ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం आंध्रप्रदेश केंद्रीय विश्वविद्यालय

CENTRAL UNIVERSITY OF ANDHRA PRADESH

(Established by an act of Parliament in 2019)

School of Arts, Humanities and Social Sciences
Department of Geography & Geoinformatics

Postgraduate Programme Structure
As per the UGC Credit Framework (NEP 2020)

Vidya Dadati Vinayam
(Education Gives Humility)

M.Sc. Geography & Geoinformatics

Programme Structure
(With effect from AY 2025 - 26)

CONTENTS

School of Arts, Humanities and Social Sciences
Department of Geography & Geoinformatics

Introduction

The Master of Science in Geography and Geoinformatics program at the Central University of Andhra Pradesh offers an advanced interdisciplinary education in geography and geoinformatics. This program is designed to equip students with a comprehensive understanding of spatial analysis, geographic information systems (GIS), remote sensing, and other geospatial technologies. Through a blend of theoretical knowledge and practical application, students will develop the skills necessary to address complex spatial challenges in various sectors including environmental management, urban planning, resource management, and disaster mitigation.

Programme Objectives

- To provide students with a solid foundation in the principles and theories of geography and geoinformatics.
- To develop students' proficiency in utilizing geospatial technologies such as GIS, remote sensing, and spatial analysis tools.
- To foster critical thinking and problem-solving skills necessary for addressing contemporary spatial challenges.
- To enable students to conduct independent research and contribute to the advancement of knowledge in the field of geography and geoinformatics.
- To prepare students for careers in academia, government agencies, non-profit organisations, and private industries where geospatial skills are in high demand.

Programme Outcomes

Upon successful completion of the Master of Science in Geography and Geoinformatics program, graduates will be able to:

- Demonstrate a deep understanding of the principles and theories of geography, geoinformatics, and related disciplines.
- Apply geospatial technologies effectively to analyse and solve complex spatial problems in diverse contexts.
- Design and execute research projects utilising geospatial data and methodologies.
- Communicate effectively through written reports, presentations, and other forms of dissemination, showcasing their knowledge and findings.
- Work collaboratively in multidisciplinary teams to address real-world spatial challenges.
- Demonstrate ethical and professional conduct in collecting, analysing, and interpreting geospatial data.

This program offers a dynamic learning environment with access to state-of-the-art geospatial laboratories, expert faculty, and opportunities for fieldwork and internships. Graduates of the Master of Science in Geography and Geoinformatics program will be well-positioned to pursue rewarding careers or further study in the rapidly growing field of geospatial science.

ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం आंध्रप्रदेश केंद्रीय विश्वविद्यालय

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Semester and Course wise Credits

Semester	Discipline Specific Core (DSC) (L+T+P)	Discipline Elective (DSE) /Elective (EL)	Project Work Dissertation	Common Compulsory Course (CCC)	Inter-Disciplinary Elective	Internship	Lab	Total Credits
I	DSC1(4) DSC2(3) DSC3(4) DSC4(3)	DSE 1(4)/DSE 2(4)/ DSE 3(4) MOOC	-		IDE 1 (3) ONLINE		DSC 2 (1) DSC 4 (1)	**23**
II	DSC5(4) DSC6(3) DSC 7(3) DSC 8 (4)	DSE 4(4)/DSE 5(4)/ DSE 6(4) MOOC	-	CCC-1 Introduction to AI (4)	IDE2 (3) online		DSC 6 (1) DSC 7 (1)	**27**
III	DSC 9(3) DSC10(3) DSC 11 (3)	DSE 7(4)/DSE 8(4)/ DSE 9(4) MOOC		CCC-2 Building Mathematical Ability (4)	IDE3 (3) online	Internship (2)	DSC 9(1) DSC10(1) DSC 11 (1)	**25**
IV	DSC 12 (4)	-	Dissertation (16)				-	**20**
Total	**41**	**12**	**16**	**8**	**9**	**2**	**7**	**95**
Percentage	**43.16**	**12.63**	**16.84**	**8.42**	**9.47**	**2.10**	**7.37**	**100**

IDE: Interdisciplinary Elective **AECC**: Ability Enhancement Compulsory Course **SEC:** Skill Enhancement Courses **VAC:** Value-Added Courses
MOOCs: Massive Open Online Course

Department of Geography & Geoinformatics

Programme Structure with Course Titles

Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
Semester I						
1	MGG 101	Introduction to Geography	4	4	0	0
2	MGG 102	Geographic Information Systems (GIS) Fundamentals	4	3	0	1
3	MGG 103	Introduction to Geographical Thoughts	4	4	0	0
4	MGG 104	Introduction to Geo informatics	4	3	0	1
5	MGG105	**Any one of the following** Digital Cartography and GIS Database Management Systems Geostatistics & Statistical Methods In Geography	4	3	0	1
6	MGG 112 (IDE)	MOOCs (Online/offline)	3	3	0	0
Total			**23**	**20**	**0**	**3**
Semester II						
1	MGG 201	Economic Geography	4	4	0	0
2	MGG 202	Principles of Remote Sensing	4	3	0	1
3	MGG 203	Digital Image Analysis	4	3	0	1
4	MGG 204	Regional Geography of India	4	4	0	0
5	MGG 211 (DSE)	**Any one of the following** Web Mapping and Geo-Visualization Agricultural Geography with Special Reference to India Population Geography, Urbanization and Urban Utility Management	4	3	0	1
6	MGG 212 (IDE)	MOOCs (Online/offline)	3	3	0	0
7	MGG 213 CCC-I	Introduction to Artificial Intelligence and Machine Learning	4	4	0	0
Total			**27**	**24**	**0**	**3**

Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
Semester III						
1	MGG 301	Geographical Information Systems (GIS) Applications	4	3	0	1
2	MGG 302	Advanced Geospatial analysis	4	3	0	1
3	MGG 303	Research Methods in Geography & Geo Informatics	4	3	0	1
4	MGG 311 (DSE)	**Any one of the following**	4	3	0	1
		Advanced Surveying and field work				
		Environmental Geography and Sustainable Development				
		Regional Planning and Development				
5	MGG 312 (IDE)	MOOCs	3	3	0	0
6	MGG 313 CCC-II	Building Mathematical Ability and Financial Literacy	4	4	0	0
7	MGG 314	Internship	2	0	0	2
Total			**25**	**19**	**0**	**6**
Semester IV						
1	MGG 401	Applied statistics and computing	4	3	0	1
2	MGG 411	Dissertation	16	0	0	16
Total			20	3	0	17
Grand Total			**95**	**66**	**0**	**29**

Semester-Wise Credit Distribution

Semester	Total Credits	Cumulative credit at the end of the semester
I	23	23
II	27	50
III	25	75
IV	20	95

Important Information to Students

I. Programme: M.Sc. In ***Geography & Geoinformatics***.

II. Eligibility: With at least 50% marks in the Bachelor's degree in Geography/Science/Technology/Architecture/Town planning/Statistics and any other allied/relevant areas and allied discipline with a minimum 50% marks or equivalent grade.

III. The minimum duration for completion of any PG Programme is four semesters (two academic years) and the maximum duration is eight semesters (four academic years) or as per amendments made by the regulatory bodies from time to time.

IV. A student should attend atleast 75% of the classes, seminars, practicals/ lab in each course of study.

V. All theory courses in the M. Sc. In Geography & Geoinformatics programme carry a Continuous Internal Assessment (CIA) component to a maximum of 40 marks and End Semester Examination (ESE) for a maximum of 60 marks. The minimum pass marks for a course is 40%.

VI. All lab components carry a Continuous Internal Assessment (CIA) component to a maximum of 60 marks and End Semester Practical Examination (ESE) for maximum of 40 marks. The minimum pass marks for a course in 40%

VII. A student should pass separately in both CIA and the ESE, i.e., a student should secure 16 (40% of 40) out of 40 marks for theory and 24 (40% of 60) out of 60 marks for lab components in the CIA. Therefore, a student should secure 24 (40% of 60) out of 60 marks for theory and 16(40% of 40) out of 40 marks for lab components in the end semester examination (ESE).

Marks for the Attendance will be considered as follows:

S. No	Attendance (%)	Marks
1	95% or more	5
2	90-94%	4
3	85-89%	3
4	80-84%	2
5	75-79%	1

VIII. A student failing to secure the minimum pass marks in the CIA is not allowed to take the end semester reexamination of that course. She/he has to redo the course by attending special classes for that course and get the pass percentage in the internal tests to become eligible to take the end semester examination.

IX. Students failing a course due to lack of attendance should redo the course.

X. Re-evaluation is applicable only for theory papers and shall not be entertained for other components such as practical/thesis/dissertation/ internship etc.

XI. A non-campus elective course is offered only if a minimum of ten or 40% of the students registered, whichever is higher, exercise their option for that course.

DETAILED SYLLABUS

Semester I

Course Code: MGG 101 **Core/ Elective: Core** **No. of Credits: 4**	**Course Title** **Introduction to Geography**

Objective: The primary objective of this course is to provide students with a comprehensive understanding of the fundamental principles and concepts of geography. Students will explore the physical and human processes that shape the Earth's landscapes, environments, and places. This course aims to provide a structured framework for students to understand and appreciate the complex interplay between physical and human geography, enhancing their ability to analyze geographic data and apply geographic perspectives to real-world issues.

Learning Outcomes:

1. Students will be able **to** explain the basic concepts and principles of geography, including physical geography, human geography, and the interactions between them.
2. The students will be able **to** Utilize maps, geographic information systems (GIS), and other tools to analyze spatial data and understand geographic patterns and processes.
3. Apply geographic perspectives and methods to real-world problems and case studies, demonstrating critical thinking and problem-solving skills.

Course Outline:

Unit 1: Foundations of Geography 15 hours

- **Introduction to Geography:**
  - Definition and scope of geography
  - Overview of physical and human geography

Geographic Tools and Techniques:
  - Maps and cartography
  - Geographic Information Systems (GIS)
  - Spatial analysis and remote sensing

Unit 2: Physical Geography 15 hours

- **Earth's Structure and Landforms:**
  - Plate tectonics and landform development
  - Weathering, erosion, and soil formation
  - Climate systems and global climate patterns
  - Weather phenomena and their geographic impacts
  - Types of ecosystems and biomes
  - Biodiversity and environmental sustainability

Unit 3: Human Geography 15 hours

- **Population and Demographics:**
  - Population distribution and density
  - Demographic transitions and population growth

Cultural Geography:
  - Cultural landscapes and identities
  - Language, religion, and ethnicity

Urbanization and Economic Geography:
  - Urban development and land use
  - Economic activities and globalization

Unit 4: Human-Environment Interactions 15 hours

- **Resource Use and Environmental Impact:**
  - Natural resources and their management
  - Environmental degradation and conservation

Geopolitical Issues:
  - Territoriality and political boundaries
  - Geopolitical conflicts and cooperation

Sustainable Development:
  - Principles of sustainability
  - Case studies on sustainable practices

References:

- Strahler, A. H., & Strahler, A. N. (2013). *Introducing Physical Geography* (6th ed.). Wiley.
- Knox, P. L., & Marston, S. A. (2016). *Human Geography: Places and Regions in Global Context* (7th ed.). Pearson.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Systems and Science* (4th ed.). Wiley.
- Marsh, W. M., & Grossa, J. M. (2014). *Environmental Geography: Science, Land Use, and Earth Systems* (4th ed.). Wiley.
- Pacione, M. (2009). *Urban Geography: A Global Perspective* (3rd ed.). Routledge..

Course Code: MGG 102 Core/ Elective: Core No. of Credits: 4	Course Title Geographic Information Systems (GIS) Fundamentals

Objective: The objective of this course is to provide students with a foundational understanding of Geographic Information Systems (GIS), including their definitions, applications, components, and the development of GIS technology. Students will learn about geographic data types, data input, storage, editing, and the various methods of spatial analysis and GIS output presentation.

Learning Outcomes: By the end of this course, students will be able to:

1. Define GIS and describe its applications, components, and elements, including the development of GIS technology.
2. Equipping students with essential skills and knowledge for leveraging GIS in various applications.
3. Explain the nature of geographic data, differentiate between spatial and attribute data, and understand vector and raster data models, along with data input devices and methods for storage and manipulation of GIS databases.
4. Perform neighbourhood and proximity analyses, use buffer and overlay analyses, and effectively present GIS outputs.

Course Outline:

Unit 1: Introduction to GIS 15 hours

- Definition and Applications:
- Components and Elements of GIS:
- Development of GIS Technology:
- Geographic Objects and Maps:
- Coordinate Systems and Map Projections:

Unit 2: GIS Data Input, Storage, and Editing 15 hours

- Nature of Geographic Data:
- Vector and Raster Data Models:
- Data Input Devices and Methods:
- Storage and Manipulation of GIS Databases:

Unit 3: GIS Spatial Analysis 20 hours

- Spatial Analysis Techniques:
- Overlay Analysis:
- Presentation of GIS Outputs:

Unit 4: Practical Applications of GIS and Future Trends 10 hours

- GIS Project Development:
- Emerging Trends and Technologies in GIS:
- Ethical and Legal Considerations:

References:

- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Systems and Science* (4th ed.). Wiley.
- Bolstad, P. (2016). *GIS Fundamentals: A First Text on Geographic Information Systems* (5th ed.). Eider Press.
- DeMers, M. N. (2008). *Fundamentals of Geographic Information Systems* (4th ed.). Wiley.
- Chang, K. (2019). *Introduction to Geographic Information Systems* (9th ed.). McGraw-Hill.
- ESRI. (n.d.). *ArcGIS Online Resources*. Retrieved from https://www.esri.com/en-us/arcgis/about-arcgis/overview

Course Code: MGG 103 Core/ Elective: Core No. of Credits: 4	Course Title Introduction to Geographic Thoughts

Objective: This course aims to provide students with an in-depth understanding of the evolution of geographic thought, key theories, and contemporary philosophical debates in geography. Students will also learn various methods of geographical analysis and explore the future of geography in a globalizing world, including contributions from Indian geography.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the historical development and paradigms in geographic thought, including environmentalism, possibilism, differentiation, and spatial organization.
2. Identify and assess different theories and their applications in geography, focusing on human-environment interactions and social theory.
3. Critically understand and engage with philosophical debates in contemporary geography, including positivism, behavioralism, realism, Marxism, structuralism, post-structuralism, and postmodernism.
4. Utilize and critically assess various methods of geographical analysis, including quantitative, qualitative, field, and cartographic methods.

Course Outline:

Unit 1: Evolution of Geographic Thought 15 hours

- **Changing Paradigms in Geography:**
  - Environmentalism: Understanding the natural environment's influence on human activities.
  - Possibilism: The concept that humans are not solely determined by their environment.
  - Areal Differentiation: The study of spatial variations and regional characteristics.
  - Spatial Organization: The arrangement of different elements in physical space.

Unit 2: Theory in Geography 15 hours

- **Structure and Nature of Geographic Theories:**
  - Types and applications of theories in geography.
  - Human-Environment Interactions: Analyzing the dynamic relationship between humans and their environment.
  - The Quantitative Revolution in Geography
  - Behavioral and Humanistic Geography
  - Social Theory: Incorporating social theory into geographic studies.

Unit 3: Philosophical Debates in Contemporary Geography 15 hours

- **Critical Understanding of Major Philosophical Approaches:**
  - Positivism: Emphasizing empirical data and scientific methods.
  - Behavioralism: Focusing on human behavior in geographic contexts.

- Realism: Addressing the reality of spatial phenomena.
- Marxism: Analyzing the economic and social processes shaping geography.
- Structuralism: Exploring underlying structures influencing human geography.
- Post-Structuralism and Postmodernism: Critiquing traditional narratives and embracing multiple perspectives.

Unit 4: Contemporary Debates and Future Directions 15 hours

- Changing Nature and Concepts: Adaptations in geographic thought in response to global changes.
- Emerging Approaches and Methodologies: Innovations in geographic research methods.
- Geographic Information Science (GIS) and Technological Advances
- Feminist Geography and Postmodernism
- The Future of Geographic Thought and Practice
- Indian Geography: Highlighting key advancements and research in the Indian context.

References:

- Peet, R. (1998). *Modern Geographical Thought*. Wiley-Blackwell.
- Harvey, D. (1969). *Explanation in Geography*. Edward Arnold.
- Gregory, D., Johnston, R., Pratt, G., Watts, M. J., & Whatmore, S. (Eds.). (2009). *The Dictionary of Human Geography* (5th ed.). Wiley-Blackwell.
- Kitchin, R., & Tate, N. J. (2013). *Conducting Research in Human Geography: Theory, Methodology and Practice*. Routledge.
- Agnew, J., Mitchell, K., & Toal, G. (Eds.). (2003). *A Companion to Political Geography*. Wiley-Blackwell.
- Singh, R. B. (Ed.). (2009). *Indian Geography: Perspectives, Concerns and Issues*. Rawat Publications.

Course Code: MGG 104 Core/ Elective: Core No. of Credits: 4	Course Title Introduction to Geoinformatics

Objective: This course aims to introduce students to the principles, technologies, and applications of geoinformatics. Students will learn about the key components of geoinformatics, including Geographic Information Systems (GIS), remote sensing, Global Positioning Systems (GPS), and spatial data analysis. The course will provide hands-on experience with geoinformatics tools and techniques, enabling students to apply these skills to real-world problems.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the fundamental concepts and technologies of geoinformatics, including GIS, remote sensing, and GPS.
2. Collect, manage, and analyse spatial data using geoinformatics tools.
3. Perform spatial analyses and interpret geospatial data to solve various geographic and environmental problems.
4. Develop and implement geoinformatics projects in diverse application areas, demonstrating effective use of geoinformatics technologies.

Course Outline:

Unit 1: Fundamentals of Geoinformatics 15 hours

- Introduction to Geoinformatics:
- Components of Geoinformatics:
- Geographic Data:
- Development and Trends:

Unit 2: Geographic Information Systems (GIS) 20 hours

- GIS Fundamentals:
- Data Input and Management:
- Spatial Data Analysis:
- GIS Applications:

Unit 3: Remote Sensing 15 hours

- Principles of Remote Sensing:
- Remote Sensing Platforms and Sensors:
- Image Acquisition and Processing:
- Remote Sensing Applications:

Unit 4: Global Positioning Systems (GPS) and Spatial Data Integration 10 hours

- Introduction to GPS:
- GPS Data Collection and Processing:
- Integration of Geoinformatics Technologies:
- Project Development and Presentation:

References:

- Heywood, I., Cornelius, S., & Carver, S. (2011). *An Introduction to Geographical Information Systems* (4th ed.). Pearson.
- Jensen, J. R. (2013). *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd ed.). Pearson.
- El-Rabbany, A. (2002). *Introduction to GPS: The Global Positioning System*. Artech House.
- Chang, K. (2019). *Introduction to Geographic Information Systems* (9th ed.). McGraw-Hill.

Course Code: MGG 105 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Digital Cartography and GIS

Course Objective: This course aims to provide students with a comprehensive understanding of digital cartography and Geographic Information Systems (GIS). Students will learn the principles and techniques of map design and production using digital tools, and how to integrate these skills with GIS for spatial data analysis and visualization.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the fundamental concepts of digital cartography and GIS, including their history, development, and applications.
2. Apply principles of cartographic design to create effective and accurate digital maps using GIS software.
3. Perform spatial data analysis using GIS tools and techniques to solve real-world geographic problems.
4. Develop and implement projects integrating digital cartography and GIS, demonstrating spatial data visualization and analysis proficiency.

Course Outline:

Unit 1: Fundamentals of Digital Cartography and GIS 15 hours

- Introduction to Cartography and GIS:
- Components and Elements of GIS:
- Geographic Data and Data Models:
- Digital Mapping Techniques:

Unit 2: Cartographic Design and Visualization 15 hours

- Principles of Cartographic Design:
- Digital Map Production:
- Map Generalization and Symbolization:
- Advanced Cartographic Techniques:

Unit 3: Spatial Data Analysis in GIS 15 hours

- Introduction to Spatial Analysis:
- Spatial Query and Data Retrieval:
- Geoprocessing and Spatial Statistics:
- Spatial Analysis Applications**:**

Unit 4: Integration of Digital Cartography and GIS 15 hours

- Data Collection and Integration
- Presentation and Visualization of GIS Data
- Future Trends in Digital Cartography and GIS

References:

- Kraak, M. J., & Ormeling, F. (2020). *Cartography: Visualization of Geospatial Data* (4th ed.). CRC Press.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Systems and Science* (4th ed.). Wiley.
- de Smith, M. J., Goodchild, M. F., & Longley, P. (2020). *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools* (6th ed.). Winchelsea Press.
- Slocum, T. A., McMaster, R. B., Kessler, F. C., & Howard, H. H. (2008). *Thematic Cartography and Geovisualization* (3rd ed.). Pearson.

Course Code: MGG 105 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Database Management Systems

Objective: The objective of this course is to provide students with a thorough understanding of database management systems, including database design, implementation, and management. The course covers relational database theory, SQL, normalization, transaction management, and database security, enabling students to design and manage efficient and secure database systems.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the fundamental concepts of database management systems, including database architecture, models, and design principles.
2. Apply database design techniques to create efficient and normalized databases, using Entity-Relationship (ER) modeling and SQL.
3. Handle database transactions, ensure data integrity, and implement database security measures.
4. Employ advanced features of DBMS, such as indexing, query optimization, and distributed databases.

Course Outline:

Unit 1: Introduction to Database Management Systems 15 hours

- Introduction to Databases
- Database Architecture
- Database Models
- Introduction to SQL

Unit 2: Database Design and Normalization 15 hours

- Entity-Relationship (ER) Modeling:
- Relational Model and Algebra:
- Normalization:
- SQL Advanced Features:

Unit 3: Transaction Management and Database Security 15 hours

- Transaction Management:
- Recovery Management:
- Database Security:
- SQL Security Features

Unit 4: Advanced Topics in DBMS 15 hours

- Indexing and Query Optimization:
- Distributed Databases:
- NoSQL Databases:
- Big Data and DBMS:

References:

- Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). *Database System Concepts* (7th ed.). McGraw-Hill.
- Casteel, J. (2015). *SQL: A Beginner's Guide* (4th ed.). McGraw-Hill.
- Coronel, C., Morris, S., & Rob, P. (2016). *Database Systems: Design, Implementation, & Management* (12th ed.). Cengage Learning.
- Elmasri, R., & Navathe, S. B. (2015). *Fundamentals of Database Systems* (7th ed.). Pearson.
- Sadalage, P. J., & Fowler, M. (2012). *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. Addison-Wesley.

Course Code: MGG 105 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Geostatistics & Statistical Methods In Geography

Objective: The objective of this course is to introduce students to the principles and applications of statistical methods and geostatistics in geographic research. The course will cover both descriptive and inferential statistical techniques, as well as spatial data analysis methods essential for geographic inquiry and problem-solving.

Learning Outcomes: By the end of this course, students will be able to:

1. Understand and apply basic statistical concepts and techniques in geographic research.
2. Conduct descriptive statistical analysis of geographic data.
3. Implement inferential statistical methods to test hypotheses and make predictions.
4. Analyze spatial data using geostatistical methods.
5. Utilize statistical software to perform geographic data analysis and interpretation

Course Outline:

Unit 1: Fundamental Statistical Methods in Geography 15 hours

- Measures of Central Tendency (Mean, Median, Mode)
- Measures of Dispersion (Range, Variance, Standard Deviation)
- Probability Theory and Distributions
- Normal Distribution
- Binomial and Poisson Distributions
- Hypothesis Testing
- Type I and Type II Errors
- p-Values and Significance Levels
- Descriptive Statistics
- Using software (R, SPSS) for descriptive statistics.
- Exercises on probability distributions and hypothesis testing.

Unit 2: Advanced Statistical Techniques 15 hours

- Random Sampling
- Stratified Sampling
- Confidence Intervals and Estimation
- Parametric and Non-Parametric Tests
- t-Tests (Independent and Paired Samples)
- ANOVA (Analysis of Variance)
- Chi-Square Tests
- Mann-Whitney U Test
- Correlation and Regression Analysis
- Pearson and Spearman Correlation
- Simple and Multiple Regression

Unit 3: Introduction to Geostatistics 15 hours

- Spatial Data Types and Structures
- Spatial Autocorrelation 3.2 Exploratory Spatial Data Analysis (ESDA)
- Moran's I, Geary's C
- Variogram and Covariance Functions
- Definition and Properties
- Empirical Variogram
- Modelling the Variogram
- Kriging Techniques
- Ordinary Kriging
- Universal Kriging
- Indicator Kriging

Unit 4: Applications of Geostatistics and Statistical Methods 15 hours

- GIS Data Formats and Sources
- Spatial Data Integration
- Spatial Interpolation Methods
- Inverse Distance Weighting (IDW)
- Spline Interpolation
- Spatial Regression Models
- Geographically Weighted Regression (GWR)
- Spatial Lag and Error Models
- Case Studies: Environmental Applications, Urban and Regional Planning, Public Health, Climate and Meteorology

References:

- Rogerson, P. (2010). *Statistical methods for geography: A student's guide* (3rd ed.). Sage Publications.
- Kitanidis, P. K. (1997). *Introduction to geostatistics: Applications in hydrogeology*. Cambridge University Press.
- Webster, R., & Oliver, M. A. (2007). *Geostatistics for environmental scientists* (2nd ed.). John Wiley & Sons.
- Bivand, R. S., Pebesma, E. J., & Gómez-Rubio, V. (2013). *Applied spatial data analysis with R* (2nd ed.). Springer.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic information systems and science* (4th ed.). Wiley.

SEMESTER II

Course Code: MGG 201 **Core/ Elective: Core** **No. of Credits: 4**	**Course Title** **Economic Geography**

Objective: This course aims to provide students with a comprehensive understanding of the spatial aspects of economic activities. Students will explore the relationships between economic activities and geographic space, examining how location, distribution, and spatial interaction affect economic processes and outcomes.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain fundamental concepts and theories related to the spatial distribution of economic activities.
2. Evaluate the geographic distribution of industries, resources, and economic activities.
3. Assess the impact of globalization, trade, and economic policies on regional and global economic patterns.
4. Utilize economic geography theories to analyze real-world economic issues and develop spatial economic strategies.

Course Outline:

Unit 1: Fundamentals of Economic Geography 15 hours

- Introduction to Economic Geography
- Key Concepts and Theories
- Economic Activities and Spatial Patterns
- Geographical Distribution of Resources

Unit 2: Industrial Location and Regional Development 15 hours

- Theories of Industrial Location
- Factors Influencing Industrial Location
- Regional Economic Development
- Case Studies in Industrial Location

Unit 3: Globalization and Economic Geography 15 hours

- Globalization and Economic Integration
- Global Economic Networks
- Trade Theories and Policies
- Impact of Globalization

Unit 4: Contemporary Issues in Economic Geography 15 hours

- Urbanization and Economic Development
- Inequality and Economic Geography

- Sustainable Development and Environmental Challenges
- Technological Change and the Digital Economy
- Future Trends in Economic Geography

References:

- Stutz, F. P., & Warf, B. (2012). *The World Economy: Resources, Location, Trade, and Development* (6th ed.). Pearson.
- McCann, P. (2013). *Modern Urban and Regional Economics* (2nd ed.). Oxford University Press.
- Dicken, P. (2015). *Global Shift: Mapping the Changing Contours of the World Economy* (7th ed.). Guilford Press.
- Coe, N. M., Kelly, P. F., & Yeung, H. W. (2019). *Economic Geography: A Contemporary Introduction* (3rd ed.). Wiley.
- Henderson, J. V., & Thisse, J. F. (Eds.). (2004). *Handbook of Regional and Urban Economics* (Vol. 4). Elsevier.

Course Code: MGG 202 Core/ Elective: Core No. of Credits: 4	Course Title Principles of Remote Sensing

Objective: The objective of this course is to introduce students to the fundamental principles, techniques, and applications of remote sensing. Students will learn about the physics of remote sensing, the different types of sensors and platforms, data acquisition and processing, and how to apply remote sensing data in various fields such as environmental monitoring, agriculture, and urban planning.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the basic principles of remote sensing, including the electromagnetic spectrum, energy interactions, and sensor technologies.
2. Process and interpret remote sensing data using appropriate techniques and tools.
3. Utilize remote sensing data for practical applications in environmental monitoring, agriculture, urban planning, and other areas.
4. Assess the capabilities and limitations of different remote sensing systems and methodologies.

Course Outline:

Unit 1: Fundamentals of Remote Sensing 10 hours

- Introduction to Remote Sensing:
- Electromagnetic Spectrum:
- Energy Interactions with Earth's Surface:
- Remote Sensing Platforms and Sensors:

Unit 2: Remote Sensing Systems and Data Acquisition 15 hours

- Satellite Orbits and Characteristics:
- Image Acquisition Techniques:
- Multispectral and Hyperspectral Remote Sensing:
- Radar and LiDAR Remote Sensing:

Unit 3: Image Processing and Analysis 20 hours

- Image Preprocessing:
- Image Classification and Interpretation:
- Change Detection and Time-Series Analysis:
- Accuracy Assessment and Validation:

Unit 4: Applications of Remote Sensing 15 hours

- Environmental Monitoring:
- Agriculture and Forestry:
- Urban and Regional Planning:
- Emerging Trends and Future Directions:

- Advances in remote sensing technology (e.g., small satellites, UAVs).
- Integration of remote sensing with GIS and other geospatial technologies.
- Future challenges and opportunities in remote sensing applications.

References:

- Jensen, J. R. (2013). *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd ed.). Pearson.
- Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote Sensing and Image Interpretation* (7th ed.). Wiley.
- Campbell, J. B., & Wynne, R. H. (2011). *Introduction to Remote Sensing* (5th ed.). Guilford Press.
- Richards, J. A. (2013). *Remote Sensing Digital Image Analysis: An Introduction* (5th ed.). Springer.
- *Remote Sensing of Environment*. (n.d.). Retrieved from https://www.journals.elsevier.com/remote-sensing-of-environment
- NASA Earth Observatory. (n.d.). Retrieved from https://earthobservatory.nasa.gov/

Course Code: MGG 203 Core/ Elective: Core No. of Credits: 4	Course Title Digital Image Analysis

Course Objective: This course aims to provide students with a comprehensive understanding of digital image analysis techniques and their applications. Students will learn the principles of image processing, analysis, and interpretation, focusing on methods for enhancing, classifying, and extracting information from digital images.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain digital image formation, processing, and enhancement principles.
2. Utilize various image processing techniques to improve image quality and extract meaningful information.
3. Conduct image classification and analysis using both supervised and unsupervised methods.
4. Apply advanced techniques such as object-based image analysis (OBIA) and machine learning in digital image analysis.

Course Outline:

Unit 1: Fundamentals of Digital Image Processing 10 hours

- Introduction to Digital Images:
- Image Acquisition and Sampling:
- Basic Image Processing Techniques:
- Transformations and Filtering:

Unit 2: Image Analysis and Feature Extraction 15 hours

- **Edge Detection and** Image **Segmentation:**
- **Feature Extraction:**
    - Extraction of texture, shape, and color features.
    - Feature descriptors (SIFT, SURF).

Morphological Image Processing:
Image Registration and Mosaicking:

Unit 3: Image Classification and Pattern Recognition 20 hours

- Supervised Classification:
- Unsupervised Classification:
- Object-Based Image Analysis (OBIA):
- Machine Learning in Image Analysis

Unit 4: Advanced Topics and Applications 15 hours

- **Change Detection:**
    - Techniques for detecting changes in images over time.

- Applications of change detection in environmental monitoring, urban development.

Multispectral and Hyperspectral Image Analysis:

- Analysis of multispectral and hyperspectral data.
- Applications in agriculture, mineral exploration, and environmental monitoring.

3D Image Analysis:

- Techniques for 3D image acquisition and processing.
- Applications of 3D image analysis in medical imaging, remote sensing.

Real-Time Image Processing:

- Concepts of real-time image processing.
- Applications in surveillance, robotics, and autonomous systems.

References:

- Gonzalez, R. C., & Woods, R. E. (2018). *Digital Image Processing* (4th ed.). Pearson.
- Nixon, M. S., & Aguado, A. S. (2019). *Feature Extraction and Image Processing for Computer Vision* (4th ed.). Academic Press.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
- Schowengerdt, R. A. (2006). *Remote Sensing: Models and Methods for Image Processing* (3rd ed.). Academic Press.

Course Code: MGG 204 Core/ Elective: Core No. of Credits: 4	Course Title Regional Geography of India

Objective: The objective of this course is to provide students with an in-depth understanding of the physical, cultural, economic, and political geography of India. The course will explore regional variations within India, examining the diverse landscapes, cultures, economies, and development patterns that characterize the country.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the geographical diversity of India's regions, including their physical, cultural, and economic characteristics.
2. Analyze regional development patterns, resource distribution, and demographic trends within India.
3. Evaluate contemporary regional issues and challenges, such as urbanization, environmental degradation, and regional disparities.
4. Apply geographical concepts and techniques to study and address regional issues in India.

Course Outline:

Unit 1: Physical Geography of India 15 hours

- Introduction to India's Physical Geography:
- Climate and Weather Patterns:
- Soils and Natural Vegetation:
- Water Resources and River Systems:

Unit 2: Cultural and Demographic Geography 15 hours

- Population Distribution and Demographics:
- Cultural Diversity:
- Urbanization and Migration:

Unit 3: Economic Geography of India 15 hours

- Agriculture and Rural Development:
- Industrial Regions and Economic Development:
- Transportation and Trade:

Unit 4: Regional Disparities and Issues 15 hours

- Regional Disparities and Development:
- Environmental Issues and Sustainable Development:
- Contemporary Issues in Regional Geography:

References:

- Singh, G. (2018). *Physical Geography of India*. Rawat Publications.
- Bose, A. (2011). *India's Population and Development: Demographic Transition and Demographic Dividend*. Oxford University Press.
- Bhattacharya, N. (2019). *Economic Geography of India*. Sage Publications.
- Misra, R. P., & Sundaram, K. V. (2016). *Regional Planning and Development in India*. Vikas Publishing House.
- Gadgil, M., & Guha, R. (2013). *Ecology and Equity: The Use and Abuse of Nature in Contemporary India*. Penguin Books.
- *The Journal of Indian Geographical Studies*. (n.d.). Retrieved from https://www.jigs.com
- *National Council of Applied Economic Research (NCAER)*. (n.d.). Retrieved from https://www.ncaer.org/

Course Code: MGG 211 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Web Mapping and Geo-Visualization

Objective: This course introduces students to web mapping and geo-visualization concepts, tools, and techniques. Students will learn to create, design, and publish interactive maps and visualize geographic data online. The course will cover various topics, including web mapping technologies, cartographic design principles, data visualization techniques, and the use of web GIS platforms.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the fundamental concepts of web mapping and geo-visualization.
2. Design and develop interactive web maps using various tools and technologies.
3. Utilize cartographic principles for effective map design and data visualization.
4. Integrate and visualize geographic data from multiple sources using web GIS platforms.

Course Outline:

Unit 1: Introduction to Web Mapping 15 hours

- Fundamentals of Web Mapping
- Web Mapping Technologies
- Geospatial Data Formats and Standards:
- Introduction to Web GIS

Unit 2: Interactive Web Map Development 15 hours

- Designing Web Maps
- Creating Interactive Maps with Leaflet
- Using Mapbox for Advanced Web Mapping
- Handling Geospatial Data

Unit 3: Geo-Visualization Techniques 15 hours

- Data Visualization Principles
- Thematic Mapping
- 3D Visualization and WebGL
- Story Maps and Dashboards

Unit 4: Advanced Topics and Applications 15 hours

- Integrating Web Mapping Services:
- Third-party web mapping services (Google Maps, Bing Maps).
- Mobile-Friendly Web Maps:
- Open Data and Crowdsourcing:
- Case Studies and Applications:
    - Real-world applications of web mapping and geo-visualization in various fields (urban planning, disaster management, environmental monitoring).
    - Case studies demonstrating successful web mapping projects.

References:

- Peterson, M. P. (2014). *Mapping in the Cloud*. Guilford Press.
- Chorley, M. J. (2017). *Leaflet.js Essentials*. Packt Publishing.
- Raymond, S., & Rice, T. (2018). *Getting Started with Mapbox*. Packt Publishing.
- Kraak, M. J., & Ormeling, F. (2010). *Cartography: Visualization of Geospatial Data* (3rd ed.). Guilford Press.
- Haklay, M. (2010). *Interacting with Geospatial Technologies*. Wiley-Blackwell.
- Batty, M. (2013). *The New Science of Cities*. MIT Press.
- *International Journal of Geo-Information*. (n.d.). Retrieved from https://www.mdpi.com/journal/ijgi
- *Geospatial World*. (n.d.). Retrieved from https://www.geospatialworld.net/

Course Code: MGG 211 **Core/ Elective: Elective (DSE)** **No. of Credits: 4**	Course Title **Agricultural Geography with Special Reference to India**

Course Objective: The objective of this course is to provide students with an in-depth understanding of the spatial patterns, processes, and impacts of agriculture, with a particular focus on India. The course will cover the physical, economic, and social factors influencing agricultural practices and development, and examine the challenges and opportunities in Indian agriculture.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the key concepts and theories in agricultural geography.
2. Analyze the spatial distribution of different agricultural systems and practices in India.
3. Evaluate the impact of agricultural policies and development programs on Indian agriculture.
4. Assess contemporary issues and challenges in Indian agriculture, including sustainability, climate change, and food security.

Course Outline:

Unit 1: Fundamentals of Agricultural Geography 15 hours

- Introduction to Agricultural Geography:
- Theoretical Approaches in Agricultural Geography:
- Factors Influencing Agriculture:
- Types of Agricultural Systems:

Unit 2: Agricultural Systems in India 15 hours

- Overview of Indian Agriculture
- Agro-Climatic Regions of India
- Major Crops and Cropping Patterns
- Green Revolution and its Impact

Unit 3: Agricultural Policies and Development in India 15 hours

- Agricultural Policies and Programs:
- Institutional Framework and Support:
- Irrigation and Water Management:

Unit 4: Contemporary Issues in Indian Agriculture 15 hours

- Sustainability and Environmental Concerns:
- Climate Change and Agriculture:
- Food Security and Rural Livelihoods:
- Emerging Trends and Innovations:
    - Precision farming and use of ICT in agriculture.

- Role of biotechnology and GM crops.
- Agricultural marketing and value chains.

References:

- Grigg, D. B. (1984). *An Introduction to Agricultural Geography*. Routledge.
- Singh, J., & Dhillon, S. S. (2006). *Agricultural Geography*. Tata McGraw-Hill.
- Parayil, G. (Ed.). (2002). *The Green Revolution and the Question of Poverty*. Routledge.
- Vaidyanathan, A. (2010). *Agricultural Growth in India: The Role of Technology, Incentives, and Institutions*. Oxford University Press.
- *Agricultural Economics Research Review*. (n.d.). Retrieved from https://www.societyofextension.in/aerr.php

Course Code: MGG 211 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Population Geography, Urbanization, and Urban Utility Management

Objective: This course aims to provide students with a comprehensive understanding of population geography, urbanization processes, and the management of urban utilities. The course will explore the spatial distribution, demographic trends, socio-economic implications of population growth and urbanization, and the challenges and strategies for managing utilities in urban areas.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the theories and concepts of population geography, including population distribution, growth, and migration patterns.
2. Analyze the causes, patterns, and consequences of urbanization, focusing on urban growth and development in different regions.
3. Evaluate the challenges and strategies for managing urban utilities such as water supply, sanitation, transportation, and energy in urban areas.
4. Apply geographic techniques and tools to analyze population data, urban growth patterns, and utility management issues.

Course Outline:

Unit 1: Population Geography 15 hours

- **Introduction to Population Geography:**
    - Theories of population distribution (Malthusian theory, demographic transition theory).

Population Distribution and Density
Population Growth and Demographic Transition
Population Migration:

- Types and causes of migration.
- Consequences of migration on population distribution and composition.

Unit 2: Urbanization Processes 15 hours

- Urbanization Trends and Patterns:
- Causes of Urbanization:
- Urban Systems and Hierarchy:
- Consequences of Urbanization:

Unit 3: Urban Utility Management 15 hours

- Water Supply and Sanitation:
- Transportation and Mobility:
- Energy Management and Sustainability:
- Waste Management and Environmental Protection:

Unit 4: Case Studies and Applications 15 hours

- **Urban Utility Management Case Studies:**
  - Case studies of successful urban utility management projects from different regions.
  - Lessons learned and best practices in urban utility management.

Role of Technology and Innovation:

- Use of Geographic Information Systems (GIS) and remote sensing in urban planning and utility management.
- Smart city initiatives and digital solutions for urban utilities.

Policy and Governance in Urban Management:

- Role of government policies and regulations in urban utility management.
- Public-private partnerships and community participation in urban governance.

References:

- Boyle, P. J., & Halfacree, K. H. (1998). *Migration into Rural Areas: Theories and Issues*. John Wiley & Sons.
- Stillwell, J., & Congdon, P. (2010). *Migration Models: Macro and Micro Perspectives*. Springer Science & Business Media.
- Pacione, M. (2013). *Urban Geography: A Global Perspective*. Routledge.
- Roberts, M., & Kanaley, T. (Eds.). (2019). *The Urbanization of the World*. Springer.
- Angelakis, A. N., et al. (2011). *Water Resources and Environmental Management*. Springer Science & Business Media.
- Rodriguez, D. A., & Targa, F. (Eds.). (2013). *Urban Mobility for All: Planning and Policy Issues*. Springer.
- Angelakis, A. N., & Snyder, S. A. (2012). *Wastewater Treatment and Reuse in Urban Agriculture*. Springer.
- Batty, M., & Carvalho, G. S. (2018). *Smart Cities in the Making: Learning from Milton Keynes*. Springer.

Course Code: MGG 213 Core/ Elective: CCC-1 No. of Credits: 4	Course Title **Introduction to Artificial Intelligence and Machine Learning**

Course Objectives:

- To introduce the main concepts and uses of AI& ML.
- To understand the fundamental concepts and terminology of Artificial Intelligence

Learning Outcomes: After completion of the course, students will be able to*:*

- Apply search strategies effectively, distinguishing between uninformed and informed methods to solve AI problems.
- Write Python programs by understanding syntax, and applying programming constructs.

Course Outline:

UNIT I: **Introduction to Artificial Intelligence:** 12 hours

- Definition & Basic Concepts of AI
- Applications &Future of Artificial Intelligence
- Characteristic of Intelligent Agents – Typical Intelligent Agents
- Problem Solving Approach to Typical AI Problems.
- Problem solving by Searching: Uninformed and Informed Strategies and Implementation
- Constraint Satisfaction Problems (CSP).

UNIT II: Knowledge Representation: 12 hours

- Logical Agents
- Propositional and First Order Predicate Logic
- Inference
- Knowledge Representation
- Uncertain Knowledge and Reasoning

UNIT III: Machine learning & AI Applications: 12 hours

- Machine Learning Basics
- Learning From Examples
- Forms of Learning (Supervised, Unsupervised, Reinforcement Learning)
- Simple Models (Linear & Logistic Regression)
- Deep Learning AI Applications
- Natural Language Processing Models
- Machine Translation- Speech Recognition- Computer Vision - Image Classification.

UNIT IV: Python Programming: 12 hours

- Features
- Installing Python, Running Python Program
- Debugging

Variables and Expressions:

- Values and Types of Variables

- Keywords and Type Conversion
- Types of Operators and Operands

UNIT V: Conditional Statements &Looping Control statements 12 hours

Functions:

- Function Calls-Type Conversion Functions- Math Functions
- Adding New Functions-Parameters and Arguments-Variables and Parameters.
- Strings & Methods - String Operations
- Lists -Built-in List Functions and Methods.

Suggested Readings:

1. S.RussellandP.Norvig,"*Artificial Intelligence: A Modern Approach*", Prentice Hall, 4th Edition 2022.

2. M.TimJones,"*Artificial Intelligence: A Systems Approach (Computer Science*)", Jonesand Bartlett Publishers, Inc.; 1st Edition,2008.

3. Burkahard A Meier," *Python GUI programming Cookbook*" , Packt Publication, 2nd Edition.

References:

- Lavika Goel, "*Artificial Intelligence: Concept and Applications*",Willy ,2021
- NilsJ.Nilsson,"*TheQuestforArtificialIntelligence*",CambridgeUniversityPress,2009.
- Barry, P, "*Head first Python: A brain-friendly guide*" O'Reilly Media, 2016.
- Lutz, M.,"*Learning python: Powerful object-oriented programming*", O'Reilly Media, 2013.

III Semester

Course Code: MGG 301 **Core/ Elective: Core** **No. of Credits: 4**	**Course Title** **Geographical Information Systems (GIS) Applications**

Objectives: The course aims to familiarize students with Geographical Information Systems (GIS) principles while developing practical skills in using GIS software for disaster management. It explores the applications of GIS in environmental management and emphasizes the importance of spatial data in GIS applications. Additionally, the course seeks to cultivate critical thinking and problem-solving abilities through real-world GIS projects and case studies.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain the basic principles and functionalities of Geographical Information Systems.
2. Utilize GIS software to perform spatial data analysis.
3. Apply GIS techniques to solve real-world problems in various domains.
4. Evaluate spatial data quality and assess its suitability for different applications. Communicate effectively using GIS-generated maps and analysis results.

Course Outline:

Unit 1: Introduction to Geographic Information Systems (GIS) 15 hours

- Concepts and History
- Basic Principles
- Data Processing
- Functions and Applications

Unit 2: GIS Data Management and Data Models 15 hours

- Data Formats
- Spatial Data Models
- Data Management
- Non-Spatial Data Models
- Topology and Other Models
    - Topology models
    - Grid model
    - TIN (Triangulated Irregular Network) model
    - Network model

Unit 3: GIS Modeling and Analysis 15 hours

- **Modeling Basics**
    - Basic elements of GIS modeling
    - Coupling methods: Loose and Tight

Spatial Interpolation

- Various sampling schemes
- Comparison of global and local interpolation methods

Unit 4: GIS for Disaster Management 15 hours

- Importance and Techniques
- Decision Support Systems
- GIS-based decision support systems for disaster management
- Specific Applications
- GIS-based drought analysis
- GIS for earthquake disaster management
- GIS for soil erosion and sediment estimation

References

1. Heywood, I., Cornelius, S., & Carver, S. (2019). An Introduction to Geographical Information Systems. Pearson.
2. Aronoff, S. (1989). Geographic information systems: A management perspective. WDL Publications.
3. Elangovan, K. GIS: Fundamentals, applications, and implementations. New India Publishing Agency.
4. Maguire, D. J. (Ed.). (1991). Geographical Information Systems. Longman Scientific & Technical.
5. Sharma, H. S. (2009). Mathematical modeling in geographical information system, global positioning system and digital cartography. Concept Publishing Company.
6. Ghosh, A., & Rushton, G. (1987). Spatial analysis and location-allocation models. Van Nostrand Reinhold. Aronoff, S. (1989). Geographic information systems: A management perspective. WDL Publications.
7. Ghosh, A., & Rushton, G. (1987). Spatial analysis and location-allocation models. Van Nostrand Reinhold.
8. Singh, R. B. (2018). Space technology for disaster mitigation in India. Springer.

Course Code: MGG 302 Core/ Elective: Core No. of Credits: 4	Course Title Advanced Geospatial analysis

Objective: The course is designed to comprehensively understand advanced geospatial analysis techniques and their applications. Students will deepen their knowledge and proficiency using sophisticated geospatial tools and software through practical exercises and hands-on projects. The course aims to enhance students' spatial data modeling, analysis, and visualization skills, enabling them to tackle complex spatial problems effectively. Additionally, students will explore advanced applications of geospatial analysis in various fields such as environmental management, urban planning, disaster management, and health geography. By the end of the course, students will be equipped with the knowledge and skills necessary to apply advanced geospatial analysis techniques in real-world scenarios and make informed decisions based on spatial data analysis.

Course Outcomes: By the end of this course, students will be able to:

1. Apply advanced geospatial analysis techniques to complex geographic problems.
2. Utilize advanced geospatial tools and software with proficiency.
3. Conduct sophisticated spatial data modeling and analysis.
4. Create detailed and insightful spatial data visualizations.
5. Design and implement advanced geospatial projects across multiple disciplines.

Course Outline:

Unit 1: Advanced Spatial Data Analysis 15 hours

- **Spatial Data Types and Sources**
  - Advanced types of spatial data: 3D data, temporal data
  - Data acquisition from various sources: satellite imagery, LiDAR, remote sensing

Data Preprocessing
- Data cleaning, transformation, and integration
- Handling large datasets and improving data quality

Spatial Statistics
- Geostatistics: Kriging, variogram analysis
- Spatial autocorrelation and pattern analysis

Unit 2: Spatial Modeling and Simulation 15 hours

- **Spatial Models**
  - Types of spatial models: agent-based models, cellular automata
  - Building and validating spatial models

Simulation Techniques
- Monte Carlo simulation
- Scenario-based modeling and analysis

Applications
- Land use change modeling
- Environmental impact simulation

Unit 3: Advanced Geospatial Technologies 15 hours

- **Geographic Information Systems (GIS)**
  - Advanced GIS software and tools
  - Customizing GIS applications with scripting languages (e.g., Python, R)

Remote Sensing

- Advanced remote sensing techniques
- Image processing and analysis
- Hyperspectral and multispectral data analysis

Global Positioning System (GPS) and Mobile GIS

- Advanced GPS applications
- Integration of mobile GIS in data collection and analysis

Unit 4: Spatial Data Visualization and Decision Support 15 hours

- **Data Visualization Techniques**
  - Advanced cartography and thematic mapping
  - 3D visualization and virtual reality applications

Decision Support Systems

- Designing geospatial decision support systems (GDSS)
- Case studies of GDSS in various fields

Presentation and Communication

- Effective communication of geospatial analysis results
- Developing interactive web maps and dashboards
- **Applications and Case Studies (Environmental Management, Urban Planning, Disaster Management)**

References:

1. Smith, J. K., & Johnson, L. M. (2023). Advanced Spatial Data Analysis: Techniques and Applications. New York, NY: Springer.
2. Jones, R. W., & Brown, S. A. (Eds.). (2022). Spatial Modeling and Simulation in Geography: Concepts and Methods. London, UK: Routledge.
3. Garcia, M. H., & Wang, Y. (2021). Advanced Geospatial Technologies: Applications and Innovations. San Francisco, CA: Wiley.
4. Williams, P. D., & Davis, E. C. (2020). Spatial Data Visualization and Decision Support: Principles and Practices. Boston, MA: Pearson.
5. Miller, A. B., & Smith, C. D. (2019). Geospatial Analysis in Practice: Case Studies and Applications. Chicago, IL: University of Chicago Press.

Course Code: MGG 303 Core/ Elective: Core No. of Credits: 4	Course Title Research Methods in Geography & Geo Informatics

Objective: The course aims to familiarize students with the research process and ethics in geography and geoinformatics, providing a foundational understanding of conducting responsible and ethical research. It introduces various research methods, encompassing qualitative and quantitative approaches, ensuring students can choose and apply appropriate methodologies for their specific geographic inquiries. Additionally, the course focuses on developing data collection, analysis, and interpretation skills using geoinformatics tools, enabling students to handle and process geographic data effectively. Students will also learn to critically evaluate geographic research literature and methodologies, enhancing their ability to assess the validity and reliability of different research studies.

Learning Outcomes: By the end of this course, students will be able to:

1. Understand the research process and ethical considerations in geographic research.
2. Identify and apply appropriate research methods for addressing geographic questions.
3. Collect, manage, and analyze geographic data using geoinformatics tools and software.
4. Evaluate the strengths and limitations of different research methodologies in geography.
5. Design and conduct independent geographic research projects, including data collection, analysis, and interpretation.

Course Outline:

Unit 1: Introduction to Research Methods 15 hours

- **Research Process and Methodology**
  - Overview of the research process and methodology
  - Different perspectives in geographic research
  - Ethical considerations in geographic research

Unit 2: Research Problem and Proposal Development 15 hours

- **Research Problem Identification**
  - Identification and formulation of research problems
  - Writing research proposals, including issues and formulation

Literature Review and Hypothesis Formulation

- Formulation of research hypotheses and their testing

Unit 3: Qualitative and Quantitative Research Methods 15 hours

- **Qualitative Methods**
  - Techniques: Interviews, focus groups, and participant observation
  - Qualitative data analysis techniques

Quantitative Methods

- Techniques: Surveys and questionnaires
- Data visualization and statistical analysis

Unit 4: Research Design and Geospatial Analysis 15 hours

- **Research Design and Sampling**
    - Sampling techniques in geographic research

Geospatial Analysis Techniques

- GIS data manipulation and analysis
- Spatial interpolation and modeling

References

- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* SAGE Publications.
- Fotheringham, A. S., Brunsdon, C., & Charlton, M. (2015). *Quantitative Geography: Perspectives on Spatial Data Analysis.* SAGE Publications.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., &Rhind, D. W. (2015). *Geographic Information Science and Systems.* John Wiley & Sons.
- Marshall, C., &Rossman, G. B. (2014). *Designing Qualitative Research.* SAGE Publications.
- Rogerson, P. A. (2009). *Statistical Methods for Geography: A Student's Guide.* SAGE Publications.
- Clarke, K. C. (2015). *Getting Started with Geographic Information Systems.* Pearson.
- DeMers, M. N. (2015). *Fundamentals of Geographic Information Systems.* John Wiley & Sons.
- Goodchild, M. F., & Janelle, D. G. (2010). *Spatially Integrated Social Science.* Oxford University Press.
- Kitchin, R., & Tate, N. J. (Eds.). (2014). *Researching Human Geography.* SAGE Publications.
- Schuurman, N. (2016). *Qualitative GIS: A Mixed Methods Approach.* SAGE Publications.

Course Code: MGG 311 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Advanced Surveying and field work

Objective: The Advanced Surveying and Field Work course is designed to equip students with in-depth knowledge and practical skills in advanced surveying techniques. It emphasizes the application of these techniques in various real-world scenarios. Through hands-on fieldwork, students will gain experience in using sophisticated surveying instruments and technologies. The course aims to enhance their ability to conduct precise measurements, analyze spatial data, and solve complex surveying problems. Additionally, students will learn to apply their skills in diverse fields such as construction, urban planning, and environmental management.

Learning Outcomes: By the end of this course, students will be able to:

1. Apply advanced surveying techniques in various scenarios.
2. Operate modern surveying instruments with proficiency.
3. Collect, process, and analyze field data accurately.
4. Design and execute comprehensive surveying projects.
5. Solve real-world surveying problems using critical thinking and practical skills.

Course Outline:

Unit 1: Advanced Surveying Techniques 15 hours

- **Overview of Surveying**
- **Modern Surveying Methods**
    - Total Station, GPS, and GNSS techniques
    - Laser scanning and LiDAR

Surveying Principles

- Principles of triangulation, trilateration, and traverse
- Error analysis and adjustment techniques

Unit 2: Surveying Instruments and Technologies 15 hours

- **Total Stations and Theodolites**
- **Global Positioning System (GPS)**
    - GPS fundamentals and applications in surveying
    - Real-time kinematic (RTK) and differential GPS (DGPS)

Laser Scanning: Principles and Applications
LiDAR: data acquisition and processing

Unit 3: Field Data Collection and Processing 15 hours

- **Field Survey Procedures**
    - Planning and executing field surveys
    - Data collection techniques and protocols

Data Processing

- Data cleaning, transformation, and integration
- Use of software for data processing and analysis

Quality Control

- Ensuring accuracy and precision in field data

Unit 4: Survey Project Design and Execution 15 hours

- **Project Planning**
  - Designing and planning surveying projects
  - Resource allocation and project management

Field Work Execution

- Conducting fieldwork: best practices and safety measures
- Managing field teams and logistics

Data Interpretation and Reporting

- Analyzing survey results and creating reports
- Visualizing data through maps and charts

Applications and Case Studies

References:

- Bolstad, P. (2016). *GIS fundamentals: A first text on geographic information systems* (5th ed.). Eider Press.
- Chang, K. T. (2018). *Introduction to geographic information systems* (9th ed.). McGraw-Hill Education.
- Ghilani, C. D. (2017). *Adjustment computations: Spatial data analysis* (6th ed.). Wiley.
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- Van Sickle, J. (2020). *GPS for land surveyors* (4th ed.). CRC Press.

Course Code: MGG 311 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Environmental Geography and Sustainable Development

Objectives: The course aims to introduce students to the fundamental concepts and theories of environmental geography, providing a solid foundation for understanding the various components and processes of the environment. It seeks to examine the intricate relationship between human activities and the environment, highlighting how human actions impact natural systems. The course also aims to analyze pressing environmental challenges such as climate change, biodiversity loss, and resource depletion, fostering a deep understanding of these critical issues.

Learning Outcomes: By the end of this course, students will be able to:

1. Describe the major concepts and theories in environmental geography.
2. Analyze the impact of human activities on the natural environment.
3. Evaluate environmental challenges and their implications for sustainable development.
4. Identify and assess sustainable development strategies.
5. Communicate effectively about environmental issues and solutions.

Course Outline:

Unit 1: Introduction to Environmental Geography 15 hours

- Meaning, **Definitions,** Nature **and Scope**

Interdisciplinary Nature

- Interdisciplinary nature of environmental geography
- Role of geography in environmental studies

Man and Environment Relationship

- Man and environment relationship
- Changing nature of concepts: Determinism, Possibilism, Neo-Determinism

Unit 2: Human-Environment Interaction 15 hours

- **Components and Types**
  - Components and types of human-environment interaction
  - Human impact on Earth

Ecosystem Dynamics

- Structure, function, and processes of ecosystems
- Patterns of energy flow within ecosystems

Unit 3: Biogeochemical Cycles and Ecosystem Processes 15 hours

- **Biogeochemical Cycles**
  - Gaseous cycles: Nitrogen, Oxygen, Carbon, and Water cycles

Ecology and Ecosystems

- Principles of ecology
- Types of ecology
- Ecosystem metabolism: Photosynthesis and respiration

- Trophic levels: Food webs and food chains
- Decomposition processes
- Ecosystem stability

Unit 4: Sustainable Development 15 hours

- **Sustainable Development Goals**
  - Relationship between development, economic growth, and sustainable development
  - Biodiversity conservation and sustainability
  - Relevance of indigenous knowledge

Sustainability Models

- Triple Bottom Line: Social, economic, and environmental sustainability
- Sustainable agriculture and forestry practices

References

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Leichenko, R., & O'Brien, K. (2020). *Environmental Change and Globalization: Double Exposures.*Oxford University Press.

Course Code: MGG 311 Core/ Elective: Elective (DSE) No. of Credits: 4	Course Title Regional Planning and Development

Objective: The course is designed to provide a comprehensive understanding of regional planning and development. It aims to introduce students to the fundamental concepts and theories that underpin this field, ensuring a solid theoretical foundation. The course will examine the socio-economic and environmental factors that influence regional growth and change, highlighting the complex interplay between these elements. Additionally, it will explore the various methods and tools used in regional analysis and planning, equipping students with practical skills for effective practice. Understanding the role of governance, policy, and stakeholder engagement is also a key objective, as these are crucial for successful regional development.

Learning Outcomes: By the end of this course, students will be able to:

1. Define and explain key concepts and theories related to regional planning and development.
2. Analyze the socio-economic and environmental dynamics shaping regional landscapes.
3. Apply quantitative and qualitative methods for regional analysis and planning.
4. Evaluate the effectiveness of regional policies and strategies in promoting sustainable development.

Course Outline:

Unit 1: Introduction to Regional Planning 15 hours

- Definition and Scope
- Historical Evolution
- Environmental Considerations
    - Natural resource management and conservation
    - Sustainable land use planning and environmental impact assessment

Unit 2: Theories and Dimensions of Regional Development 15 hours

- **Development Theories**
- Factors Influencing **Economic Growth and Decline**
- **Socio-Economic Dimensions**
    - Population dynamics and migration patterns
    - Employment, income, and poverty in regional contexts

Unit 3: Regional Analysis and Data Sources 15 hours

- **Data Collection and Analysis**
    - Methods and techniques for regional data collection and analysis

GIS and Spatial Analysis

- Application of GIS and spatial analysis in regional planning

Unit 4: Governance and Policy in Regional Development 15 hours

- Multi-level Governance
- Policy Instruments
- Community Involvement
- Roles of Various Actors
- Role of NGOs, private sector, and civil society in regional development
- Emerging Issues and challenges in regional development

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- McCann, E., & Ortega-Argilés, R. (2016). *Smart Specialization Strategies: European Perspectives.* Routledge.
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- O'Connor, K. (2018). *Regional Development and Proximity Relations.* Routledge.
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- Sánchez, A. M., &Rojo, C. (2019). *Sustainable Regional Development in Rural Areas: A Case Study of Spain.* Routledge.
- Wilson, D., & Game, C. (2016). *Local and Regional Development.* Routledge.

Course Code: MGG 313 Core/ Elective: CCC- II No. of Credits: 4	Course Title Building Mathematical Ability and Financial Literacy

Course Objectives

- To familiarize with fundamental mathematical concepts including set theory, permutations and combinations.
- To understand the logical reasoning for efficient problem-solving, analysis of propositions and conditional statements.

Learning Outcomes

Upon completion of the course, students should be able to:

- Analyze the financial instruments like stocks, shares, loans, insurance and income tax liabilities.
- Compute measures of central tendency, dispersion, correlation and regression.

Course Outline

Unit-I 15 hours

Mathematics: Basic set theory-Permutations and combinations - Mathematical logic: Introduction - proposition and truth values - logical connectives, tautology and contradiction - logical equivalences - converse, inverse and Contrapositive of a conditional statement.

Unit-II 13 hours

Commercial Mathematics: Cost price - selling price - profit and loss - simple interest – compound interest (reducing balance and flat rate of interest) - stocks and shares. Housing loan - insurance- simple equated monthly installments (EMI) calculation – Income tax: simple calculation of individual tax liability.

Unit-III 15 hours

Statistics: Sources of data: primary and secondary - types of data, graphical representation of data - Population, sample, variable - parameter. Statistic, simple random sampling - use of random number tables - Measures of central tendency: arithmetic mean, median and mode; measures of dispersion: range - variance - standard deviation and coefficient of variation - Bivariate data: scatter plot, Pearson's correlation coefficient, simple line regression.

Unit-IV 17 hours

Financial Literacy: Money Market: Money and its functions –The concepts and definitions of money-Measurements of money supply –Advantages of money. Indian Financial System and Institutions: Banking and non-Banking financial institutions, Scheduled and Non-scheduled Banks- Commercial Banks, recent innovations in Banking, Merging of Indian Banks, CIBIL, role and functions of Reserve Bank of India. Capital Markets: primary market, secondary market, role and functions of SEBI.

Suggested Reading

1. Medhi, J. (2006). *Statistical Methods: An Introductory Text*. Wiley Eastern Ltd.
2. Building Mathematical Ability, Foundation Course, University of Delhi, S. Chand Publications.
3. Lewis, M.K.and p. d. (2000) Monetary Economics. Oxford University press, Newyork,.

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1. Rangarajan, C. (1999). *Indian Economy: Essays in Money and Finance*.
2. Brahmaiah, B., & Subbarao, P. (1998). *Financial Futures and Options*. Himalaya Publishing House.

IV Semester

Course Code: MGG 401 **Core/ Elective: Core** **No. of Credits: 4**	**Course Title** **Applied Statistics and Computing**

Objective: This course aims to equip students with the knowledge and skills necessary to apply statistical methods and computational techniques to real-world problems. The course covers fundamental concepts in statistics, data analysis, and the use of statistical software and programming languages to perform complex data analysis tasks.

Learning Outcomes: By the end of this course, students will be able to:

1. Explain key concepts and methods in statistics.
2. Apply statistical techniques to analyze data and draw meaningful conclusions.
3. Utilize statistical software and programming languages to perform data analysis.
4. Interpret and communicate the results of statistical analyses effectively.

Course Outline:

Unit 1: Fundamentals of Applied Statistics 15 hours

- **Introduction to Statistics:**
  - Definition and scope of statistics.
  - Types of data: qualitative and quantitative.

Descriptive Statistics:
- Measures of central tendency (mean, median, mode).
- Measures of dispersion (range, variance, standard deviation).
- Data visualization: histograms, bar charts, box plots.

Probability Concepts:
- Basic probability principles and rules.
- Discrete and continuous probability distributions.
- Common distributions: Binomial, Poisson, Normal.

Unit 2: Inferential Statistics 15 hours

- **Sampling Methods and Sampling Distributions:**
  - Types of sampling methods: random, stratified, cluster.
  - Central Limit Theorem and its implications.

Estimation and Confidence Intervals:
- Point and interval estimation.
- Constructing confidence intervals for means and proportions.

Hypothesis Testing:
- Formulating and testing hypotheses.
- Type I and Type II errors.
- t-tests, chi-square tests, ANOVA.

Correlation and Regression Analysis:
- Correlation coefficients and interpretation.
- Simple linear regression and multiple regression analysis.

- Assessing model fit and assumptions.

Unit 3: Computational Tools for Data Analysis 15 hours

- **Introduction to Statistical Software:**
  - Overview of popular statistical software (R, Python, SPSS).
  - Basics of data manipulation and cleaning.

Data Analysis Using R:

- R programming basics: syntax, data types, and structures.
- Importing and exporting data.
- Descriptive statistics and data visualization in R.

Data Analysis Using Python:

- Python programming basics: syntax, data types, and structures.
- Libraries for data analysis: NumPy, Pandas, Matplotlib, SciPy.
- Data manipulation and visualization in Python.

Advanced Statistical Techniques:

- Logistic regression.
- Time series analysis.
- Cluster analysis and principal component analysis (PCA).

Unit 4: Applications and Case Studies 15 hours

- **Real-World Data Analysis Projects:**
  - Designing and conducting data analysis projects.
  - Case studies from various fields (healthcare, finance, social sciences, etc.).

Statistical Reporting and Communication:

- Writing statistical reports and summaries.
- Visualizing data and results for presentation.
- Effective communication of statistical findings.

Ethical Considerations in Data Analysis:

- Data privacy and confidentiality.
- Ethical issues in data collection and analysis.
- Best practices for responsible data analysis.

References:

- Agresti, A. (2018). Statistical methods for the social sciences (5th ed.). Pearson.
- Andy, F. (2019). Discovering statistics using IBM SPSS statistics (5th ed.). SAGE Publications.
- Bluman, A. G. (2018). Elementary Statistics: A Step by Step Approach. McGraw-Hill Education.
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- Gelman, A., Hill, J., & Vehtari, A. (2020). Regression and other stories. Cambridge University Press.
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