1.2 Background and philosophy of research
1.3 Concept and Elements of research

Unit-2 Research Hypothesis

2.1 Null hypothesis
2.2 Alternate hypothesis
2.3 Problem statement

Unit-3 Data collection methods

3.1 Primary data collection
3.2 Secondary data collection
3.3 Surveying

Unit-4 Surveying Techniques

4.1 Introduction to different surveying Equipment
4.2 Surveying techniques & data collection methods
4.3 Processing of Survey Data

Unit-5 Data Analysis

5.1 Raster and Vector data analysis
5.2 Interpretation of data analysis
5.3 Discussion on research findings

Unit-6 Thesis writing

6.1 Abstract
6.2 Introduction

6.3 Materials and methods
6.4 Results and discussion
6.5 Conclusion
6.6 References

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

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- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. J.G. Maphanyane, R.B. Mthanganyika and M.O. Akinola (2018), Handbook of Research on Geospatial Science and Technologies, IGI Global, ISBN: 9781522534402.
2. F. Sami and M. Khaoula (2016), Handbook of Research on Geographic Information Systems Applications and Advancements. IGI Global, ISBN:1522509380, 9781522509387.
3. S. L. Steinberg and S. J. Steinberg (2015), GIS Research Methods: Incorporating Spatial Perspectives. Esri Press, ISBN:1589483782, 9781589483781.
4. Bhatta, B. (2013). Research methods in remote sensing. Berlin: Springer.

GMT-510 GEOMATICS: BIG SPATIAL DATA ANALSYIS (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

In this course students will get the knowledge about;

- Advanced spatial analysis using Google Earth Engine
- Applications of Geomatics in various fields.
- Utilization of freely available Geospatial data platforms and their processing

Contents

This course provides the knowledge about the advanced geospatial analysis., Introduction to Google earth engine, and other spatial data platforms for data acquisition and processing. Spatial data models and spatial analysis will also be covered in this course.

Unit-1 Introduction to Big Geodatasets

1.1 Concept about big Spatial datasets
1.2 Databases development
1.3 Processing of big spatial datasets

Unit-2 Google Earth Engine Basics

2.1 Introduction to Google Earth engine
2.2 Datasets available on Google earth engine
2.3 Working on Google Earth engine

Unit-3 Google Earth Engine Processing

3.1 Algorithms / code generation
3.2 Graphical representation of datasets
3.3 Data rectification

Unit-4 Google Earth Engine Analysis

4.1 Spatio-temporal assessment
4.2 Landuse landcover change detection

Unit-5 Application of Google Earth Engine in Environment

5.1 Assessing the change in temperature over time period
5.2 Assessing the change in precipitation over time period

Unit-6 Application of Google Earth Engine in Earth Sciences

6.1 Landuse and Landcover change analysis
6.2 Urbanization
6.3 Forest cover assessment

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Shamsi, J. A., & Khojaye, M. A. (2021). Big Data Systems: A 360-degree Approach. CRC Press.
2. Ly, V. (2020). Mapping Snow Sensor Usability in the Northern Hemisphere with Google Earth Engine. University of Washington.
3. Kumar, L., & Mutanga, O. (Eds.). (2019). Google Earth Engine Applications. MDPI.
4. Shen, Z., & Li, M. (Eds.). (2017). Big Data Support of Urban Planning and Management: The Experience in China. Springer.
5. Bivand, R. S., Pebesma, E. J., Gómez-Rubio, V., & Pebesma, E. J. (2008). Applied spatial data analysis with R (Vol. 747248717, pp. 237-268). New York: Springer.

GMT-510 GEOMATICS: BIG SPATIAL DATA ANALSYIS (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

In this course students will be able to perform;

- Advanced spatial analysis using Google Earth Engine
- Applications of GIS in Environmental and earth sciences
- Acquisition and utilization of freely available GIS data platforms and their processing

Contents

This course provides the practical knowledge about the advanced geospatial analysis.
Hand on practice using Google earth engine, and other spatial data platforms for data acquisition and processing and applications in environment, earth sciences and hydrology etc.

Unit-1 Big Datasets

1.1 Conventional methods for data downloading
1.2 Conventional methods for data processing

Unit-2 Processing Big datasets using Google Earth Engine

2.1 Selection of Punjab province imagery (Sentinel-II)
2.2 Algorithm generation for image rectification (if any error)

Unit-3 Digital Elevation Model processing

3.1 ASTER and SRTM DEM selection for Punjab province
3.2 Elevation and slope profile of Punjab province

Unit-4 Applications in Environment and Earth Sciences

4.1 Spatio-temporal assessment of Rainfall for Last 30years
4.2 Spatio-temporal assessment of Temperature for Last 30years
4.3 Vegetation cover change detection in Pakistan
4.4 Urbanization in Pakistan over time period
4.5 Graphical repetition of different variables in Google earth engine

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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5. Bivand, R. S., Pebesma, E. J., Gómez-Rubio, V., & Pebesma, E. J. (2008). Applied spatial data analysis with R (Vol. 747248717, pp. 237-268). New York: Springer.

GMT-511 IMAGE INTERPRETATION AND PHOTOGRAMMETERY (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- This course strengthens the students' knowledge about different platforms being in operation for aerial and space imagery acquit ion
- Students will get detail knowledge about different techniques regarding satellite and aerial images acquisition, processing images interpretation.

Contents

This course provides an introduction to the principles and techniques of air photo interpretation and satellite image interpretation. This course also provides comprehensive information about satellite and aerial images processing and interpretation. Stereoscopic viewing, parallax, flight line planning, and mapping from air photos. Introduction to various remote sensing platforms for spatial data collection, working methodologies of aerial and satellite-based platforms, advantages of aerial and satellites-based data collection methods will be covered in this course

Unit-1 Satellite and Aerial Imagery

1.1 Satellite orbits
1.2 Satellite image acquisition
1.3 Aerial imagery platforms

Unit-2 Concepts of Image acquisition

2.1 Stereoscopic viewing
2.2 flight line planning
2.3 parallax

Unit-3 Sensor Types

3.1 Active and Passive sensors
3.2 Various optical sensors
3.3 Synthetic Aperture RADAR

Unit-4 Image processing

4.1 High- and low-resolution imagery comparison
4.2 Satellite and aerial imagery processing and rectification
4.3 Comparison of Satellite and aerial imagery

Unit-5 DEM Generation using Ortho-imagery

5.1 Ortho-imagery
5.2 1m DEM Generation using Aerial ortho-imagery
5.3 Applications of high-resolution DEM

Unit-6 Photogrammetry Techniques

6.1 Aerial and terrestrial Photogrammetry
6.2 Aerial Triangulation
6.3 dimensions and position of objects

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. Avtar, R., & Watanabe, T. (Eds.). (2020). *Unmanned aerial vehicle: Applications in agriculture and environment*. Springer International Publishing.
2. Valavanis, K. P., & Vachtsevanos, G. J. (Eds.). (2015). *Handbook of unmanned aerial vehicles* (Vol. 2077). Dordrecht: Springer Netherlands.
3. Paine, D. P., & Kiser, J. D. (2012). *Aerial photography and image interpretation*. John Wiley & Sons.
4. Aber, J. S., Marzolff, I., & Ries, J. (2010). *Small-format aerial photography: Principles, techniques and geoscience applications*. Elsevier.
5. Morgan, D., & Falkner, E. (2001). *Aerial mapping: methods and applications*. CRC press.

GMT-511 IMAGE INTERPRETATION AND PHOTOGRAMMETERY(PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. /BS in allied disciplines

Learning Outcomes

- Students will get the practical knowledge about different platforms being in operation for aerial and space imagery acquit ion
- Utilization of different techniques regarding satellite and aerial images acquisition, processing images interpretation.
- Different software's will be used by students to process the aerial and satellite imagery

Contents

Hands on practice on digital image processing techniques for analyzing remotely sensed satellite imagery using commercial image analysis software (IDRISI, ERDAS IMAGINE, SAGA & Fusion). Lab exercises focus on specific applications in natural habitats and in rural and urban settings. Topics covered include image enhancement, filtering, band rationing, transforms, and change detection

Unit-1 Satellite Imagery

1.1 High resolution satellite imagery (Sentinel)
1.2 Image enhancement and sharpening

Unit-2 Aerial data using Drone

2.1 High resolution Aerial photographs using Drone
2.2 Processing of aerial photographs in software
2.3 Mosaicing and rectification etc.

Unit-3 High Resolution DEM

3.1 Processing of ortho-aerial imagery
3.2 1M DEM generation from Aerial imagery
3.3 Topographical mapping

Unit-4 Applications of Aerial imagery

4.1 Natural habitats and in rural and urban settings
4.2 Tracking changes in river direction
4.3 Environmental studies as mapping forests

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
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2. Valavanis, K. P., & Vachtsevanos, G. J. (Eds.). (2015). *Handbook of unmanned aerial vehicles* (Vol. 2077). Dordrecht: Springer Netherlands.
3. Paine, D. P., & Kiser, J. D. (2012). *Aerial photography and image interpretation*. John Wiley & Sons.
4. Aber, J. S., Marzolff, I., & Ries, J. (2010). *Small-format aerial photography: Principles, techniques and geoscience applications*. Elsevier.
5. Morgan, D., & Falkner, E. (2001). *Aerial mapping: methods and applications*. CRC press.

GMT512 ADVANCED TOPICS IN GEOINFORMATICS (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

This course will provide knowledge about;

- Applications of Remote sensing and GIS in Environmental sciences.
- Different freely available online spatial data platforms
- Various spatial models being used for environmental studies
- Advanced digital cartography techniques

Contents

This course provides an advanced knowledge about digital cartography, spatial models for environmental studies, suitability analysis, Hydrological modelling and freely available platforms for spatial data collection.

Unit-1 Spatial and non-Spatial Datasets

1.1 Raster and Vector datasets
1.2 Digitization and Topological errors
1.3 Geodatabases

Unit-2 Advanced Digital Cartography

2.1 Advancement in Cartography
2.2 Cartography techniques
2.3 Large- and Small-scale maps

Unit-3 Spatial Data Acquisition

3.1 Online freely available platforms
3.2 Spatial data creation
3.3 Data joining and import

Unit-4 Geo-statistical Analysis

4.1 Interpolation methods
4.2 Analytical Hierarchy process
4.3 Multicriteria indexing and scoring

Unit-5 Spatial Analysis

5.1 Site suitability techniques
5.2 Digital Elevation models
5.3 Image classification techniques

Unit-6 Spatial Modelling

6.1 Model Builder in Arc GIS
6.2 1D and 2D Hydrological Modeling
6.3 Environmental and Hydrological Models

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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2. Maribeth, P. 2018. Mastering ArcGIS, 8th Edition, McGraw-Hill Education.
3. William, E. & Adriano, C., 2017. Introduction to Satellite Remote Sensing: Atmosphere, Ocean, Land and Cryosphere Applications, 1st Edition, Elsevier, ISBN: 9780128092545
4. S Lavender 2016-Practical handbook of remote sensing-CRC Press. Routledge, Taylor and Frncis Group.
5. Jian, G. L., & Philippa, J. M. 2016. Image Processing and GIS for Remote Sensing:
6. Lawrence, F., 2015. Essential Earth Imaging for GIS, Esri Press,ISBN: 9781589483453.
7. Thomas, L., Ralph, W., Kiefer, J. C., 2015. Remote Sensing and Image Interpretation, 7th Edition, Wiley, ISBN: 978-1-118-34328-9 Further Reading:
8. Paul M. Mather. 2011. An introduction to Computer Processing of Remotely-Sensed Images, University of Nottingham. Wiley Blackwell.

GMT512 ADVANCED TOPICS IN GEOINFORMATICS (PRACTICAL) (01 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

- This course will provide hands on practice about different applications of remote sensing and GIS in Environmental sciences.
- Students will learn how to get the freely available data of different environmental variables (i.e. temperature, precipitation, evapotranspiration, vegetation cover, Landuse landcover etc.)
- Preparation of spatial models being used for environmental studies will also be covered
- Students will process satellite and aerial imagery for suitability analysis, hydrological analysis and flood hazard assessment

Contents

This course provides Hands on practice about digital cartography, development of different spatial models for environmental studies, specie distribution analysis, Groundwater quality and quantity modelling, Acquisition and processing of satellite imagery for Landuse landcover classification, Watershed and Flood hazard analysis.

Unit-1 Spatial and non-Spatial Datasets

1.1 Working on Google Earth
1.2 Spatial and non-spatial data creation
1.3 Data imports from Google earth, Excel, Auto-cad in ArcGIS

Unit-2 Advanced Digital Cartography

2.1 Map indexing and Grids
2.2 Fishnet
2.3 Large- and Small-scale maps

Unit-3 Geo-statistical Analysis

3.1 SRTM & ASTER DEM
3.2 Satellite imagery and DEM rectification and processing
3.3 IDW and Kriging Interpolation techniques
3.4 Development of Paired Comparison Matrix
3.5 Inter and Intra class weighting and scoring

Unit-4 Spatial Analysis and Modelling

4.1 Specie distribution mapping
4.2 Elevation, Slope and Drainage mapping using DEM
4.3 Landuse and Landcover classification
4.4 Developing Suitability model for specie distribution modeling
4.5 Hydrological model generation for watershed analysis
4.6 Models for flood hazard assessment

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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3. William, E. & Adriano, C., 2017. Introduction to Satellite Remote Sensing: Atmosphere, Ocean, Land and Cryosphere Applications, 1st Edition, Elsevier, ISBN: 9780128092545
4. S Lavender 2016-Practical handbook of Remote sensing-CRC Press. Routledge, Taylor and Frncis Group.
5. Jian, G. L., & Philippa, J. M. 2016. Image Processing and GIS for Remote Sensing:
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GMT 513 ENVIRONMENTAL MODELING (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

To acquaint the students, with the understanding of spatial modeling techniques for GIS problem solving. The students will be trained to understand spatial modeling and its application in environment and different fields.

Contents

The modelling process; integrating environmental models and GIS; spatial heterogeneity and representative areal units; measurement scales vs. process scales; sensitivity and uncertainty analysis; model complexity; effects of input data quality; simulation model experiments; technical and conceptual limits of environmental modelling, various spatial interpolation methods. Students will complete a small research project.

Unit-1 Spatial Analysis

1.1 Spatial analyst tools
1.2 Conversion tools
1.3 Data management tools

Unit-2 Spatial Modelling

2.1 Model conceptualization
2.2 Model design
2.3 Model implementation

Unit-3 ArcGIS Model Builder

3.1 ArcGIS Model Builder
3. 2 Validation of a model
3.3 Running a model

Unit-4 Erdas Imagine Model Builder

4.1 Erdas Model Builder
4.2 Validation of a model
4.3 Running a model

Unit-5 Hydrological Models

5.1 Watershed
5.2 Flood Hazard
5.3 Groundwater

Unit-6 Environmental Models

6.1 Specie Distribution modeling
6.2 Forest Change Detection models

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behaviors, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. John R, L, Stern, F. and Clarke, F.,(2016). Applied Spatial Modelling and Planning, Taylor & Francis, London, ISBN:1317406737, 9781317406730.
2. Obermeyer, N. and Pinto., J. (2008). Managing Geographic Information Systems, 2nd Ed., Guilford: New York.
3. Hall, G. Brent and Yeung, A., (2007), Spatial Database Systems: design, implementation and project management, Springer: Dordecht, The Netherlands.
4. Stillwell, S. and Clarke, G., (2004). Applied GIS and Spatial Analysis, John Wiley & Sons, UK. ISBN: 1-57504-101-4
5. David L. Verbyla., (2002). Practical GIS Analysis, Taylor & Francis, London
6. Donald P. Albert & Wilbert M. Gesler., (2000). Spatial Analysis, GIS and Remote Sensing Application in Health Sciences, Ann Arbor Press, Michigan, USA.1-57504-101-4

GMT513 ENVIRONMENTAL MODELING (PRACTICAL) (01 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

- To acquaint the students, with the practical expertise on spatial modeling techniques for GIS problem solving.
- The students will be trained to design and develop different spatial models for applications in environment and different fields.

Contents

Practical use of integrating environmental models and GIS; spatial heterogeneity and representative areal units; measurement scales vs. process scales; sensitivity and uncertainty analysis; model complexity; effects of input data quality; simulation model experiments; technical and conceptual limits of environmental modelling, various spatial interpolation methods. Students will complete a small research project.

Unit-1 ArcGIS Model Builder

1.1 Making a model in ArcGIS Model Builder
1.2 Validation of a model in ArcGIS Model Builder
1.3 Running a model in ArcGIS Model Builder

Unit-2 Erdas Imagine Model Builder

2.1 Making a model in Erdas Model Builder
2.2 Validation of a model in Erdas Model Builder
2.3 Running a model in Erdas Model Builder

Unit-3 Hydrological Modelling

3.1 Watershed Model
3.2 Flood Risk assessment model
3.3 Groundwater-spatio-temporal models

Unit-4 Environmental Models

4.1 Specie Distribution modeling
4.2 Forest cover change assessment modeling
4.3 Rainfall and temperature assessment models

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
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5. David L. Verbyla., (2002). Practical GIS Analysis, Taylor & Francis, London
6. Donald P. Albert & Wilbert M. Gesler., (2000). Spatial Analysis, GIS and Remote Sensing Application in Health Sciences, Ann Arbor Press, Michigan, USA.1-57504-101-4

GMT- 514 REMOTE SENSING AND GIS IN GEO SCIENCES (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

The basic aim of this course is to broaden the vision of students;

- In earth sciences and give them exposure in solving a problem using remote sensing and geographical information systems.
- Identify a research problem related to earth sciences and solve that problem using GIS and remote sensing.

Contents

Detailed investigation of advanced application areas of GIS and remote sensing. Topics may include Geo-hazards including landslides, earthquakes, floods, air pollution, various spatial interpolation methods, decision-support using analytical hierarchy process, geological, web-based, temporal, agricultural, land parcel, and natural resources applications. Students will be asked to complete application project during the semester.

Unit-1 Geo-hazards

1.1 Fundamental of Landslides
1.2 Causes of Earthquakes
1.3 Floods Management

Unit-2 Mapping techniques

2.1 Risk mapping
2.2 Hazard mapping
2.3 Vulnerability mapping

Unit-3 Surface Generation

3.1 Inverse distance weighting
3.2 Radial basis function
3.3 Kriging

Unit-4 Weighting and Scoring

4.1 Weight assigning techniques
4.2 Analytical Hierarchy Process
4.3 Paired Comparison Matrix
4.4 Inter and Intra criteria scoring/ranking

Unit-5 Hot-Spot Analysis

5.1 Weight Sum
5.2 Weighted Overlay
5.3 Potential/Hotspot site mapping

Unit-6 GIS & RS in Earth Sciences

6.1 Applications for Vegetation
6.2 Applications for Water
6.3 Applications for Urban area

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is a continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- Short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXTBOOKS / SUGGESTED READINGS

1. RaffaelaCefalo, Janusz B. Zieliński and Maurizio barbarella (2018), New Advanced GNSS and 3D Spatial Techniques: Applications to Civil and Environmental Engineering, Geophysics, Architecture, Archaeology and Cultural Heritage, Springer, ISBN 978-3-319-56218-6

2. DieuTien Bui, Anh Ngoc Do, Hoang-Bac Bui and Nhat-Duc Hoang (2017), Advances and Applications in Geospatial Technology and Earth Resources, Springer, ISBN 978-3-319-68239-6
3. Dwivedi, R. S. (2017). Remote Sensing of Soils.Springer Berlin Heidelberg, ISBN:3662537400, 9783662537404
4. Saied Pirasteh and Jonathan Li (2017), Global Changes and Natural Disaster Management: Geo-information Technologies, Springer, ISBN 978-3-319-51843-5
5. SmRamasamy (2016), Geomatics in Applied Geomorphology, New India Publishing Agency-Nipa, ISBN 9789385516429
6. J.R. Jensen (2007), Remote Sensing of the Environment: An Earth Resource Perspective. 2nd Edition
7. Reddy, A. M. (2004). Geoinformatics for environmental management.B.S. Publications

GMT- 514 REMOTE SENSING AND GIS IN GEO SCIENCES (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

This course will strengthen the practical expertise of the students in;

- Processing of different geospatial techniques in data acquisition, management and processing
- Solving a problem using remote sensing and geographical information systems using different software's

Contents

Detailed investigation of advanced application areas of GIS and remote sensing. Topics may include Geo-hazards including landslides, earthquakes, floods, disaster management, various spatial interpolation methods, decision-support using analytical hierarchy process, geological, agricultural, land parcel, and natural resources applications. Students will be asked to complete application project during the semester.

Unit-1 Geo-Hazard Mapping techniques

1.1 Risk mapping
1.2 Hazard mapping
1.3 Vulnerability mapping

Unit-2 Weightage and Scoring

2.1 Weight assigning techniques
2.2 AHP for landslides criteria
2.3 Inter and Intra criteria scoring/ranking

Unit-3 Hot-Spot Analysis

3.1 Weight Sum
3.2 Weighted Overlay
3.3 Potential/Hotspot site mapping

Unit-4 GIS & RS in Earth Sciences

4.1 Flood risk assessment
4.2 Earthquake damage assessment
4.3Urban Flooding hotspot area

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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4. J.R. Jensen (2007), Remote Sensing of the Environment: An Earth Resource Perspective. 2nd Edition
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6. Dwivedi, R. S. (2017). Remote Sensing of Soils.Springer Berlin Heidelberg, ISBN:3662537400, 9783662537404
7. Reddy, A. M. (2004). Geoinformatics for environmental management.B.S. Publications

GMT- 515 DATABASES AND ADVANCED WEB GIS (THEORY) (02 Credit Hrs)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

- The course will provide participants with an introduction to the knowledge and skills regarding web applications using geographical information systems. It will help students to understand the development in the field of GIS.
- The students will be trained in terms of basic programming skills and the use of relational database management system that is an integral part of geographic information systems.

Contents

Cloud computing, parallel computing, machine learning, Web Design, HTML, WebGIS Basic Concepts, WebGIS, its Technology & Architecture, ArcGIS Server, GIS Services, Web API's (JavaScript), Microsoft SQL Server, Geodatabases, database management system, relational database management system, Web 2.0, Web 3.0, open-source GIS software's, Volunteered geographic information.

Unit-1 Geodatabase and its types

1.1 Personal Geodatabase
1.2 File Geodatabase
1.3 Enterprise level Geodatabase

Unit-2 Fundamentals of Web GIS

2.1 Web Basic concepts
2.2 Web Technology
2.3 Web Architecture

Unit-3 Advanced Computing Concepts

3.1 Parallel computing
3.2 Cloud computing
3.3 Machine learning

Unit-4 Databases

4.1 Database Schema
4.2 DB Management System
4.3 Relational Database Management System
4.4 ERP

Unit-5 Basics of Programming

5.1 HTML & XML
5.2 Python
5.3 Java
5.4 C++

Unit-6 Web GIS Development

6.1 web development
6.2 Opensource web development
6.3 Geoserver, openlayer, Leaflets etc.

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is a continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
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2. AnujTiwari and Kamal Jain (2017), Concepts and Applications of Web GIS, Nova Science Publishers, ISBN 9781536127799
3. CláudioElízioCalazansCampelo, MichelaBertolotto and Padraig Corcoran (2017), Volunteered Geographic Information and the Future of Geospatial Data, IGI Global, ISBN 9781522524465
4. Giles Foody, Linda See, Steffen Fritz, Peter Mooney, Ana-Maria Olteanu-Raimond, Cidália Costa Fonte and Vyron Antoniou (2017), Mapping and the Citizen Sensor, Ubiquity press, ISBN 978-1-911529-16-3
5. Longley, P., Goodchild, M., Maguire, D., and Rhind, D (2011), Geographic Information Systems and Science, 3rd Edition, John Wiley

GMT- 515 DATABASES AND ADVANCED WEB GIS (PRACTICAL) (01 Credit Hr)

PRE-REQUISITE: M.Sc. / BS in allied disciplines

Learning Outcomes

The course will provide practical knowledge and skills regarding web applications using geographical information systems. It will help students to understand the development in the field of GIS.

The students will be trained in programming skills and the use of relational database management system that is an integral part of geographic information systems.

Contents

Cloud computing, parallel computing, machine learning, Web Design, HTML, Web GIS Basic Concepts, Web GIS, its Technology & Architecture, ArcGIS Server, GIS Services, Web API's (JavaScript), Microsoft SQL Server, Geodatabases, database management system, relational database management system, Web 2.0, Web 3.0, open-source GIS software's, Volunteered geographic information.

Unit-1 Geodatabases

1.1 Personal Geodatabase
1.2 File Geodatabase
1.3 Enterprise level Geodatabase

Unit-2 Web Components

2.1 Navigation
2.2 Web Hosting
2.3 Call-to-Actions
2.4 Headline

Unit-3 Web Databases

3.1 Analysis
3.2 Design Phase
3.3 Implementation
3.4 Maintenance etc.

Unit-4 Web GIS Development

4.1 Web development
4.2 Open-source web development
4.3 Geoserver, openlayer, Leaflets etc.

TEACHING – LEARNING STRATEGIES

- Lecture based examination
- Presentation/seminars
- Class discussion
- Quizzes

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5. Longley, P., Goodchild, M., Maguire, D., and Rhind, D (2011), Geographic Information Systems and Science, 3rd Edition, John Wiley

Checklist for a New Academic Program

Parameters	
1. Department Mission and Introduction	☐
2. Program Introduction	☐
3. Program Alignment with University Mission	☐
4. Program Objectives	☐
5. Market Need/ Rationale	☐
6. Admission Eligibility Criteria	☐
7. Duration of the Program	☐
8. Assessment Criteria	☐
9. Courses Categorization as per HEC Recommendation	☐
10. Curriculum Difference	☐
11. Study Scheme / Semester-wise Workload	☐
12. Award of Degree	☐
13. Faculty Strength	☐
14. NOC from Professional Councils (if applicable)	☐

Program Coordinator **Principal**