PANJAB UNIVERSITY, CHANDIGARH-160014 (INDIA)

(Estd. under the Panjab University Act
VII of 1947- enacted by the Govt. of India)

FACULTY OF ARTS

SYLLABI

FOR

MASTERS IN GEOINFORMATICS

(SEMESTER SYSTEM)

Examinations, 2023-24, 2024-25, 2025-26

APPLICABILITY OF REGULATIONS FOR THE TIMEBEING IN FORCE

Notwithstanding the integrated nature of a course spread over more than one academic year, the regulations in force at the time a student joins a course shall hold good only for the examinations held during or at the end of the academic year. Nothing in these regulations shall be deemed to debar the University from amending the regulations subsequently and the amended regulations, if any, shall apply to all students whether old or new.

MASTERS IN GEOINFORMATICS
(Semester System)
Outlines of Course Content and Syllabi
forthe examination 2023-24, 2024-25 and 2025-26

ABOUT THE COURSE

Masters in Geoinformatics is a multi-disciplinary & professional postgraduate course offered by Department of Geography, Panjab University Chandigarh from the academic session 2019-20. Department of Geography, Panjab University Chandigarh has been a pioneer in introducing such professional courses on geospatial technology. We first introduced a PG Diploma course in Remote Sensing and Geographic Information System in 2001 which was later upgraded into two-year Masters in Remote Sensing and Geographic Information System (RS & GIS).Keeping pace with changing technological scenario in the field, the course was restructured and renamed as Masters in Geoinformatics which is now more robust in terms of course content and professional attitude as well as more flexible and interdisciplinary in nature. This two-year course divided into four semesters is aimed at developing scientific, technical and professional attitude and skills among students.

WHY STUDY WITH US

Department of Geography, Panjab University offers a postgraduate Masters course thataims at developing technically skilled and scientifically oriented professionals in the field of geoinformatics. The course is dynamic, uniquely designed and flexible that not only produce highly trained professionals in the field of geospatial technology but also encourages innovation and out-of-box thinking. During the two years stay with us students are exposed to a wide range of knowledge learning and character-building practices. We offer a wide spectrum of learning skills ranging over conceptual and theoretical clarity of the subject, technical capabilities, analytical and decision-making qualities. Using a focussed field-based approach, we prepare our students to develop practical understanding of geospatial processes, mechanisms and operational aspects of space-based technology to seek effective solutions to problems. ***Some of the highlights of our curriculum are:***

- Conceptual & Theoretical Clarity of Key Concepts in Geoinformatics.
- Exposure to Remote Sensing and Digital Image Processing.
- Technical skills in the field of Photogrammetry.
- Innovative learning of GIS and GNSS.
- Understanding of basic Computer Skills and Programming.
- Development of Analytical and Creative Skills in Spatial Analysis.
- Specialization in Geosciences, Urban & Regional Planning and Disaster Management.
- Upgradation of Skills for Field-work Based Data Collection of Geo-Information.
- Improvement in Quantitative and Qualitative Research Skills.
- Project Formulation and Management.
- Report Writing and Delivering High Quality Output.

ELIGIBILITY CRITERIA

- The eligibility for this course is Bachelor's Degree with Geography/Geology/Geophysics/ Mathematics/ Physics/Botany/Environment Science/Computer Science/Urban Planning/Regional Planning/B. Tech./B.C.A. or Master's Degree in Geography/Geology/ Geophysics/ Mathematics/Physics/ Botany/Environment Science/ Computer Science/M.C.A./Urban Planning/Regional Planning with at least 50% marks in aggregate. The admission to the course shall be through an Entrance Test.
- All candidates, except those sponsored by the Government/Semi-Government Organisations and Institutions, will be required to qualify the Entrance Test conducted by the Panjab University, Chandigarh. The apportioning of weightages for the purpose of preparing the merit list will be as follows:
  Entrance Test: 50%
  Qualifying Examination (Bachelor's Degree): 50%
- Students who have studied Geography at the B.A./B.Sc./M.A./M.Sc. level shall be given an additional weightage of 15 per cent of the academic score at Bachelor's level.
- Academic and other weightage(s), if any, shall be based on the percentage of marks obtained by the eligible candidates in the Qualifying Examination (Bachelor's Degree) as prescribed and admissible under Panjab University Rules.

GUIDELINES FOR CONTINUOUS INTERNAL ASSESSMENT (20%)

For Regular Students of Masters in Geoinformatics (Semester System)
(Effective from the First Year Admissions for the Academic Session 2023-2024)

1. The Syndicate has approved the following guidelines, mode of testing and evaluation including Continuous Internal Assessment of Students:

i. Terminal Evaluation :**80%**(Theory 50% and Practical 30% as specified in syllabus)
ii. Continuous Assessment:**20%**
iii. Continuous Assessment may include written assignment, snap tests, participation in discussions in the class, term papers, attendance etc.
iv. In order to incorporate an element of Continuous Internal Assessment of students, the colleges/ Departments will conduct one written test as quantified below:

a) Written Test	: 25 (reduced to 5)
b) Snap Test	: 25 (reduced to 5)
c) Term Paper	: 25 (reduced to 5)
d) Participation in class discussions	: 15 (reduced to 3)
e) Attendance	: 10 (reduced to 2)

Total: 100 reduced to 20

2. Weightage of 2 marks for attendance component out of 20 marks for Continuous Assessment shall be available only to those students who attend 75% and more of classroom lecture/ seminars/ workshops. The break-up of marks for **attendance component** for theory papers shall be as under:

Attendance Component	*Marks for Theory Papers*
(a) 75% and above up to 85%	**: 1**
(b) Above 85%	**: 2**

3. It shall **not be compulsory** to pass in Continuous Internal Assessment. Thus, whatever marks are secured by a student out of 20% marks, will be carried forward and added to his/her score out of 80%, i.e., the remaining marks allocated to the particular subject and, thus, he/she shall have to secure pass marks both in the University examinations as well as total of Internal Continuous Assessment and University examination.

4. Continuous Internal Assessment awards from the affiliated Colleges/Departments must be sent to the Controller of Examinations, by name, **two weeks before** the commencement of the particular examination on the *proforma* obtainable from the Examination Branch.

Masters in Geoinformatics COURSE OUTLINE			
Course Code	**Course Title**	**Max. Marks**	**Credits**
SEMESTER-I			
GI 101	Fundamentals of Remote Sensing	100	4
GI 102	Fundamentals of Photogrammetry	100	4
GI 103	Fundamentals of Geographic Information Systems	100	4
GI 104	Fundamentals of Computers and Computer Programming	100	4
	Semester Total	*400*	*16*
SEMESTER-II			
GI 201	Cartography	100	4
GI 202	Spatial Analysis	100	4
GI 203	Digital Image Processing	100	4
GI 204	Fundamentals of GNSS	100	4
	Semester Total	*400*	*16*
SEMESTER-III			
GI 301	Research Methodology and Internship Report	100	4
GI 302	Geoinformatics for Geosciences	100	4
GI 303	Geoinformatics for Urban and Regional Planning	100	4
GI 304	Geoinformatics for Disaster Management	100	4
	Semester Total	*400*	*16*
SEMESTER-IV			
GI 401	Dissertation 1. Formulation of Research Proposal 2. Mid Term appraisal 3. Pre-submission Presentation 4. Dissertation Evaluation 5. Presentation 6. Viva-voce	 50 50 50 150 50 50	16
	Semester Total	*400*	*16*
	GRAND TOTAL (Semester-I, II, III, IV)	**1600**	**64**

NOTE:

1. After successful completion of first two semesters of the Masters course, there shall be a provision for the candidate/s to opt out of the Course. In such an instance the candidate will be awarded Diploma in Geoinformatics.
2. The minimum marks required to pass the examination shall be 50% in aggregate in each semester and 45% in each individual paper: (i) theory paper, (ii) practical examination, (iii) internship report and (iv) Dissertation.
3. The Internship Report shall be prepared by the candidate on the basis of work done or experience gained on visit(s) to Remote Sensing Centre(s)/Institute (s) in India. The candidate shall submit three copies of Internship Report ten days before the commencement of the theory examination of the said semester.
4. In case of Dissertation, the Board of Control shall assign Supervisor/Co-supervisors for each candidate for supervising candidate's Dissertation on an approved topic. External Supervisor/Co-supervisors may be allotted, subject to their eligibility to be determined by the Board of Control.

SEMESTER-I

GI 101: FUNDAMENTALS OF REMOTE SENSING

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The aim of this course is to introduce the students with basic principles of remote sensing, satellite systems, their functioning and applications of space-based technology. It also intends to expose students to technical skills required to analyse and interpret satellite data.

(A) THEORY **Marks: 50**

Unit-I

Fundamental Concepts of Remote Sensing:

i. Remote Sensing: Concept, Types and Applications
ii. Remote Sensing Platforms, Sensors and Scanning Systems
iii. Earth Observation Satellites and Applications

Unit-II

Energy Principles and Interaction Mechanisms:

iv. Radiation Principles; Electromagnetic Spectrum
v. Energy-Atmosphere Interaction; Atmospheric Windows
vi. Energy-Earth Interaction; Spectral Signatures of Surface Features

Unit-III

Image Processing and Interpretation:

vii. Image: Meaning, Types and Characteristics
viii. Resolution: Spatial, Spectral, Radiometric and Temporal
ix. Basics of Image Processing; Elements of Image Interpretation.

Unit-IV

Advances in Remote Sensing:

x. Thermal Remote Sensing: Concept, Mechanism and Application
xi. Microwave Remote Sensing: Concept, Mechanism and Application
xii. Hyperspectral Remote Sensing: Concept, Mechanism and Application

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Measuring Orbital velocity, Orbital Period and Orbital Height of satellites
2. Introduction to Energy Wavelength, Frequency and Spectrum
3. Calculation of EMR Frequency, Wavelength, Energy and Radiant Exitance
4. Analysis of Spectral Signatures of Surface Features
5. Visual Interpretation of Features from Satellite Imagery
6. Georeferencing Satellite Image
7. Preparing Image Subset, Mosaic, Layer stacking and Resolution merge
8. Digital Image Interpretation: Band Combination, Histogram and Pixel Values
9. Digital Image Classification-I: Supervised Classification
10. Digital Image Classification-II: Unsupervised Classification

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Campbell, J. B. and R.H. Wynne, *Introduction to Remote Sensing*, Guilford Press, 2012.
2. Chapman, R, and R. Gasparovic, Remote Sensing Physics-An Introduction to Observing Earth from Space, John Wiley and Sons, 2022
3. Jensen, J.R., *Introductory Digital Image Processing: A Remote Sensing Perspective*, Pearson Prentice Hall, 2005.
4. Joseph, G. *Fundamentals of Remote Sensing*, Second Edition, Universities Press, 2005.
5. Lillesand, T.M., R.W. Kiefer and J.W. Chipman, *Remote Sensing and Image Interpretation*, 5th Edition, John Wiley and Sons, 2004.
6. Mather, P.M. and M.G. Koch, *Computer Processing of Remotely-Sensed Images: An Introduction,* John Wiley & Sons, 2011.
7. Srivastava, G.S., *An Introduction to Geoinformatics*, McGraw Hill Education, India, New Delhi, 2014

Further Readings:

1. Gomarasca, Mario A, *Basics of Geomatics*, Springer, Heidelberg, 2009.
2. Dong, P. and Qi Chen, LiDAR Remote Sensing and Applications. CRC Press, 2018.
3. Njoku, E.G., *Encyclopaedia of Remote Sensing*, Springer, New York, 2014
4. Rees, W.G., *Physical Principles of Remote Sensing,* 3rd Ed., Cambridge University Press, 2012.
5. Richards, John A. *Remote Sensing Digital Image Analysis: An Introduction,* 5th Edition, Springer-Verlag Berlin Heidelberg, 2013.

Pedagogy: Students may be taken to field for verification of identifiable features on satellite imageries; they may be asked to trace the temporal and spatial changes. Students may be taken to different institutions to acquaint with different remote sensing techniques. Professionals may also be invited to interact and deliver special lectures to students on remote sensing techniques.

GI 102: FUNDAMENTALS OF PHOTOGRAMMETRY

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: To provide a general overview of Photogrammetry, its theory and general working principles. It introduces the basic concepts and significance of Photogrammetry. Further, a practical understanding of principles of measurement from vertical aerial photographs is provided.

(A) THEORY **Marks: 50**

Unit-I

i. Photogrammetry: Definition, Types and Historical Developments
ii. Flight Planning Parameters for Photogrammetry
iii. Basic Elements of Overlap and Side-overlap, Crab and Drift

Unit-II

iv. Basic Geometry of Aerial Photographs; Calculation of Photo Scale
v. Relief Displacement: Concept and Calculations; Parallax: Concept and Determination
vi. Calculation of Height of Objects on Vertical Aerial Photograph

Unit-III

vii. Stereoscopy: Definition
viii. Principles of vision, Binocular Vision, Stereoscopic Vision Testing, Pseudoscopic Views
ix. Types of Stereoscopes and their Operations

Unit-IV

x. Planimetric Positions
xi. Photogrammetry in Space Age
xii. Applications of Photogrammetry

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Distinction between Map, Photo and Stereoscopic view.
2. Arranging Aerial Photographs using photograph numbers and preparation of Photo Index.
3. Understanding the simple geometry of aerial photographs
4. Interpretation of information given on the margins of photograph and satelliteimageries.
5. Locating principal point, conjugate principal point, flight line
6. Stereoscopic vision Test, selection of stereo-pair, its orientation &placing under stereoscope.
7. Identification and mapping of features from single photograph.
8. Identification and mapping of features from a stereo pair and their verification in the field.
9. Measurement of scale, height and slope from verticalaerial photographs
10. Measurement of relief displacement and parallax from verticalaerial photographs
11. Identification of planimetric positions

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Classdiscussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. McGlone, J. Chris, *Manual of Photogrammetry (Sixth Edition),* American Society ofPhotogrammetry and Remote Sensing, 2013.
2. Mikhail, E. M. et al, *Introduction to Modern Photogrammetry*, John Wiley &Sons Inc. 2001.
3. Moffitt, F. H., *Photogrammetry*, 3rd Edition, Harper & Row, NY, 1980.
4. Paul Wolf et al., *Elements of Photogrammetry with Application in GIS*, Fourth Edition,McGraw-Hill Professional, 2013.
5. Srivastava, G.S., *An Introduction to Geoinformatics*, McGraw Hill Edu., India, New Delhi, 2014
6. Wolf, P. R., *Elements of Photogrammetry*. McGraw-Hill, NY, 1983.
7. Zorn, H. C., *Introductory Course in Photogrammetry*. 6th Ed. ITC, Netherlands, 1980.

Further Reading:

1. Burnside, C. D., *Mapping from Aerial Photography,* 2nd Ed, Collins, 1985.
2. Campbell, J.B., *Introduction to Remote Sensing*, 3rd ed., The Guilford Press, 2002.
3. Curran Paul, J., *Principles of Remote Sensing*, UK: ELBS, 1984.

4. Gomarasca, Mario A, *Basics of Geomatics*, Springer, Heidelberg, 2009.
5. Joseph, George, *Fundamentals of Remote Sensing,* Universities Press India, 2007.
6. Lillesand, T. M.; R.W. Kiefer, and J.W. Chipman, *Remote Sensing and ImageInterpretation*, 5th Edition, Wiley, 2007.
7. Sabins, Floyd F., *Remote Sensing: Principles and Interpretation,* New York: WHFreeman and Company, 2007.

Pedagogy: Students will be demonstrated the difference between qualitative andquantitative understanding of various aspects of Photogrammetry. Demo exercise onmeasurements on the map and photo will make students aware the importance ofPhotogrammetry in objective and precise mapping using aerial photographs.

GI 103: FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEMS

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The main objective of this course is to expose the students to fundamental principles of Geographical Information Systems including basic concepts and definitions, methods and techniques. It also introduces basics of GIS software and tools.

(A) THEORY **Marks: 50**

Unit- I

Concepts and Definitions

i. Geographic Information Systems: Concept and Components
ii. Historical Development of GIS
iii. Advantages and Applications of GIS

Unit-II

Functional Elements

iv. Spatial data: Points, Lines and Polygons
v. Data Acquisition, Input and Editing
vi. Data Manipulation and Topology Creation, Data Analysis and Query

Unit-III

Data Management and Structure

vii. Data Base Management System (DBMS): Purpose and structure
viii. Database Modeling
ix. Data Organisation

Unit-IV

GIS Applications

x. Open-Source GIS: Concept, Tools, and Applications
xi. Mobile GIS, Web GIS and Cloud-Based GIS
xii. Future of GIS

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. GIS Software: Introduction to Arc GIS
2. Georeferencing Maps and Images, Projections and Datum
3. Geodatabase Creation and Building Topology
4. Digitization and Modifications: Point, Line and Polygon
5. Attribute Data: Attribute Tables, Editing, Joining and Calculating Fields
6. Basic Data Processing and Management
7. Query Building and Basic Statistics: Spatial and Non-Spatial Query
8. Introduction to Open-source GIS

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Fazal, S. and Rahman, A., *Geographic Information System (GIS) Terminology*, New Age International Publishers, New Delhi, 2007.
2. Harvey, F., *A Primer of GIS: Fundamental Geographic and Cartographic Concepts*, Guilford Press, New York, 2008.
3. Heywood, I., Sarah Cornelius and Steve Carver, *An Introduction to Geographical Information Systems*, 3rd Edition, Pearson, Dorling Kindersley (India) Pvt. Ltd, 2010.
4. Kang-TsungChang, *Introduction to Geographic Information Systems*, 9th Edition, Tata McGraw-Hill, New Delhi, 2019.
5. Longley, Paul A., Goodchild, Michael F. Maguire, David J., and David W. Rhind, *Geographic Information Systems and Science*, 3rd ed., John Wiley and Sons, England, 2011.
6. Maguire, D.J.; M. Batty and M.F. Goodchild, *GIS, Spatial Analysis and Modeling*, ESRI Press, 2005.
7. Wise, S., *GIS Fundamentals*, 2nd Edition, CRC Press, Taylor & Francis Group, 2013.
8. Sherman, Gary. Desktop GIS: mapping the planet with opensource tools. Pragmatic Bookshelf, 2008.

Further Readings:

1. Bolstad, P.: *GIS Fundamentals: A First Text on Geographic Information Systems*, 5th ed., XanEdu Publishing Inc, 2016.
2. Burrough, P. A., McDonnell, R. A. and Lloyd, C.D.,*Principles of Geographical Information Systems*, 3rd. ed., Oxford University Press, Toronto, 2016.
3. ESRI: *Esri Map Book*, Volume 32, Esri Press, 2017.
4. Graser, A.: *Learning QGIS: Create great maps and perform geoprocessing tasks with ease*, 3rd. ed., Packt Publishing, 2016.
5. Neteler, Markus, and Helena Mitasova. Open Source GIS: a GRASS GIS approach. Vol. 689. Springer Science & Business Media, 2013.
6. Pinde Fu, P.,*Getting to Know Web GIS*, Esri Press, 2018.
7. Shen, Zhenjiang, *Geospatial Techniques in Urban Planning*, Springer-Verlag Berlin Heidelberg, 2012.

Pedagogy: Taking students for fieldwork, inviting professionals for lectures, taking students to institutes/training centres engaged in imparting professional training and providing research consultancy in business, tourism and area/regional planning will be the main component of the teaching methodology.

GI 104: FUNDAMENTALS OF COMPUTERS AND COMPUTER PROGRAMMING

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: This course intends to develop basic skills and understanding of computer operations; skills of Word Processing for written communication of results and documentation of work performed. It aims to impart skills for data management, charting, and visualization; and to expose students to the effective techniques of using search engines & the services of Internet as well as imparting programming skill for developing programs in 'C' language.

(A) THEORY **Marks: 50**

Unit-I

Computer Concepts OS and Application Software

i. Introduction to Computers, Computer System, Hardware, Software, Input and Output Devices
ii. Data Representation; Fundamental Concepts of Operating Systems.
iii. Introduction to Windows Operating System; MS-Word and MS-Excel Software.

Unit-II

Computer Graphics, Computer Networks and Web Application Development

iv. Fundamentals of Computer Graphics, Image Formats
v. Introduction to Computer Networks
vi. Overview of Internet and its services, Search Engines, Techniques to search effectively
vii. Introduction to web application development using HTML

Unit-III

Data Concepts and Information Systems

viii. Key Database Concepts; Database Management Systems, Type of DBMS
ix. Structured Query Language (SQL); Data Visualization, Data Mining
x. Introduction to Information Systems; Types of Information Systems

Unit-IV

Programming Concepts

xi. Concept of a Program, Data Types, Keywords, Structure of a Program.
xii. Writing 'C' Programs: Statements, Types of Statements
xiii. Library Functions and User Defined Functions, Arrays, File Handling.

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25- 30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Hands on experience on Windows operating system.
2. Hands on experience on MS-Word
3. Hands on experience on MS-Excel
4. Creating web pages using HTML,
5. Techniques to use search engines effectively.
6. Writing queries using SQL.
7. Writing C programs.

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings

1. Basandra, S. K., *Computers Today*, Galgotia Publications Pvt. Ltd., 2010.
2. Frye, C., *Microsoft Excel 2013: Step by Step*, Microsoft Press, 2013.
3. Lambert, J. and J. Cox, *Microsoft Word 2013: Step by Step*, Eastern Economy Edition, 2013.
4. Miller, M., *Easy Computer Basics, Windows 8.1 Edition*, Pearson Education, Inc. 2014.
5. Online Resources: www.w3schools.com for HTML and SQL. (*Live and latest).*
6. Salaria, R.S. *Computer Concepts and Programming in C*, Salaria Publishing House, 2013.
7. Yang, Chaowei, *Introduction to GIS Programming and Fundamentals with Python and ArcGIS*, CRC Press, 2017.

Further Readings

1. Freedman, J., *Microsoft Word 2013: Plain & Simple*, O'Reilly Media Inc., 2013.
2. Lutz, M. *Programming Python*, 3rd Edition, O'Reilly Media, Inc. 2006.
3. Norton, P., *Introduction to Computers*, 6th Edition, McGraw-Hill Education, 2004.
4. Norton, P., *Computing Fundamentals*, Student Edition, McGraw-Hill, 2004.
5. Tateosian, L. *Python for ArcGIS*, Springer, 2015

Pedagogy: Bottom-up approach of explaining concepts; programming exercises to simulate interest to practice programming applications; Audio visual presentations; Test/Assignment as per the latest in industry/real-life. Students will be encouraged to ask questions and participate in the classroom discussion.

SEMESTER-II

GI 201: CARTOGRAPHY

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objective: The course is designed to emphasize the relevance and scope of cartography in GIS. It shall highlight the value of this vital field in the current and highly versatile field of geoinformatics.

(A) THEORY **Marks: 50**

Unit-I

Basic Concepts of Cartography

i. Cartography: Definition, Scope and Significance
ii. Historical Perspective of Cartographic Development
iii. Traditional and Digital Cartography; Cartography and GIS

Unit-II

Data Types and Map Basics

iv. Levels of Measurements; Data: Types (Spatial and Attribute data), Sources and Analysis
v. Map Types and Classifications; Topographic Maps
vi. Map Projections, Datum and Coordinate System

Unit-III

Map Designs and Production

vii. Principles of Symbolization; Basics of Colour Schemes and Representation
viii. Map Lettering and Legend Presentation
ix. Map Layout and Product Generation

Unit-IV

Interpretation of Topographical Maps

x. Relief Representation: Contours, Hachures, Hill Shading
xi. Relief (Absolute and Relative) and Profiles (Longitudinal and Transverse)
xii. Slope Analysis (Wentworth and Robinson); Reading Topographical Maps

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25- 30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Classification of Topographical Sheets
2. Slope Analysis (Wentworth and Robinson)
3. Generation of Hill Shading Map
4. Profiles: Longitudinal and Transverse Profiles
5. Interpretation of Physical and Cultural features from Topographical Sheet
6. Map Design: Symbolization, Lettering, and Legends
7. Map Layout: Representing Geographical Data
8. Thematic Maps: Dot Map, Choropleth Map, Proportionate Circles, Isopleth Map

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings

1. Cromley, R.G., *Digital Cartography*, Prentice-Hall of India, New Delhi, 1992.
2. Crampton, W.C., *Mapping: A Critical Introduction to Cartography and GIS,* John Wiley & Sons, New York, 2010.
3. Dent, B.D., *Cartography-Thematic Map Design*, WBC McGraw–Hill, Boston, 1999.
4. John Krygier and Denis Wood, *Making Maps: A visual guide to map design for GIS,* Guilford Publications, New York, 2005.
5. Keates, J.S., *Cartographic Design and Production*, Longman, London, 1998.
6. Monkhouse, F.J., *Maps and Diagrams*, Methuen and Co., London, 1994.
7. Robinson, A.H. et. al, *Elements of Cartography*, John Wiley & Sons, New York, 2009.

Further Readings:

1. Harley J.B. and David Woodward, *The History of Cartography* Volume 2, Book 2,The University of Chicago Press, 1995.
2. Raisz, Erwin, *Principles of Cartography*, McGraw Hill, New York, 1962.
3. Ramamurthy, K., *Maps Interpretation: India Landscapes Through Survey of India*,Topographic Maps, R.K. Mutt Road, Madras, 1982.
4. Tyner, J.A., *Principles of Map Design*, Guilford Publications, New York, 2010.
5. Wood Clifford H. and Keller C., *Cartographic Design- Theoretical and PracticalPerspectives*, John Wiley & Sons, 1996.

Pedagogy: Students will be encouraged to ask questions and participate in classroom discussions. Assignments, term papers and group discussions will be the additional methods to make teaching more focused and interesting.

GI 202: SPATIAL ANALYSIS

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The course is designed to help the students to understand the tools and techniques which assist in providing focused and precise analysis of emerged pattern of geographical phenomena. The aim is to enhance the capabilities of students in perceiving, analysing and creating statistical information with sound geographical basis.

(A) THEORY **Marks: 50**

Unit- I

Spatial Analysis: Fundamental Concepts

i. Concept and Significance of Spatial Analysis
ii. Nature of Spatial Data and Data Models
iii. Measures of Central Tendency and Dispersion

Unit- II

Spatial Techniques: Point and Line Analysis

iv. Measurement of Point Features over Space
v. Measurement of Linear Features over Space
vi. Network Analysis

Unit-III

Vector Analysis: Tools and Techniques

vii. Query Techniques; Feature Extraction Techniques
viii. Proximity Analysis Techniques; Overlay Techniques
ix. Statistical Techniques: Nearest Neighbour Analysis; Spatial Autocorrelation

Unit-IV

Raster Analysis: Elevation Models and Surface Analysis

x. Elevation Models: DEM, DTM, DSM and TIN
xi. Surface Analysis: Characterisitcs, Types and Representation
xii. Surface Creation: Interpolation Techniques; Raster Operations

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Database Creation for Spatial Analysis.
2. Measuring Geographical Distribution
    - Central Feature, Mean Centreand Median Centre
    - Standard Distance and Standard Distance Ellipse
3. Analysing Patterns and Clusters
    - Nearest Neighbour and Spatial Autocorrelation
    - Hot-Spot Analysis
4. Network Analysis
    - Finding Best Route, Service area, Closest Facility, OD Cost Matrix, Routing problem, Location-allocation
    - Model Building for route analysis
5. Vector Analysis
    - Feature Extraction Techniques, Proximity Analysis
    - Vector Overlay Operation
6. Raster Analysis:
    - Map Algebra and Boolean Overlay
    - Distance, Density and Zonal Calculation
7. Interpolation Techniques and Analysis
8. Surface Analysis using DEM
9. Model Building in GIS

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Burt, James E., Gerald M. Barber, and David L. Rigby. Elementary statistics for geographers. Guilford Press, 2009.
2. Chang, Kang-Tsung, *Introduction to Geographic Information Systems, 9*th Edition,Tata McGraw-Hill Education, 2019.

3. Chang, Kang-Tsung, *Introduction to Geographic Information Systems, 8th* Edition,Tata McGraw-Hill Education, 2015.
4. Fotheringham Stewart A and Rogerson A. Peter, *The SAGE Handbook of Spatial Analysis*, SAGE Publications, London, 2009.
5. Laurini, R. & Thomson, D., *Fundamentals of Spatial Information Systems*, Academic Press, 1994.
6. Sanders, L., *Models in Spatial Analysis*, John Wiley & Sons, 2013.
7. Wong, David W.S. & Jay Lee, *Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS*, John Wiley and Sons, 2005.

Further Readings:

1. Burrough, P.A. & Macdoneli, R.A., *Principles of Geographic Information Systems,* Oxford University Press, 2000.
2. Demers, M.N., *Fundamentals of Geographic Information Systems*, 2nd Edition, John Wiley and Sons, 2000.
3. Lloyd, Christopher D., *Spatial Data Analysis: An Introduction for GIS Users*, Oxford University Press Inc., New York, 2010.
4. Maguire, D.J.; M. Batty and M.F. Goodchild, *GIS, Spatial Analysis and Modeling*, ESRI Press, 2005.
5. Murayama, Y. and R. Thapa, *Spatial Analysis and Modeling in Geographical Transformation Process: GIS Based Applications*, Springer, 2011.

Pedagogy: Based on participatory teaching-learning, students shall be encouraged to enhance their skills through joint productive activity. Learning-by-doing shall be the guiding principle with a focus on specifically designed hands-on-training and group exercises. Students may be asked to prepare a report on outcomes of different spatial techniques. Students will be encouraged to discuss important themes amongst peers and seek their answer by participating in active classroom discussions

GI 203: DIGITAL IMAGE PROCESSING

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The course is designed to introduce the student to analytical tools and methods which are currently used in digital image processing. The idea is to improve their capabilities for image information extraction by applying cutting edge tools available for satellite image restoration, enhancement and information extraction.

A. THEORY **Marks: 50**

Unit- I

Digital Image Pre-processing

i. Concept and Characteristics: Digital Image and Image Processing
ii. Radiometric Correction: Sources, Types and Correction Methods
iii. Geometric Correction: Sources, Types and Correction Methods.

Unit-II

Image Enhancement Techniques

iv. Introduction to Image Enhancement Techniques
v. Spectral and Radiometric Enhancement Techniques
vi. Spatial Enhancement: Filtering Techniques

Unit-III

Image Transformation: Spectral Enhancement

vii. Image Arithmetic and Indices of Vegetation, Water, Bare Soil and Built-up
viii. Principal Component Analysis (PCA)
ix. Intensity, Hue and Saturation; Fourier Transformation

Unit- IV

Digital Image Classification

x. Pattern Recognition and Image Classification: Approaches and Techniques
xi. Supervised and Unsupervised Classification
xii. Fuzzy Classifier, Hybrid Classifier, Decision Tree Classification and Data Mining
xiii. Accuracy Assessment; Change Detection and Analysis

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25- 30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Familiarization with Image Processing Software
2. Downloading Satellite Imagery, Data Import and Conversion
3. Georeferencing/Image Registration and Re-projection
4. Applications of FCC
5. Image Enhancement: Spectral and Radiometric
6. Look up table and Histogram Manipulation
7. Applications of Filtering Techniques
8. Computing Indices: NDVI, NDBSI, mNDWI, NDBI
9. Principal Component Analysis (PCA)
10. Unsupervised Classification and Accuracy Assessment
11. Supervised Classification and Accuracy Assessment
12. Change Detection Analysis

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Burger W., & Burge, M.J., *Principles of Digital Image Processing,* Springer-Verlag London Limited, 2009.
2. Campbell, J. B. and R.H. Wynne,*Introduction to Remote Sensing* (Fifth Edition), Guilford Press, 2012.
3. Chen, C.H., *Image Processing for Remote Sensing,* CRC Press, 2008.
4. Gonzalez, R.C. & Woods, R.E., *Digital Image Processing*, 2nd edition, Prentice-Hall, Inc., 2002.
5. Jensen, J.R., *Introductory Digital Image Processing: A Remote Sensing Perspective*, Prentice Hall, New Jersey, 1986.
6. Liu, J.G. & Mason, P.J., *Essential Image Processing and GIS for Remote Sensing,* John Wiley & Sons, 2009.
7. Mather, P.M. & Magaly, K., *Computer Processing of Remotely-Sensed Images: An Introduction,* Fourth Edition, John Wiley & Sons, 2011.
8. Richards, John A.,*Remote Sensing Digital Image Analysis: An Introduction,* 5th Edition, Springer Verlag Berlin Heidelberg, 2013.

Further Readings:

1. Dong, P. and Qi Chen, *LiDAR Remote Sensing and Applications*. CRC Press, Taylor & Francis Group, 2018.

2. Gomarasca, Mario A, *Basics of Geomatics*, Springer: Heidelberg, 2009.
3. Jain, A.K., *Fundamentals of Digital Image Processing,* Prentice-Hall, Inc., 2002.
4. Joseph, G. *Fundamentals of Remote Sensing*, Universities Press, 2005.
5. Lillesand, T.M., Kiefer, R.W. & Chipman, J. W., *Remote Sensing and Image Interpretation*, Fourth Edition, John Wiley and Sons, 2004.
6. Pratt, W.K., *Digital Image Processing*, 3rdEdition, John Wiley & Sons, 2001.
7. Prost, Gary L., *Remote Sensing for Geoscientists: Image Analysis and Interpretation*, 3rd Edition, CRC Press, Taylor & Francis, 2013.
8. Schowengerdt, Robert A. *Remote Sensing: Models and Methods for Image Processing*, Second Edition, Academic Press: San Diego, 2017.

PEDAGOGY: Learning shall be promoted through joint productive activity with a focus on participatory learning, hands-on-training and group exercises. Students may be asked to prepare a report of outcomes of image processing techniques applied on satellite images. Students will be encouraged to ask questions and participate in classroom discussions.

GI 204: FUNDAMENTALS OF GNSS

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The objectives of this paper are to give a comprehensive introduction to GNSS, GPS and DGPS technology, system concepts, design, operation, implementation and applications, to provide detailed information on the GPS signal, the processing by the receiver, and the techniques by which GPS obtains position, velocity and time.

(A) THEORY **Marks: 50**

Unit-I

i. Concept and Characteristics of Global Navigational Satellite System (GNSS)
ii. Historical Background, GPS Segments, Features of GPS Satellites, Principles ofOperation, Fundamentals on Satellite Geodesy, Co-ordinate Systems related to GNSS,Survey and Characteristics of Observed Values.

Unit-II

iii. Surveying with GPS: Absolute, Relative and Differential Positioning, Kinematic GPS.
iv. Performing GNSS Measuring and Data Processing, Overview on Geodetic Dataand Data Transformation

Unit-III

v. Survey on GNSS Application: Basic Principles in Working with DGNSS
vi. Methods for Determining and Techniques for Searching Ambiguities both for Phase Data and the Combination of Code and Phase Data GNSS Application in: Geodesy, Geodynamics, Tectonic Plate Movement with Time Alternating Coordinates, Navigation, Space.

Unit-IV

vii. Diverse Systems for Global Positioning: GPS, GLONASS, GALILEO, Beidou, IRNSS
viii. Location-based Services: Practical Application.

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questionsshall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from eachunit. The candidates will attempt 4 questions selecting one from each unit carrying 9marks each (total 36 marks). These will be in addition to the Compulsory Question atserial number I.

(B) PRACTICAL **30 Marks**

1. Components and Operation of GPS Instrument
2. Understanding the Different Pages of GPS

3. Collecting Readings using Primary Pages
4. Surveying a Small Area and Area Calculation
5. Mapping of the Surveyed Area
6. Tabulation of Information of the Surveyed Area
7. Analysis of the Map and Data Collected
8. Application Exercises

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Anderle, R., *The Global Positioning System*, Royal Society of London, UK, 1988.
2. El-Rabbani, Ahmed, *Introduction to GPS: The Global Positioning System*, Artech House, 2002.
3. Kaplan, E. D. and C.J. Hegarty (eds.), *Understanding GPS/GNSS: Principles and Applications*, 3rd Edition, Artech House, 2017.
4. Leick, A, Lev Rapoport and Dmitry Tatarnikov, *GPS Satellite Surveying*, 4th Edition, John Wiley & Sons, 2015.
5. Letham, Lawrence, *GPS Made Easy: Using Global Positioning Systems in the Outdoors*, Rocky Mountain Books, 2008.
6. Rao, G.S., *Global Navigation Satellite Systems- With Essentials of Satellite Communications*, Tata McGraw Hill Education Private Limited, New Delhi, 2010.

Further Readings:

1. Fell, P. J., *Geodetic Positioning Using GPS*, The Ohio State University Report no. 299, Columbus, Ohio, USA, 1980.
2. Goad, C. C., *Proceedings of First International Symposium on GPS*, USA, 1985.
3. Gomarasca, Mario A, *Basics of Geomatics*, Springer: Heidelberg, 2009
4. King, R. W. & Others, *Surveying GPS*, University of New South Wales, Australia, 1985.
5. Noureldin. A., Karamat, T.B. and Jacques Georgy, *Fundamentals of Inertial Navigation, Satellite-based Positioning and their Integration*, Springer, 2013.
6. Rizos, *Introduction to GPS*, University of New South Wales, 1999.
7. Srivastava, G.S., *An Introduction to Geoinformatics*, McGraw Hill Edu., India, New Delhi, 2014

PEDAGOGY: Students will be provided demo exercises to increase their awareness about wide ranging applications of GPS. Students may be asked to prepare a database of various themes gathered using GPS devices and analyse the data after relevant post-processing. Students will be encouraged to ask questions and participate in classroom discussions.

SEMESTER-III

GI 301: RESEARCH METHODOLOGY AND INTERNSHIP REPORT

Max. Marks: 100
Theory: 50
Internship Report: 30
Internal Assessment: 20

Objectives: The aim of this paper is to train the students regarding the various aspects ofresearch writing so that they are in a position to write research reports independently.

(A) THEORY **Marks: 50**

Unit-I

Basic Concepts in Research

i. Meaning, Objectives and Significance of Research
ii. Types of Research and Research Approaches.
iii. The Research Process

Unit-II

Data Collection and Analysis in Research

iv. Types and Sources of Data
v. Data Collection: Methods and Techniques
vi. Data Processing and Analysis

Unit-III

Sampling and Sampling Design:

vii. Sampling: Concept, Need and Significance
viii. Probability and Non-Probability Sampling
ix. Sampling Techniques; Spatial Sampling

Unit-IV

Research Proposal and Report Writing

x. Formulation of Research Proposal
xi. Types and Elements of Report;
xii. Steps involved in Report Writing; Presentation of Findings

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) INTERNSHIP REPORT **Max. Marks: 30**

- **Distribution of Marks**:
  a. Evaluation of the Internship Report: 10 marks
  b. Presentation of Data Analysis and Main Findings: 10 marks
  c. Viva-voce: 10 marks
- **Duration of Internship**: 4 Weeks
- **Timing of Internship**: During Summer Vacation following Semester -II Examination
- **Arrangement of Internship:** The Board of Control of Department will plan the task of Internship and coordinate withGovt. Institutes/ Companies, Consultancies, NGOs, Govt. Agency and Other Agencies,Institutes and Centers in India.Candidates desirous of identifying an agency on their own may submit to the Department aletter stating their intent and a letter of acceptance from the said agency. Those who wishthe Department to arrange Internship may express this through a letter to the Chairperson.The Board of Control will consider these

applications and make arrangements in the bestinterest of the students. All those agencies where Internship will be allowed and undertaken will certify the Attendance, Joining and Relieving of the students/candidates.

- **Evaluation of Internship Report:**

1. Each candidate shall be assigned by the Board of Control to a faculty member for supervision/co-supervision of his/her Internship Report.
2. The Internship Report shall be prepared by the candidate on the basis of work done or experience gained on visit(s) to Remote Sensing Centre(s)/Institute(s)/ Companies, Consultancies, NGOs, Govt. Agency and Other Agencies, Institutes and Centres in India. The candidate shall submit three copies of his/her Internship Report ten days before the commencement of the theory examination of the said semester.
3. Three examiners shall comprise the Board of Examiners consisting of Supervisor/Co-supervisor, Chairperson of the Department and one more Faculty Member teaching the Course. They shall evaluate the Internship Report independently and the student shall be awarded the mean score of the three evaluations.
4. The evaluation process shall have three components: (i) Evaluation of the Internship Report, (ii) Presentation of Data Analysis and Main Findings, and (iii) Viva- voce before the Board of Examiners.

(C) INTERNAL ASSESSMENT **Marks: 20**

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

LIST OF READINGS

Essential Readings:

1. Creswell, John W., *Research Design; Qualitative, Quantitative and Mixed Methods Approach*, SAGE Publications, Los Angeles, 2008.
2. Flick, U. *An Introduction to Qualitative Research*, 5th Edition, SAGE, 2014.
3. Kothari, C. R., *Research Methodology, Methods & Techniques,* New Age International Publisher, N. Delhi, 2008.
4. Kumar Ranjit, *Research Methodology: A step-by-step Guide for Beginners*, SAGE Publications, Ltd. London (Third Edition), 2010.
5. Montello, D. and P. Sutton, *An Introduction to Scientific Research Methods in Geography and Environmental Studies*, SAGE, 2012

Further Readings:

1. Bennet P. Lientz and Kathryn P.**,** *Project Management for the 21st Century*, Academic Press, California, 1995.
2. Earickson, R., and Harlin, J., *Geographic Measurement & Quantitative Analysis*, Macmillan, New York, 1994.
3. Kothari, C.R., *Research Methodology: Methods and Techniques (Third Edition),* New Age International Limited, 2015.
4. Misra, H. N and V. P. Singh, *Research Methodology in Geography, Social, Spatial and Policy Dimensions*, Rawat Publications, N. Delhi, 1998.
5. W. E. Huxold & A. G.Lerinsons Aronoft. S., *Managing Geographic Information Projects*, 1989.

PEDAGOGY: Assignments pertaining to a relevant problem shall be given to students to apply the various aspects of research. The application will expose them about the importance of research and the practical exercises will ignite them to do effective research in future.

GI-302: GEOINFORMATICS FOR GEOSCIENCES

Max. Marks	**: 100**
Theory	: 50
Practical	: 30
Internal Assessment	: 20

Objectives: To train the students to detect, identify and analyse the various facets of geomorphic and geological features; analyse hydrological and geo-environmental parameters and seek solutions to environmental problems with the help of geospatial technology.

(A) THEORY **Marks: 50**

Unit - I

Geoinformatics for Geological Studies

i. Role of Geoinformatics in Geological Mapping, Mineral and Oil Exploration
ii. Identification and Mapping of Geomorphological Features
iii. Spectral Signatures of Rocks; Mapping Lithological/Structural Features
iv. Terrain Analysis and Interpretation

Unit - II

Geoinformatics for Hydrological Studies

v. Spectral Signature of Water; Surface Water Analysis and its Characteristics
vi. Drainage Mapping and Morphometric Analysis of Drainage Basin
vii. Bathymetric Mapping and Analysis
viii. Water Quality Monitoring and Groundwater Potential Analysis

Unit - III

Geoinformatics for Land Evaluation Studies

ix. Role of Geoinformatics in Land Evaluation and Management
x. Land Use/Land Cover Analysis
xi. Wasteland: Mapping and Management
xii. Analysis of Soil and Land Degradation

Unit - IV

Geoinformatics for Agriculture and Forestry

xiii. Spectral Signature of Crops and Principles of Crop Identification
xiv. Crop Acreage Estimation and Crop Yield Modeling
xv. Forest Cover Mapping and Analysis
xvi. Forest Fire Analysis and Management

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Generation of 3-Dimensional Model of Terrain
2. Mapping and Analysis of Absolute and Relative Relief
3. Measurement of Slopes: Degree, Aspect and Curvature
4. Generation of Spatial Profile and Surface Profile
5. Geomorphological Mapping
6. Lineaments/Fault Mapping and Analysis
7. Drainage Pattern Analysis
8. Morphometric Analysis of a Drainage Basin
9. Groundwater Potential Zonation and Mapping
10. Land Use/Land Cover Analysis
11. Forest Cover and Forest Density Analysis

12. Forest Fire Risk Analysis
13. Soil Erosion Mapping and Analysis

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Gomarasca, Mario A, *Basics of Geomatics*, Springer: Heidelberg, 2009.
2. Gupta, R.P., *Remote Sensing Geology*, 3rd Edition, Springer, Heidelberg, Germany, 2018.
3. Joseph, George, *Fundamentals of Remote Sensing,* Universities Press India, 2007.
4. Lillesand, T. M.; R.W. Kiefer, and J.W. Chipman, *Remote Sensing and Image Interpretation*, 5th Edition, Wiley, 2007.
5. Prost, G.L. *Remote Sensing for Geoscientists- Image Analysis and Interpretation* (3rdEdition), CRC Press, 2014.
6. Sabins, Floyd F., *Remote Sensing: Principles and Interpretation,* New York: WH Freeman and Company, 2007.

Further Readings:

1. Campbell, J. B. and R.H. Wynne, *Introduction to Remote Sensing* (Fifth Edition), Guilford Press, 2012.
2. Agarwal, C.S. and P.K. Garg, *Text Book on Remote Sensing in Natural Resources Monitoring and Management*, Wheeler PublishingCo, New Delhi, 2000.
3. Verbyla, David, L., *Satellite Remote Sensing of Natural Resources*, Lewis Publishers, New York, 2005.

Pedagogy: Students may be taken to institutions such as IIRS, NRSC and State Remote Sensing Centers to acquaint them with equipment, techniques and their products. Students may be asked to prepare a report on landform using topographical sheets, aerial photographs and satellite images. Students may acquaint with the satellite imageries of various kinds of environmental problems.

GI 303: GEOINFORMATICS FOR URBAN AND REGIONAL PLANNING

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: The courseis designed to develop skills to enhance the understanding of urban and regional planning process. It aims at demonstrating applicability of geoinformatics in preparing geodatabase, analysing and solving problems related to urban and regional planning.

(A) THEORY **Marks: 50**

Unit-I

Basic Concepts in Planning

i. Planning: Definition and Types
ii. Concept of Urban and Urban Planning
iii. Concept of Region and Regional Planning

Unit- II

Urban Planning

iv. Role of Remote Sensing and GIS in Urban Planning
v. Creation of Data Base for Urban Planning
vi. Urban Land Use Maps; Location of Facilities and Amenities

Unit-III

Regional Planning

vii. Role of Remote Sensing and GIS in Regional Planning
viii. Creation of Data Base for Regional Planning
ix. Land Use/Land Cover Analysis; Land Use Suitability Evaluation

Unit-IV

Urban and Regional Management

x. Urban Change Detection and Growth Monitoring, Urban Heat Island Monitoring
xi. Slum Identification and Improvement; Urban Policing.
xii. Geoinformatics for Perspective Urban and Regional Planning

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25- 30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Preparation of Base Maps for Regional and Urban Planning.
2. Location of Basic Amenities and Facilities
3. Land Use and Land Cover Analysis.
4. Urban Growth Monitoring and Change Detection.
5. Mapping Urban Heat Island
6. Location Allocation Modelling
7. Site Suitability Analysis
8. Slum Identification and Mapping.
9. Urban Crime Analysis

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Bhatta, B., *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, Springer-Verlag Berlin Heidelberg, 2010.
2. Campbell, J. B. and R.H. Wynne, *Introduction to Remote Sensing* (5th Edition), Guilford Press, 2012.
3. Chang, Kang-Tsung, *Introduction to Geographic Information Systems,* Sixth Edition, Tata McGraw-Hill, 2011.
4. Muralikrishna, I.V., *Remote Sensing Applications and Geographic Information Systems - Recent Trends*, Tata McGraw Hill, New Delhi, 1992.
5. Ian Heywood,Sarah Cornelius and Steve Carver, *An Introduction to Geographical Information Systems*, Prentice Hall College Div, New Jersey, USA, 2000.
6. Shen, Zhenjiang, *Geospatial Techniques in Urban Planning*, Springer-Verlag Berlin Heidelberg, 2012.
7. Wong, David W.S. & Jay Lee, *Statistical Analysis of Geographic Information withArcView GIS and ArcGIS*, John Wiley and Sons, 2005.

Further Readings:

1. Barret, E.C. & Curtis, E.F., *'The Built Environment' in Remote Sensing of Environment*, Second edition, pp. 293-306, 1982.
2. Brimicomne, A. GIS, *Environmental Modeling and Engineering*, 2nd Edition, CRC Press: Taylor & Francis Group, 2010.
3. Burrough, P.A. & Macdoneli, R.A., *Principles of Geographic Information Systems,* Oxford University Press, 2000.
4. Demers, M.N., *Fundamentals of Geographic Information Systems*, 2nd Edition, John Wiley and sons, 2000.
5. Maguire, D.J.; M. Batty and M.F. Goodchild, *GIS, Spatial Analysis and Modeling*, ESRI Press, 2005
6. Sundaram, K.V., *Urban and Regional Planning in India*, Concept, New Delhi, 1977.
7. Taylor, John, L., *Urban Planning Practice in Developing Countries*, Williams, David C Pergamon Press, 1981.
8. Verbyla, David, L., *Satellite Remote Sensing of Natural Resources*, Lewis Publishers, New York, 2005.

Pedagogy: Taking students for fieldwork, inviting professionals for lectures, taking students to institutes/training centers engaged in imparting professional training and providing research consultancy in urban and regional planning should be the main focus.

GI 304: GEOINFORMATICS FOR DISASTER MANAGEMENT

Max. Marks: 100
Theory: 50
Practical: 30
Internal Assessment: 20

Objectives: To train the students to detect, identify and analyze hazards and disasters using geospatial technology. The focus is on developing technical skills among students for analysing various geo-tectonic and hydro-meteorological disasters with the help of remote sensing and GIS technology.

(A) THEORY **Marks: 50**

Unit- I

Geoinformatics Perspective for Disaster Management

i. Significance of Geoinformatics in Disaster Management
ii. Contribution of Geoinformatics to Disaster Management
iii. Satellite Sensors and Data for Disaster Management

Unit- II

Geoinformatics for Disaster Mitigation and Preparedness

iv. Hazard Evaluation: Analysis, Zonation and Modelling
v. Risk and Vulnerability Assessment
vi. Monitoring and Forecasting; Warning and Evacuation

Unit-III

Geoinformatics for Geo-tectonic Hazards and Disasters

vii. Landslide Hazard Assessment and Monitoring
viii. Seismic Hazard Assessment and Monitoring
ix. Volcanic Hazard Assessment and Monitoring

Unit-IV

Geoinformatics for Hydro-meteorological Hazards and Disasters

x. Flood Hazard Assessment and Monitoring
xi. Cyclone Hazard Assessment and Monitoring
xii. Drought Hazard Assessment and Monitoring

Note:

1. A Compulsory Question at serial number I containing 10 short answer type questions shall be set covering the whole syllabus. Student will attempt any 7 parts in about 25-30 words each. Each part shall carry 2 marks (total 14 marks).
2. A total of eight questions will be set out of the whole syllabus, at least 2 from each unit. The candidates will attempt 4 questions selecting one from each unit carrying 9 marks each (total 36 marks). These will be in addition to the Compulsory Question at serial number I.

(B) PRACTICAL **Marks: 30**

1. Data requirements for various hazards and disasters
2. Preparation of Terrain/Topographical and thematic layers
3. Hazard Auditing and Vulnerability Assessment
4. Landslide Hazard Zonation
5. Seismic Hazard Assessment
6. Volcanic Hazard Assessment
7. Flood Hazard and Risk Analysis
8. Drought Analysis and Mapping

Note: The practical examination shall be conducted by a team of three examiners, including the faculty teaching the paper, Chairperson of the Department and one additional faculty member teaching the course.

(C) INTERNAL ASSESSMENT **Marks: 20**

Internal assessment shall be based on Written Test, Snap Test, Participation in Class discussion, Term Paper and Attendance as prescribed by the University.

LIST OF READINGS

Essential Readings:

1. Campbell, J. B. and R.H. Wynne, *Introduction to Remote Sensing* (5thEd.), Guilford Press, 2012.
2. Hyndman, D. and D. Hyndman, *Natural Hazards and Disasters*, 2nd edition. USA, Belmont: Brooks/Cole, 2009.
3. Oosterom, P. van, Zlatanova,S. and E.M. Fendel*, Geo-information for Disaster Management,* Springer, 2005.
4. Roy, P.S.; Van Westen, C.J.; Jha, V.K.; Lakhera, R.C. and Champati Ray, P.K., *Natural Disaster and their Mitigation: Remote Sensing and Geographical Information System Perspectives*, IIRS, Dehra Dun, Govt. of India, 2000.
5. Tomaszewski, B., *Geographic Information System (GIS) for Disaster Management*, CRC Press, Taylor & Francis Group, Boca Raton, 2015.

Further Readings:

1. Bankoff, G.; Frerks, G. and Hilhorst, D. (2004). *Mapping Vulnerability: Disasters, Development and People*, Earthscan Publications Ltd.
2. Blaikie, P.; T. Cannon; I. Davis; and B. Wisner (1994). *At Risk: Natural Hazards, People's Vulnerability, and Disasters*, 1st edition, London: Routledge.
3. Pirasteh, S. and Jonathan Li (eds.), *Global Changes and Natural Disaster Management: Geo-information Technology*, Springer, 2017.
4. Verbyla, David, L., *Satellite Remote Sensing of Natural Resources*, Lewis Publishers, New York, 2005.

Pedagogy: Students will be encouraged to undergo practical problem-solving exercises on various aspects of disaster mitigation, preparedness, warning, forecast and manage disaster with key inputs from geospatial technology. They may be taken to institutions such as IIRS, NRSC and State Remote Sensing Centers to acquaint them with equipment, techniques and their products available for disaster management. Students may be acquainted with the satellite data, products, software of various kinds.

SEMESTER-IV

GI 401: DISSERTATION

Marks: 400

1. Formulation of Research Proposal 50 marks 2. Mid Term appraisal 50 marks 3. Pre-submission Presentation 50 marks	**Examination Board** Chairperson Supervisor/Co-supervisor One Faculty teaching the course
1. Dissertation Evaluation 150 marks 2. Presentation 50 marks 3. Viva-voce 50 marks	**Examination Board** Chairperson Supervisor/Co-supervisor One External Examiner

- Three copies of the dissertation shall be submitted only on the approval of the Supervisor; the signatures of the supervisor are mandatory for submission of dissertation.
- A Summary shall be submitted with the dissertation in hard and soft copy. Dissertation to be submitted 3 weeks prior to commencement of University Semester Examination.

Note:

1. **Assigning the Title:** Candidates shall submit in the department office the proposed titles for dissertation after due consultation with their supervisor/s within 10 days of commencement of academic session
2. **Formulation of Research Proposal:** Candidates are required to give a presentation on research proposal including the research objectives, methodology and the chapter scheme ***three weeks after the assigning of the dissertation title***. The Board of Examiners consisting of the Chairperson of the Department, Supervisor/s and one Faculty Member teaching the course shall evaluate the student independently and student shall be awarded the mean score of the three evaluations.
3. **Mid-term Appraisal:** Mid-term appraisal of the dissertation of each student shall be done by the Board of Examiners ***within a month of formulation of research proposal***. The Board of Examiners consisting of the Chairperson of the Department, Supervisor and one Faculty Member teaching the course shall evaluate the student independently and student shall be awarded the mean score of the three evaluations.
4. **Pre-submission Presentation:** Pre-submission Presentation shall be done by the Board of Examiners ***within a fortnight of the mid-term appraisal***. The Board of Examiners consisting of the Chairperson of the Department, Supervisor and one Faculty Member teaching the course shall evaluate the student independently and student shall be awarded the mean score of the three evaluations.
5. **Evaluation Process:** The evaluation process shall have three-components:
   i. Evaluation of dissertation
   ii. Presentation of data analysis and main findings
   iii. Viva voce examination

   Evaluation, Presentation and Viva-voce shall be done by the Board of Examiners consisting of the Chairperson of the Department, Supervisor and one External Examiner. They shall evaluate the dissertation, submitted by the student, independently and student shall be awarded the mean score of the three evaluations. The dissertation shall incorporate the findings arrived at on the basis of the data/information collected from the field and processed, analysed and mapped.
