ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం

आंध्रप्रदेश केंद्रीय विश्वविद्यालय

CENTRAL UNIVERSITY OF ANDHRA PRADESH

Jnana Seema, Ananthapuramu, India - 515701

DEPARTMENT OF GEOGRAPHY & GEOINFORMATICS
SCHOOL OF INTERDISCIPLINARY AND APPLIED SCIENCES

Masters Programme
(as per the National Credit Framework 2023)

Vidya Dadati Vinayam
(Education Gives Humility)

M.Sc. Geography & Geoinformatics

Programme Structure
(Effect from Academic Year 2026 - 27)

M.Sc. Geography & Geoinformatics

Department of Geography & Geoinformatics

School of Interdisciplinary and Applied Sciences

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M.Sc. Geography & Geoinformatics
Department of Geography & Geoinformatics
School of Interdisciplinary and Applied Sciences

1. Introduction to the Programme

The Master of Science in Geography and Geoinformatics (MGG) programme at the Central University of Andhra Pradesh is designed to equip students with the in-demand skills required to succeed in today's competitive job market. The programme aims to produce competent postgraduates who can make meaningful contributions to academia, industry, government, and society, armed with both theoretical knowledge and practical expertise. Emphasizing critical thinking and problem-solving, the curriculum develops advanced analytical skills essential for addressing emerging challenges such as climate change, urbanisation, disaster management, and sustainable development. It integrates insights from geography—human-environment interaction, spatial patterns, and regional planning—with modern geoinformatics techniques. A strong foundation in both geography and geospatial science is provided through core courses, while electives in remote sensing, GIS, spatial analytics, and environmental applications allow students to specialise further.

Technical competencies form the heart of the programme. Students gain hands-on experience with leading software packages, ensuring they are proficient in handling complex spatial and non-spatial datasets. Beyond classroom learning, the programme offers opportunities to apply knowledge through field surveys, internships, dissertations, laboratory work, and expert lectures. This multidisciplinary approach ensures that students not only refine their technical and analytical skills but also develop professional competencies. By combining theory with practice, the programme prepares postgraduates to meet real-world challenges and thrive in diverse professional settings.

2. Programme Vision

The vision of the Master of Science in Geography and Geoinformatics (MGG) programme is to become a globally recognised leader in advanced education that integrates geographic knowledge with geospatial technologies, spatial analytics, and environmental applications using the latest tools and techniques. It seeks to empower students with the knowledge, skills, and ethical framework necessary to excel in a dynamic and interconnected world. Through innovative research, interdisciplinary collaboration, and a commitment to excellence, the programme aims to prepare postgraduates to address complex spatial, environmental, and developmental challenges and make meaningful contributions to society. The vision is to foster a vibrant learning community that nurtures intellectual curiosity, critical thinking, and lifelong learning, equipping students to become leaders in academia, industry, government, and beyond.

3. Programme Educational Objectives (PEOs)

PEO1: Foundational Knowledge Graduates will acquire advanced knowledge in geography, geoinformatics, and spatial sciences, enabling them to understand and address complex environmental, social, and regional challenges.

PEO2: Analytical & Technical Skills Graduates will develop proficiency in modern geospatial tools, analytical software, and programming languages to solve applied spatial, environmental, and planning problems.

PEO3: Research & Innovation Graduates will design and conduct independent research projects, dissertations, field surveys, and geospatial studies, contributing innovative solutions to academia, industry, and governance.

PEO4: Professional & Ethical Competence Graduates will demonstrate ethical responsibility, critical thinking, and professional readiness to work effectively in diverse teams and multidisciplinary environments.

PEO5: Lifelong Learning & Leadership Graduates will recognize the need for lifelong learning, adapt to evolving geospatial and technological landscapes, and assume leadership roles in academia, industry, government, and society.

4. Programme Outcomes (POs)

The purpose of this programme is to equip students with advanced knowledge and practical skills in geography and geoinformatics. After successful completion of the programme, students will be able to:

PO1 Applied Geographical Knowledge: Apply advanced knowledge of physical geography, human geography, GIS, remote sensing, cartography, and spatial analytics to solve complex environmental, regional, and planning problems.

PO2 Problem Analysis: Identify, formulate, and analyse geographic, environmental, and socio-spatial problems using geospatial techniques, statistical methods, and data-driven approaches.

PO3 Design & Development of Solutions: Design solutions for spatial and developmental challenges by integrating geographic theories with applied geoinformatics, ensuring relevance to social, cultural, and environmental contexts.

PO4 Research & Investigation: Conduct independent research using geospatial methods, field surveys, spatial modelling, and computational tools to interpret data and derive valid conclusions.

PO5 Modern Tool Usage: Select and apply modern software tools for mapping, modelling, simulation, and solving applied geographic problems.

PO6 Geography & Society: Apply contextual knowledge to assess societal, legal, health, and cultural issues, and evaluate the impact of spatial decisions on communities.

PO7 Sustainability & Environment: Understand the implications of geographic and geospatial solutions in environmental and societal contexts, demonstrating commitment to sustainable development.

PO8 Ethics: Apply ethical principles and professional standards in spatial data handling, geographic analysis, and research practice.

PO9 Individual & Team Work: Function effectively as an individual and as a member or leader in diverse teams, demonstrating collaboration in multidisciplinary settings.

PO10 Communication: Communicate effectively on geographic and geospatial issues with peers, academia, industry, and society through reports, maps, documentation, and presentations.

PO11 Project Management & Finance: Demonstrate knowledge of geography, geoinformatics, and management principles, and apply them to project work, internships, and dissertations.

PO12 Lifelong Learning: Recognize the need for, and develop the ability to engage in independent and lifelong learning in geography, geoinformatics, and interdisciplinary domains.

5. Programme-Specific Outcomes (PSOs)

The learning outcomes are designed to equip students with the knowledge, skills, and abilities necessary to succeed in careers related to geography, geospatial technology, environmental analysis, and spatial decision-making:

PSO1: Geographic Knowledge: Students will demonstrate advanced understanding of physical geography, human geography, regional geography, and applied geography, enabling them to interpret human-environment interactions and spatial development processes.

PSO2: Geospatial Analytics Proficiency: Students will acquire hands-on expertise in modern geospatial tools and programming languages to analyse, map, and visualize complex spatial datasets.

PSO3: Technical & Computational Competence: Students will integrate computational skills with GIS modelling, remote sensing applications, database management, and spatial analytics techniques to solve applied geographic, environmental, and planning problems.

PSO4: Research & Critical Evaluation: Students will critically analyze environmental change, urban systems, resource management, and regional development issues, while designing independent research projects, field studies, and dissertations that contribute to academia, industry, and government.

PSO5: Professional Readiness & Ethics: Students will develop professional competencies, teamwork, communication, and leadership skills, while adhering to ethical and professional standards in spatial data handling, geographic analysis, and evidence-based decision-making.

5. Pedagogy of the Programme

The pedagogy for the M.Sc. in Geography and Geoinformatics is carefully designed to progress through the six levels of Bloom's Taxonomy, ensuring a structured and engaging learning environment that blends theory with practice. Students begin by recalling and defining fundamental concepts in physical geography, human geography, cartography, GIS, remote sensing, and spatial analysis through interactive lectures and foundational readings. They then move to understanding and interpreting theories of human-environment interaction, spatial organisation, regional development, and environmental systems, strengthening conceptual clarity through group discussions, debates, and problem-solving activities. At the application stage, learners engage in field surveys, laboratory exercises, mapping projects, and hands-on training, using geospatial tools to connect theory with real-world practice. This systematic approach ensures that students develop both analytical depth and technical proficiency early in the programme.

As students advance, they are trained to analyze and evaluate geographic problems and complex spatial datasets through dissertation work, case studies, and interdisciplinary assignments that integrate geography with environmental science, urban planning, computer science, and public policy. They critique research findings, assess developmental and environmental implications, and apply ethical and professional standards in collaborative projects and peer learning. Finally, at the creation stage, the programme culminates in a capstone project or thesis, where students design and conduct independent research, innovate solutions to pressing spatial and societal challenges, and present findings to academic and industry audiences. Complementary activities such as networking events, career fairs, expert lectures, and mentorship programmes further enhance professional readiness, leadership development, and smooth transition into diverse career pathways. This pedagogy not only equips graduates with advanced knowledge and technical expertise but also nurtures critical thinking, ethical responsibility, and lifelong learning.

6. Programme Structure

- The Master of Science in Geography & Geoinformatics is a two-year postgraduate programme divided into four semesters, comprising a total of 95 credits.
- The curriculum integrates Core Courses, Discipline-Specific Electives, Multidisciplinary Courses, MOOCs, Skill/Internship Components, and Dissertation Work, ensuring a balanced and comprehensive learning journey.
- **Semester-wise Structure:**
  - **Semester I:** Foundational courses in geomorphology, tectonics, soil geography, and Geographic Information Systems (GIS), supported by one discipline-specific elective and one MOOC. Includes practical/laboratory components for developing mapping and spatial analysis skills.
  - **Semester II:** Advanced courses in economic geography, political geography, remote sensing, and digital image analysis, with one elective, one MOOC, and a compulsory core course. Laboratory work strengthens geospatial interpretation and applied technical skills.
  - **Semester III:** Courses in advanced geospatial analysis and research methodology, alongside electives, a MOOC, and a skill-based internship/project. Practical and field components ensure hands-on training in spatial technologies and research applications.
  - **Semester IV:** Dedicated to dissertation work (12 credits) along with advanced courses in statistics, regional geography, and geography of India, enabling students to apply knowledge to significant research questions and practical geographic problems.

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Semester and Course wise Credits Distribution

Semester	Core Course Credits				DSE Credits		IDE Credits		CCC Credits				SIP Credits		Dissertation Credits		Total Credits
	Code	T	P	Total	Code	Total	Code	Total	Code	T	P	Total	Code	Total	Code	Total	
1	MGG101	4	0	4	MGG111	4	MGG112 MOOC	3	-		-	-	-	-	-	-	19
	MGG102	3	1	4													
	MGG103	3	1	4													
	Total	**10**	**2**	**12**	**-**	**4**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
II	MGG201	4	0	4	MGG211	4	MGG212 MOOC	3	MGG213	2	2	4	-	-	-	-	27
	MGG202	4	0	4													
	MGG203	3	1	4													
	MGG204	3	1	4													
	Total	**14**	**2**	**16**		**4**	**-**	**3**	**-**	**2**	**2**	**4**	**-**		**-**	**-**	
III	MGG301	4	0	4	MGG311	4	MGG312 MOOC	3	MGG313	2	0	2	MGG314	2	-	-	23
	MGG302	3	1	4													
	MGG303	3	1	4													
	Total	**10**	**2**	**12**		**4**	**-**	**3**	**-**	**2**	**0**	**2**	**-**	**2**	**-**	**-**	
IV	MGG401	4	0	4	-	-	-	-	-	-	-	-	-	-	MGG411	**8**	16
	MGG402	3	1	4													
	Total	**7**	**1**	**8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8**	
Total Courses	**12**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**22**
Total Credits	**-**	41	7	48	-	12	-	9	-	4	2	6	-	2	**-**	**12**	**89**
Percentage	**-**	46.06	7.86	53.92	-	13.48	-	10.11	-	4.49	2.24	6.73	-	2.24	**-**	**13.48**	**100**

Note: **T:** Theory **P:** Practical **DSE:** Discipline Specific Elective
IDE: Inter-disciplinary Electives **CCC:** Common Compulsory Course **SIP:** Summer Internship Project

Programme Structure

Semester I						
Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
1	MGG101	Geomorphology, Tectonics & Soil Geography	4	4	0	0
2	MMG102	Fundamentals of Geographic Information System	3	3	0	0
		Lab: Fundamentals of Geographic Information System	1	0	0	1
3	MGG103	Geodesy, Digital Cartography & GNSS	3	3	0	0
		Lab: Geodesy, Digital Cartography & GNSS	1	0	0	1
4	**Elective-I: Any one of the following**		3	3	0	0
	MGG111	Database Management Systems				
		Geography of Semi-Arid Regions				
		Social, Economic & Political Geography				
		Lab: MGG111	1	0	0	1
5	MGG112	***IDE-I:** MOOCs	3	3	0	0
Total			**19**	**16**	**0**	**3**

Semester II						
Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
1	MGG201	Evolution of Geographical Thought	4	4	0	0
2	MGG202	Climatology and Oceanography	4	4	0	0
3	MGG203	Principles of Remote Sensing	3	3	0	0
		Lab: Principles of Remote Sensing	1	0	0	1
4	MGG204	Digital Image Analysis	3	3	0	0
		Lab: Digital Image Analysis	1	0	0	1
5	**Elective-II: Any one of the following**		3	3	0	0
	MGG211	Agricultural Geography				
		Population & Settlement Geography				
		Web Mapping & Geo-Visualization				
		Lab: MGG211	1	0	0	1
6	MGG212	***IDE-II:** MOOCs	3	3	0	0
7	MGG213	**CCC-I:** Introduction to AI and ML	2	2	0	0
		Lab: Introduction to AI and ML	2	0	0	2
Total			**27**	**22**	**0**	**5**

Semester III						
Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
1	MGG301	Geography of India & Regional Planning	4	4	0	0
	MGG302	Advanced Geospatial Analysis	3	3	0	0
		Lab: Advanced Geospatial Analysis	1	0	0	1
3	MGG303	Advanced Spatial Statistics & Modelling	3	3	0	0
		Lab: Advanced Spatial Statistics & Modelling	1	0	0	1
4	**Elective-II: Any one of the following**		3	3	0	0
	MGG311	Advanced Surveying Techniques				
		Environmental Geography & Bio-Geography				
		Urban Geography and Planning				
		Lab: MGG311	1	0	0	1
5	MGG312	***IDE-III:** MOOCs	3	3	0	0
6	MGG313	**CCC-II:** Building Mathematical Ability and Financial Literacy	2	1	1	0
7	MGG314	**SIP:** Summer Internship Programme	2	0	0	2
Total			**23**	**17**	**1**	**5**

Semester IV						
Sl. No.	Course Code	Title of the Course	Credit Points	Credit Distribution		
				L*	T*	P*
1	MGG401	Research Methodology	4	4	0	0
2	MGG402	Statistical Methods in Geography	3	3	0	0
		Lab: Statistical Methods in Geography	1	0	0	1
3	MGG411	Dissertation	12	0	0	12
Total			**20**	**7**	**0**	**13**
Grand Total			**89**	**62**	**1**	**26**

Note: **L:** Lectures**; T:** Tutorial**; P:** Practical

Semester-wise Credit Distribution

Semester	Total Credits	Cumulative credit at the end of the semester
I	19	19
II	27	46
III	23	69
IV	20	89

I. Credit Requirement

- The minimum number of credits required to be earned by a student for the award of the degree is **85**.
- Students may earn credits in excess of 85 by opting for additional courses; however, the upper limit shall not exceed **96 credits**.

II. Assessment Pattern

- **Theory Courses**:
  - **Internal (40%)** – Formative evaluation comprising two best out of three tests (each test carrying a maximum of 15 marks, totalling 30 marks), along with seminar/assignments/attendance (10 marks).
  - **External (60%)** – Summative evaluation through the semester-end examination.

III. Laboratory Components:

- **Internal (60%)** – Continuous assessment through lab work and internal examination.
- **External (40%)** – Summative evaluation through the semester-end practical examination.

IV. End-Semester Examination:

- Maximum Marks: **60**
- Duration: **3 Hours**

Important Information to Students

i. Eligibility: Bachelor's degree in Geography/Science/ Engineering/ Technology/ Architecture/ Town planning/ Statistics and any other allied/ relevant areas and allied disciplines with a minimum 50% marks or equivalent grade.

ii. The minimum duration for completion of the 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.

iii. A student should attend at least 75% of the classes, seminars, practical in each course of study.

iv. All theory courses in the programme carry a Continuous Internal Assessment (CIA) component to a maximum of 40 marks and Semester End Examination (SEE) for a maximum of 60 marks. The minimum pass marks for a course is 50%.

v. All lab components carry a Continuous Internal Assessment (CIA) component to a maximum of 60 marks and Semester End Practical Examination (SEE) for maximum of 40 marks. The minimum pass marks for a course in 50%.

vi. A student should pass separately in both CIA and the SEE, i.e., a student should secure 20 (50%) out of 40 marks for theory and 30 (50%) out of 60 marks in the lab components in CIA. A student should secure 30 (50%) out of 60 marks for theory and 20 (50%) out of 40 marks for lab components in the SEE.

vii. There are 3 CIA tests for each course per semester from which the best 2 performances are considered for the purpose of calculating the marks in CIA. A record of the continuous assessment is maintained by the academic unit. A record of the continuous assessment is maintained by the academic unit.

viii. Each CIA contains 15 marks, out of the best 2 tests scores are considered for 30 marks. Remaining 10 marks awarded for assignments, class presentations and class participation and punctuality of the student.

ix. A student failing to secure the minimum pass marks in the CIA is not allowed to take the semester end examination of that course. S/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.

x. Semester-end examination shall consist of objective type questions, descriptive type questions, short answer questions and case studies or any other recommended by the Board of Studies (BoS).

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

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

xiii. An on-campus elective course is offered only if 10 or 50% of the students registered, whichever is higher.

SEMESTER WISE
DETAILED SYLLABUS

SEMESTER-I

Course Code : **MGG101** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Geomorphology, Tectonics & Soil Geography**

Course Objectives:

- To understand the concepts, theories, and evolution of geomorphology, including Earth structure, landform development, and tectonic processes.
- To examine major geomorphic processes and systems such as weathering, rivers, glaciers, deserts, coasts, and climatic regions in shaping landforms.
- To study soil formation, classification, and distribution, with special reference to India, and apply geomorphology using GIS and Remote Sensing for resource and environmental management.

Course Outcomes (COs):

By the end of the course, students can be able to;

- **CO1: Explain** the concepts, scope, theories, and historical development of geomorphology and Earth's internal structure.
- CO2: Describe tectonic processes such as isostasy, plate tectonics, earthquakes, volcanism, folding, and faulting, and their associated landforms.
- CO3: Analyze geomorphic processes including weathering, mass wasting, erosion, transportation, deposition, and drainage basin characteristics.
- CO4: Evaluate specialized geomorphic systems such as glacial, aeolian, coastal, karst, and climatic geomorphology in landscape development.
- CO5: Assess soil formation, classification, distribution, and degradation problems in India, and apply GIS and Remote Sensing for soil and environmental management.

COs /POs Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓					✓					
CO3 Apply Models	✓	✓	✓				✓					
CO4 Analyse & evaluate	✓	✓		✓		✓	✓					
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓

Course Outline:

Foundations of Geomorphology: Meaning, nature, scope and recent trends in geomorphology. Development of geomorphic thought and historical evolution of the discipline. Internal structure of the Earth including crust, mantle, core, lithosphere and asthenosphere. Fundamental concepts such as uniformitarianism, catastrophism and systems approach. Theories of landform development, including the Geographical Cycle of William Morris Davis, slope replacement model of Walther Penck and the pediplanation cycle of Lester Charles King.

Unit-II: [12 Hours]

Tectonic Geonmorphology: Concept of isostasy with Airy and Pratt models. Plate tectonics theory and continental drift theory proposed by Alfred Wegener. Crustal movements including orogenesis, epeirogenesis, folding and faulting. Earthquakes and volcanism as geomorphic agents. Landforms associated with tectonic activity. Concepts of neotectonics and active tectonics.

Unit-III: [14 Hours]

Geomorphic Processes: Weathering processes including physical, chemical and biological weathering. Mass wasting and slope evolution. Processes of erosion, transportation and deposition. Fluvial processes and development of river landforms. Drainage basin characteristics and morphometric analysis.

Unit-IV: **[10 Hours]**

Specialized Geomorphic Systems: Glacial geomorphology including glaciers and associated erosional and depositional landforms. Periglacial processes and landforms. Aeolian geomorphology with emphasis on desert landscapes and dunes. Coastal geomorphology including waves, tides and shoreline development. Karst geomorphology and limestone landscapes. Applied geomorphology in environmental management and resource planning.

Unit-V: **[12 Hours]**

Climatic Geomorphology and Soil Geography: Climatic geomorphology with reference to arid, humid, tropical and glacial regions. Concept of morphogenetic regions. Impact of climate change on geomorphic systems and landforms. Anthropogenic geomorphology and human impact on landscapes. Soil forming factors including climate, organisms, relief, parent material and time. Processes of soil genesis and pedogenesis. Soil profile development and horizons. Physical and chemical properties of soil including texture, structure, pH, water holding capacity and cation exchange capacity. Soil classification systems including USDA and FAO approaches. Major soils of India including Alluvial soils, Black soils, Red soils, Laterite soils, Desert soils, Forest and Mountain soils, Saline and Alkaline soils, and Peaty soils with their characteristics and regional distribution in India. Soil erosion, salinity, desertification and methods of soil conservation and management. Soil mapping using GIS and Remote Sensing.

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Course Code :**MGG102** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Fundamentals of Geographic Information System**

Course Objectives:

- To understand the principles, components, data models, and development of Geographic Information System (GIS).
- To examine GIS database management, spatial analysis techniques, and methods of data input, editing, and output generation.
- To analyze GIS applications, project development, and emerging technologies for planning, governance, and resource management.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, scope, evolution, components, and applications of Geographic Information System (GIS).
- CO2: Describe geographic data sources, vector and raster models, and methods of data input such as GPS, total station, and remote sensing.
- CO3: Analyze GIS database creation, topology, data editing, updating, and quality assessment procedures.
- CO4: Apply spatial analysis techniques including buffering, overlay, network, and terrain analysis using DEM.
- CO5: Assess GIS applications, project development stages, emerging trends such as Web GIS, Cloud GIS, AI integration, and ethical issues in GIS.

COs /POs Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓		✓	✓							
CO3 Apply Models	✓	✓	✓	✓	✓			✓				
CO4 Analyse & evaluate	✓	✓	✓	✓	✓		✓					
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Introduction to GIS: Meaning, definition, nature and scope of Geographic Information System (GIS). Historical development and evolution of GIS technology. Components of GIS including hardware, software, data, people and methods. Geographic objects, spatial entities and map representation. Applications of GIS in planning, environment and resource management.

Unit-II: [12 Hours]

GIS Data Models and Data Input: Nature and sources of geographic data. Spatial and non-spatial data. Primary and secondary data sources. Vector and raster data models, their characteristics, advantages and limitations. Data input devices and methods including digitizer, scanner, GPS, total station and remote sensing data sources. Geo-referencing and data conversion techniques.

Unit-III: [14 Hours]

GIS Database Management and Editing: Concept of GIS databases. Database creation, storage, retrieval and management. Attribute data handling and linking spatial with non-spatial data. Topology concepts and topology building. Data editing, updating and map revision. Error detection, correction and data quality assessment.

Unit-IV: [10 Hours]

GIS Spatial Analysis and Output: Concept and importance of spatial analysis in GIS. Measurement and query operations. Buffering, proximity analysis, network analysis and interpolation methods. Overlay analysis including union, intersect, clip and dissolve operations. Terrain analysis using DEM including slope, aspect, contour and watershed analysis. Presentation of GIS outputs through maps, charts, tables, reports.

Unit-V: [12 Hours]

GIS Applications, Project Development and Future Trends: Stages of GIS project development including problem identification, database design, data collection, analysis and output generation. Applications of GIS in agriculture, forestry, urban planning, disaster management, health, transport and governance. Emerging trends in GIS including Web GIS, Mobile GIS, Cloud GIS, 3D GIS, UAV mapping, Artificial Intelligence and Big Data integration. Ethical and legal issues in GIS including privacy, copyright, data security and policy concerns.

References:

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Course Code : **MGG103** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Geodesy, Digital Cartography & GNSS**

Course Objectives:

- To understand the principles of geodesy, Earth measurement, coordinate systems, and cartographic science.
- To examine modern surveying and positioning techniques using GNSS, projections, and digital cartography methods.
- To analyze applications of geodesy, cartography, and GNSS in mapping, navigation, planning, and geospatial management.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, scope, and significance of geodesy, including Earth shape, geoid, ellipsoid, and control networks.
- CO2: Describe coordinate reference systems, projections, geographic data types, and geo-referencing techniques.
- CO3: Apply principles of digital cartography, map design, thematic mapping, and web cartography.
- CO4: Analyze GNSS principles, satellite systems such as GPS, GLONASS, Galileo, and NavIC, along with surveying methods.
- CO5: Assess applications of geodesy, cartography, and GNSS in cadastral surveys, disaster management, navigation, smart cities, and geospatial technologies.

COs /POs Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓			✓							
CO3 Apply Models	✓	✓	✓		✓					✓		
CO4 Analyse & evaluate	✓	✓	✓	✓	✓							
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Geodesy and Earth Measurement: Meaning, scope and significance of geodesy. Shape and size of the Earth. Concepts of geoid, spheroid, ellipsoid and gravity field of the Earth. Geodetic reference systems and control networks. Principles of triangulation, trilateration and leveling. Horizontal and vertical control. Modern developments in geodesy.

Unit-II: [12 Hours]

Coordinate Reference Systems and Projection Science: Nature and sources of geographic data. Spatial and non-spatial data. Primary and secondary data sources. Vector and raster data models, their characteristics, advantages and limitations. Data input devices and methods including digitizer, scanner, GPS, total station and remote sensing data sources. Geo-referencing and data conversion techniques.

Unit-III: [14 Hours]

Advanced Digital Cartography: Cartographic communication and map perception. Principles of map design, layout and composition. Symbolization, typography, color schemes and visual hierarchy. Cartographic generalization and scale effects. Thematic cartography including choropleth, dot density, proportional symbol, isopleth and flow mapping. Atlas cartography, interactive maps, animated maps and web cartography.

Unit-IV: [10 Hours]

GNSS Surveying and Positioning Techniques: Principles of Global Navigation Satellite Systems. Major systems including GPS, GLONASS, Galileo and NavIC. Satellite signals and positioning methods. GNSS errors

and accuracy factors. Differential GPS (DGPS), Static survey, Kinematic survey, Real Time Kinematic (RTK) and Precise Point Positioning (PPP). Field survey planning and data processing.

Unit-V: [12 Hours]

Applications and Emerging Technologies: Applications of geodesy, cartography and GNSS in cadastral surveying, engineering projects, disaster management, transport navigation, deformation monitoring, precision agriculture and environmental studies. Integration with GIS, Remote Sensing and UAV mapping. Mobile mapping systems, location-based services, autonomous navigation and smart city applications. Legal, ethical and security issues related to geospatial data and positioning systems.

References:

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Maling, D. H. (1973). Coordinate Systems and Map Projections. George Philip & Sons Ltd., London.

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Course Code : **MGG111** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Database Management Systems**

Course Objectives:

- To understand the principles, architecture, models, and functions of Database Management Systems (DBMS).
- To examine database design, SQL operations, normalization, transaction management, and security mechanisms.
- To analyze advanced database technologies and applications in business, cloud systems, GIS, and geospatial data management.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, need, architecture, components, and applications of Database Management Systems (DBMS).
- CO2: Describe database models, relational concepts, keys, relationships, and SQL commands for data definition and manipulation.
- CO3: Apply ER modeling, relational schema design, normalization techniques, and functional dependency concepts.
- CO4: Analyze transaction management, concurrency control, recovery methods, and database security mechanisms.
- CO5: Assess advanced topics such as indexing, query optimization, distributed databases, NoSQL, Big Data, cloud databases, and GIS applications.

COs /POs Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓			✓							
CO3 Apply Models	✓	✓	✓	✓	✓							
CO4 Analyse & evaluate	✓	✓	✓	✓	✓			✓				
CO5 Research & create	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: **[12 Hours]**

Introduction to Database Management Systems: Meaning, definition, nature and scope of database systems. Need and advantages of DBMS over file processing systems. Components of database systems. Database users and administrators. Levels of data abstraction and data independence. Database architecture including one-tier, two-tier and three-tier architecture. Functions of DBMS. Applications of DBMS in business, government, education and geospatial systems.

Unit-II: **[12 Hours]**

Database Models and SQL Fundamentals: Database models including hierarchical, network, relational and object-oriented models. Concepts of tables, tuples, attributes, keys and relationships. Introduction to relational database model. Structured Query Language (SQL): data types, data definition language (DDL), data manipulation language (DML), data control language (DCL) and transaction control language (TCL). Basic SQL commands for create, insert, update, delete and select operations.

Unit-III: **[14 Hours]**

Database Design and Normalization: Entity-Relationship (ER) modeling and diagram construction. Entities, attributes, relationships and constraints. Mapping ER model to relational schema. Relational algebra and relational calculus. Functional dependency and keys. Normalization concepts including First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF) and denormalization.

Unit-IV: **[10 Hours]**

Transaction Management, Recovery and Security: Concept of transactions and ACID properties. Concurrency control techniques. Lock-based protocols, deadlock handling and timestamp methods. Recovery management using logs, checkpoints and backup techniques. Database security concepts including authentication, authorization, access control and auditing. SQL security features including roles, privileges, grant and revoke commands.

Unit-V: **[12 Hours]**

Advanced Topics in DBMS: Indexing methods including B-tree and hashing. Query processing and query optimization techniques. Distributed database systems and client-server databases. Data warehousing and data mining concepts. NoSQL databases including key-value, document, column-family and graph databases. Big Data management systems and cloud databases. Emerging trends in database technologies and applications in GIS and geospatial data management.

References:

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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 : **MGG111** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Geography of Semi-Arid Regions**

Course Objectives:

- To understand the physical, climatic, and environmental characteristics of semi-arid regions.
- To examine human geography, agriculture, resource use, and environmental challenges in semi-arid areas.
- To analyze development issues, management strategies, and geospatial applications for sustainable planning in semi-arid regions.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, characteristics, and global distribution of arid, semi-arid, and dry sub-humid regions with special reference to India.
- CO2: Describe the geomorphology, soils, water resources, vegetation, and land degradation processes of semi-arid regions.
- CO3: Analyze population patterns, livelihoods, agriculture, irrigation systems, migration, and vulnerability in semi-arid areas.
- CO4: Assess drought, water scarcity, desertification, climate change impacts, and sustainable resource management strategies.
- CO5: Evaluate regional development issues, case studies of Rayalaseema, Karnataka dry zones, Rajasthan, and the Sahel, using GIS and Remote Sensing applications.

COs /POs Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓					✓	✓					✓
CO2 Explain & interpret	✓	✓				✓	✓					
CO3 Apply Models	✓	✓	✓			✓	✓					
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓					
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Concept and Characteristics of Semi-Arid Regions: Meaning and definition of arid, semi-arid and dry sub-humid regions. Climatic characteristics of semi-arid environments. Rainfall variability, evapotranspiration, drought and water balance. Global distribution of semi-arid regions. Semi-arid regions of India with special reference to Rayalaseema, Deccan Plateau and Rajasthan.

Unit-II: [12 Hours]

Physical Environment of Semi-Arid Regions: Geomorphology of semi-arid landscapes. Weathering and erosion processes. Soils of semi-arid regions and their limitations. Surface water and groundwater resources. Vegetation characteristics, scrublands and grasslands. Desertification and land degradation processes.

Unit-III: [14 Hours]

Human Geography of Semi-Arid Regions: Population distribution and settlement patterns. Rural livelihoods and occupational structure. Agriculture in semi-arid regions: dry farming, millet cultivation, livestock economy. Irrigation systems, tanks and watershed dependence. Migration, poverty and vulnerability.

Unit-IV: [10 Hours]

Environmental Problems and Resource Management: Drought: causes, impacts and mitigation. Water scarcity and groundwater depletion. Soil erosion and desertification control. Watershed management, rainwater harvesting and tank rehabilitation. Climate change impacts on semi-arid regions. Sustainable land and water resource

management.

Unit-V: **[12 Hours]**

Regional Development and Case Studies: Development issues in semi-arid India. Regional disparities and planning approaches. Government programmes for dryland development. Case studies of Rayalaseema, Karnataka dry zones, Rajasthan and African Sahel. Role of GIS and Remote Sensing in drought monitoring, land use planning and resource assessment.

References:

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Reddy, C. R., Tonapi, V. A., Bezkorowajnyj, P. G., Navi, S. S., & Seetharama, N. (2007). *Seed System Innovations in the Semi-Arid Tropics of Andhra Pradesh*. International Livestock Research Institute (ILRI), ICRISAT.

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Course Code: **MGG 111** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Social, Economic & Political Geography**

Course Objectives:

- To understand the concepts, approaches and contemporary issues in social and cultural geography.
- To examine the historical evolution and philosophical foundations of geographical thought.
- To develop critical understanding of major geographical theories, paradigms and contemporary perspectives.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1. Explain key concepts and themes of social and cultural geography.
- CO2. Analyze social and cultural processes shaping spatial patterns and regional diversity.
- CO3. Assess the contributions of major geographical thinkers and schools of thought.
- CO4. Evaluate classical and contemporary paradigms in geographical thought.
- CO5. Apply geographical concepts, theories and perspectives to interpret contemporary geographical issues.

COs/Pos Mapping:

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓					✓						✓
CO2 Explain & interpret	✓	✓				✓	✓					
CO3 Apply Models	✓	✓	✓			✓	✓					
CO4 Analyse & evaluate	✓	✓		✓						✓		✓
CO5 Research & create	✓	✓	✓	✓		✓	✓	✓		✓		✓

Course Outline:

Unit-I: [12 Hours]

Social Geography: Meaning, nature, scope and development of social geography. Concepts of social space, place and society. Social structure and social processes. Ethnicity, tribe, caste, dialect, language and religion as social categories with special reference to India. Social exclusion, poverty, crime, segregation and geographies of inequality. Geography of health, well-being and welfare with special reference to India. Urban and rural social issues including housing, migration, slums, rural transformation and social infrastructure.

Unit-II: [12 Hours]

Cultural Geography: Definition, nature and scope of cultural geography. Culture, identity and spatial organization. Race, religion, language and ethnicity as cultural attributes with special reference to India. North-South socio-cultural divide and regional diversity. World cultural realms and cultural diversity. Morphology of cultural landscape with special reference to Carl O Sauer. Cities as melting pots of culture. Traditional folk culture, crisis and transformation. Cultural processes including diffusion, acculturation, assimilation and cultural pluralism.

Unit-III: [14 Hours]

Evolution of Geographical Thought: Nature, Scope, and Significance of Economic Geography. Major Approaches and Concepts in Economic Geography. Economic Activities: Primary, Secondary, Tertiary, Quaternary, and Quinary Sectors. Theories of Agricultural Location: Johann Heinrich von Thünen. Industrial Location Theories: Alfred Weber and Modern Perspectives. Resource Distribution and Regional Economic Development.

Unit-IV: [10 Hours]

Contemporary Perspectives in Economic Geography: Globalization and the Changing Spatial Organization of Economic Activities. Trade, Transportation, and Economic Networks. World systetem theoryUrbanization,

Industrialization, and Economic Development. Immanuel Wallerstein and the Core–Periphery Framework. Regional Inequalities and Development Disparities. Sustainable Development and Green Economy. Emerging Trends: Digital Economy, Knowledge Economy, and Economic Restructuring

Unit-IV: [10 Hours]

Introduction to Political Geography: Nature, Scope, and Evolution of Political Geography. State, Nation, Nation-State, and Sovereignty. Boundaries, Frontiers, and Territoriality. Classical Geopolitical Theories: Halford Mackinder – Heartland Theory and Nicholas Spykman – Rimland Theory. Contemporary Geopolitics and Geostrategy. Electoral Geography and Political Behaviour. Globalization, Regionalism, and Contemporary Geopolitical Issues.

References:

Bist, B. S., & Panth, V. K. (1998). Backward Communities in India. Rawat Publications.
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Goblet, Y. M. (1955). *Political Geography and the World Map*. George Philip and Sons.
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Taylor, P. J. (1985). *Political Geography: World Economy, Nation-State and Locality*. Longman.
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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.

SEMESTER-II

Course Code : **MGG201** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Evolution of Geographical Thought**

Course Objectives:

- To understand the evolution and philosophical foundations of geographical thought.
- To examine the contributions of major geographical thinkers and schools of thought.
- To develop critical understanding of contemporary geographical theories and perspectives.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1. Explain the historical development of geographical thought and major geographical traditions.
- CO2. Assess the contributions of key geographers and schools of thought.
- CO3. Analyze major geographical paradigms and methodological approaches.
- CO4. Compare classical and contemporary perspectives in geography.
- CO5. Apply geographical concepts and theories to contemporary geographical issues.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓	✓				✓					
CO3 Apply Models	✓	✓		✓		✓						✓
CO4 Analyse & evaluate	✓	✓	✓	✓		✓				✓		
CO5 Research & create	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Foundations of Geographical Thought: Meaning, nature and scope of geography. Geography as a science of synthesis and its place in the classification of sciences. Nature of geographical knowledge and epistemology. Philosophical foundations of geography. Development of geographical ideas and traditions. Concepts of space, place, region and environment.

Unit-II: [12 Hours]

Ancient and Pre-modern Geographical Thought: Emergence and historical development of geography as a discipline. Contributions of major scholars in the ancient world including Greek, Roman and Indian traditions. Development of geographical knowledge during the Middle Ages, Renaissance, Reformation and Age of Enlightenment. Pre-modern geography with special reference to Bernhardus Varenius and Immanuel Kant.

Unit-III: [12 Hours]

Classical and Modern Geographical Thought: Nineteenth-century geography and the contributions of Alexander von Humboldt and Carl Ritter. Environmental determinism with reference to Friedrich Ratzel and Ellen Churchill Semple. Possibilism and the French School with reference to Paul Vidal de la Blache and Jean Brunhes. Neo-determinism and contemporary environmental thought.

Unit-IV: [12 Hours]

Regional Geography and Scientific Approaches: Concept of region and regional geography. Contributions of Richard Hartshorne and areal differentiation. Exceptionalism and the Fred K. Schaefer–Hartshorne debate. Scientific explanation and theory building in geography. Positivism, logical positivism and the quantitative revolution. Dualisms in geography including regional versus systematic and physical versus human geography.

Unit-v: **[12 Hours]**

Contemporary Geographical Thought and Emerging Perspectives: Behavioural geography, humanistic geography, radical and Marxist geography, welfare geography and feminist geography. Structuralism, post-structuralism, modernism and postmodernism. Applied geography and contemporary relevance of geographical thought. Spatial and temporal dimensions including absolute, relative and social space, third space and time-space prism. Emerging trends in geographical research under geospatial technologies, big data and digital geography.

References:

Adhikari, S. (1992). *Geographical Thought*. Chaitanya Publishing House.

Chorley, R. J., & Haggett, P. (Eds.). (1965). *Frontiers in Geographical Teaching*. Oxford University Press.

Dikshit, R. D. (Ed.). (1994). *The Art and Science of Geography: Selected Readings*. Prentice Hall of India.

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Gregory, D., & Walford, R. (Eds.). (1988). *Horizons in Human Geography*. Macmillan.

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Massey, D., & Allen, J. (Eds.). (1984). *Geography Matters: A Reader*. Cambridge University Press.

Stoddart, D. R. (1986). *On Geography and Its History*. Basil Blackwell.

Course Code : **MGG202** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Climatology & Oceanography**

Course Objectives:

- To understand the principles, components, and technological foundations of remote sensing systems.
- To examine satellite missions, data acquisition methods, sensor systems, and image characteristics.
- To analyze applications and emerging trends of remote sensing in resource management, planning, and environmental monitoring.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, characteristics, evolution, components, and principles of remote sensing, including electromagnetic spectrum and energy interactions with the atmosphere and Earth's surface.
- CO2: Describe remote sensing platforms, sensor systems, satellite orbits, image resolutions, multispectral and hyperspectral systems, microwave remote sensing, SAR, and LiDAR data acquisition techniques.
- CO3: Analyze major Earth observation satellite missions and remote sensing programmes including IRS, Cartosat, Resourcesat, INSAT, Landsat, Sentinel, and MODIS.
- CO4: Apply remote sensing techniques in environmental monitoring, land use and land cover mapping, agriculture, forestry, hydrology, urban planning, and disaster management.
- CO5: Assess emerging trends such as CubeSats, UAVs, thermal and hyperspectral remote sensing, AI integration, cloud geospatial analytics, and future challenges in climate change and sustainability studies.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓			✓							
CO3 Apply Models	✓	✓	✓	✓	✓					✓		✓
CO4 Analyse & evaluate	✓	✓	✓	✓	✓	✓	✓					
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Climatology: Nature, Scope, and Significance of Climatology. Composition and Structure of the Atmosphere. Insolation and Heat Budget of the Earth–Atmosphere System. Temperature Distribution: Horizontal and Vertical Variations. Atmospheric Humidity: Evaporation, Condensation, Clouds, and Precipitation. Stability and Instability of the Atmosphere. Atmospheric Radiation and Energy Balance. Elements and Controls of Weather and Climate. Weather and Climate: Concepts, Differences, and Applications

Unit-II: [12 Hours]

Atmospheric Processes and Climatic Systems: Atmospheric pressure belts and planetary wind systems. Air masses, fronts and temperate cyclones. Tropical cyclones, thunderstorms and local winds. Monsoon system with special reference to India. Classification of climates with reference to Wladimir Köppen and Thornthwaite schemes. Climatic regions of the world.

Unit-III: [14 Hours]

Applied Climatology and Climate Change: Urban climatology, agricultural climatology and bioclimatology. Climatic hazards including droughts, floods, heat waves and cold waves. Climate variability and teleconnections such as El Niño and La Niña. Global warming, greenhouse effect and climate change. Impacts of climate change on environment, agriculture and water resources. Climate adaptation and mitigation strategies.

Unit-IV: [10 Hours]

Fundamentals of Oceanography: Meaning, nature, scope and branches of oceanography. Distribution of land and water on the Earth. Relief of the ocean floor including continental shelf, slope, abyssal plains, trenches and mid-ocean ridges. Physical and chemical properties of seawater including temperature, salinity, density and marine sediments. Ocean water budget.

Unit-V: **[12 Hours]**

Ocean Dynamics and Marine Resources: Waves, tides and ocean currents. Surface and deep ocean circulation. Major ocean currents of the Atlantic, Pacific and Indian Oceans. Marine ecosystems and coral reefs. Ocean-atmosphere interaction and its role in climate. Marine resources including fisheries, minerals and energy resources. Coastal hazards such as tsunami, storm surge and sea level rise. Ocean governance and sustainable management of marine resources.

References:

Barry, R. G. and Chorley, R. J. (1992). *Atmosphere, Weather and Climate*, 6th edition. Routledge, London: 392p.
Critchfield, H. J. (1983). *General Climatology*, 4th edition. Prentice Hall India Ltd., New Delhi: 453p.
Das, P. K. (1995). *Monsoons*, 2nd edition. National Book Trust, New Delhi: 347p.
Lal, D. S. (1993). *Climatology*, 3rd edition. Chaitanya Publishing House, New Delhi: 412p.
Linacre, E. and Geerts, B. (1997). *Climates and Weather Explained*. Routledge, London: 464p.
Lutgens, F. K. and Tarbuck, E. J. (1998). *The Atmosphere: An Introduction to Meteorology*, 7th edition. Prentice-Hall.
Moran, J. M. and Morgan, M. D. (1997). *Meteorology: The Atmosphere and the Science of Weather*, 5th edition. Prentice-Hall Inc., Upper Saddle River: 530p.
Pinet, P. R. (2006). *Invitation to Oceanography* (4th ed.). Jones and Bartlett Publishers.
Sverdrup, K. A., Duxbury, A. C., & Duxbury, A. B. (2005). *The World's Oceans* (International edition). McGraw-Hill.
Segar, D. A. (2007). *Introduction to Ocean Sciences* (2nd ed.). W. W. Norton and Company, New York.

Course Code :**MGG203** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Principles of Remote Sensing**

Course Objectives:

- To understand the principles of climatology and oceanography, including semi-arid climates, atmospheric systems, and oceanic characteristics.
- To examine atmospheric and oceanic processes such as monsoons, cyclones, currents, tides, and climate variability influencing weather and climate.
- To analyze climate change, climatic hazards, marine resources, and sustainable management with special reference to India.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts, characteristics, evolution, components, and principles of remote sensing, including electromagnetic energy interactions and sensor systems.
- CO2: Describe remote sensing platforms, satellite orbits, image resolutions, multispectral and hyperspectral systems, microwave remote sensing, SAR, and LiDAR data acquisition techniques.
- CO3: Analyze major Earth observation satellite missions and remote sensing programmes including IRS, Cartosat, Resourcesat, INSAT, Landsat, Sentinel, and MODIS.
- CO4: Apply remote sensing techniques in environmental monitoring, land use and land cover mapping, agriculture, forestry, hydrology, urban planning, and disaster management.
- CO5: Assess emerging trends such as CubeSats, UAVs, thermal and hyperspectral remote sensing, AI integration, cloud geospatial analytics, and future challenges in climate change and sustainability studies.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							
CO2 Explain & interpret	✓	✓			✓							
CO3 Apply Models	✓	✓	✓	✓	✓							
CO4 Analyse & evaluate	✓	✓	✓	✓	✓	✓	✓					
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓				

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Remote Sensing: Meaning, definition, nature, scope and significance of remote sensing. Historical development and evolution of remote sensing technology. Components of remote sensing system including energy source, atmosphere, target, sensor, platform and data transmission. Electromagnetic spectrum and its characteristics. Energy interactions with atmosphere and Earth's surface including reflection, absorption, transmission and scattering. Remote sensing platforms including ground-based, airborne and satellite systems. Types of sensors including active and passive sensors.

Unit-II: [12 Hours]

Remote Sensing Systems and Data Acquisition: Satellite orbits and orbital characteristics including geostationary, polar sun-synchronous and low Earth orbit systems. Spatial, spectral, radiometric and temporal resolution. Image acquisition techniques and data products. Multispectral and hyperspectral remote sensing. Microwave remote sensing including radar principles and Synthetic Aperture Radar (SAR). LiDAR principles and data acquisition. Major satellite programmes including ISRO, Landsat and Sentinel.

Unit-III: [14 Hours]

Remote Sensing Missions and Satellite Systems: Development of Earth observation satellites and global remote sensing programmes. Major Indian satellite missions including IRS, Cartosat, Resourcesat and INSAT. International missions including Landsat, Sentinel, MODIS and other global systems. Comparison of satellite missions and data applications.

Unit-IV: [10 Hours]

Applications of Remote Sensing: Applications of remote sensing in environmental monitoring, land use and land cover mapping, agriculture, forestry, hydrology, geology and ocean studies. Urban and regional planning applications including urban growth analysis, transport planning and infrastructure monitoring. Disaster management applications including flood, drought, cyclone, wildfire and landslide monitoring.

Unit-V: [12 Hours]

Emerging Trends and Future Directions: Advances in remote sensing technology including small satellites, CubeSats, UAVs and drone mapping. Thermal remote sensing and hyperspectral innovations. Integration of remote sensing with GIS, GNSS and Artificial Intelligence. Cloud computing and big geospatial data analytics. Real-time Earth observation systems. Future challenges and opportunities in remote sensing applications including climate change studies, sustainability and policy issues.

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.
Allison, L. J., & Schnapf, A. (1983). Meteorological satellites. In R. N. Colwell (Ed.), *Manual of Remote Sensing*. American Society of Photogrammetry, Falls Church.
Campbell, J. B. (1996). *Introduction to Remote Sensing* (2nd ed.). Taylor & Francis, London.
Chaisman, N. (1992). *Exploring Geographical Information Systems*. John Wiley and Sons Inc., New York.
Colwell, R. N. (Ed.). *Manual of Remote Sensing* (2nd ed.). American Society of Photogrammetry, Falls Church.
Curran, P. J. (1988). *Principles of Remote Sensing*. Longman Group UK Ltd.
Guha, P. K. (2003). *Remote Sensing for the Beginner*. Affiliated East-West Press Pvt. Ltd., New Delhi.
George, J. (2003). *Fundamental Remote Sensing*. Universities Press, New Delhi.
Narayan, L. R. A. (2000). *Remote Sensing and Its Applications*. Universities Press, Hyderabad.
Rajan, M. S. (1995). *Space Today* (2nd ed.). National Book Trust, New Delhi.
Slater, P. N. (1983). *Photographic Systems for Remote Sensing*. Singapore Science Centre.
Bhatta, B. (2011). *Remote Sensing and GIS*. Oxford University Press.

Course Code : **MGG 204** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Digital Image Analysis**

Course Objectives:

- To understand the principles, techniques, and significance of digital image analysis and processing.
- To examine image interpretation, feature extraction, classification, and advanced analytical methods.
- To analyze applications and emerging trends of digital image analysis in geospatial and decision support systems.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the concepts of digital images, image representation, resolutions, sampling, quantization, and basic image processing techniques.
- CO2: Describe image analysis methods including segmentation, edge detection, feature extraction, morphology, registration, and mosaicking.
- CO3: Apply image classification and pattern recognition techniques such as supervised, unsupervised, and object-based methods.
- CO4: Analyze advanced techniques including change detection, hyperspectral analysis, dimensionality reduction, 3D imaging, and real-time analytics.
- CO5: Assess applications of digital image analysis in remote sensing, agriculture, medical imaging, disaster management, Artificial Intelligence, and cloud-based geospatial systems.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓			✓							
CO3 Apply Models	✓	✓	✓	✓	✓							
CO4 Analyse & evaluate	✓	✓	✓	✓	✓		✓					✓
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Digital Image Analysis: Meaning, nature, scope and significance of digital image analysis. Introduction to digital images and image representation. Pixels, spatial resolution, radiometric resolution and spectral characteristics. Image acquisition systems and sensors. Sampling and quantization. Image formats and data structures. Basic image processing techniques including contrast enhancement, histogram operations, noise reduction and image restoration. Image transformations and filtering in spatial and frequency domains.

Unit-II: [12 Hours]

Image Analysis and Feature Extraction: Principles of image interpretation and analysis. Edge detection techniques and image segmentation methods. Region growing, thresholding and boundary detection. Feature extraction techniques for texture, shape, color and spectral features. Feature descriptors including SIFT and SURF. Morphological image processing including dilation, erosion, opening and closing. Image registration, geometric alignment and mosaicking techniques.

Unit-III: [14 Hours]

Image Classification and Pattern Recognition: Concepts of image classification and pattern recognition. Supervised classification methods including minimum distance, maximum likelihood and support vector machine. Unsupervised classification including clustering techniques such as K-means and ISODATA. Object-Based Image Analysis (OBIA) and rule-based classification. Accuracy assessment and confusion matrix. Applications of machine learning in image analysis.

Unit-IV: [10 Hours]

Advanced Image Analysis Techniques: Change detection methods and multi-temporal image analysis.

Applications of change detection in environmental monitoring, urban growth and land use studies. Multispectral and hyperspectral image analysis. Dimensionality reduction and spectral unmixing. 3D image acquisition and processing techniques. Digital surface models, point clouds and stereo image analysis. Real-time image processing concepts and automated image analytics.

Unit-V: **[12 Hours]**

Applications and Emerging Trends: Applications of digital image analysis in remote sensing, agriculture, forestry, geology, medical imaging, surveillance and autonomous systems. Urban mapping and disaster management applications. Artificial Intelligence and Deep Learning in image analysis. Cloud-based image processing and big image data analytics. Future trends in geospatial image analysis and decision support systems.

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.

Allison, L. J., & Schnapf, A. (1983). Meteorological satellites. In R. N. Colwell (Ed.), *Manual of Remote Sensing*. American Society of Photogrammetry, Falls Church.

Campbell, J. B. (1996). *Introduction to Remote Sensing* (2nd ed.). Taylor & Francis, London.

Chaisman, N. (1992). *Exploring Geographical Information Systems*. John Wiley and Sons Inc., New York.

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Curran, P. J. (1988). *Principles of Remote Sensing*. Longman Group UK Ltd.

Guha, P. K. (2003). *Remote Sensing for the Beginner*. Affiliated East-West Press Pvt. Ltd., New Delhi.

George, J. (2003). *Fundamental Remote Sensing*. Universities Press, New Delhi.

Narayan, L. R. A. (2000). *Remote Sensing and Its Applications*. Universities Press, Hyderabad.

Rajan, M. S. (1995). *Space Today* (2nd ed.). National Book Trust, New Delhi.

Slater, P. N. (1983). *Photographic Systems for Remote Sensing*. Singapore Science Centre.

Bhatta, B. (2011). *Remote Sensing and GIS*. Oxford University Press.

Course Code :**MGG 211** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Agricultural Geography**

Course Objectives:

- To understand the concepts, scope, theories, and factors influencing agricultural geography.
- To examine agricultural systems, policies, development programmes, and regional patterns with special reference to India.
- To analyze contemporary issues, innovations, and sustainable practices in agriculture.

Course Outcomes (COs):

By the end of the course, students can be able to;

- CO1: Explain the meaning, nature, scope, and theoretical approaches of agricultural geography, including the location theory of Johann Heinrich von Thünen.
- CO2: Describe agricultural systems, agro-climatic regions, major crops, cropping patterns, and livestock economy in India.
- CO3: Analyze agricultural policies, land reforms, irrigation systems, MSP, cooperatives, and institutional support mechanisms in India.
- CO4: Assess contemporary issues such as sustainability, climate change impacts, food security, agrarian distress, and regional disparities in agriculture.
- CO5: Evaluate emerging trends including precision farming, GIS, remote sensing, biotechnology, organic farming, e-NAM, and future prospects of Indian agriculture.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓				✓	✓					
CO3 Apply Models	✓	✓	✓	✓		✓	✓			✓	✓	
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓	✓				✓
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Agricultural Geography: Meaning, nature, scope and significance of agricultural geography. Development and approaches in agricultural geography. Theoretical approaches including agricultural location theory of Johann Heinrich von Thünen and modern perspectives. Physical, economic, technological and socio-cultural factors influencing agriculture. Land use and agricultural productivity. Types of agricultural systems including subsistence farming, commercial farming, plantation agriculture, mixed farming, intensive and extensive agriculture.

Unit-II: [12 Hours]

Agricultural Systems in India: Overview of Indian agriculture and its regional diversity. Agro-climatic regions of India and agricultural zoning. Major crops including rice, wheat, pulses, oilseeds, cotton, sugarcane, tea, coffee and horticultural crops. Cropping patterns, crop combinations and crop diversification. Livestock economy and allied agricultural activities. Green Revolution, White Revolution and their regional impacts..

Unit-III: [14 Hours]

Agricultural Policies and Development in India: Agricultural policies and development programmes in India. Land reforms, tenancy reforms and consolidation of holdings. Institutional framework including cooperatives, rural credit, agricultural extension and insurance. Minimum Support Price (MSP), procurement and public distribution system. Irrigation development and water management including canal irrigation, tank irrigation, tube wells and watershed management. Role of Indian Council of Agricultural Research and agricultural universities.

Unit-IV: [10 Hours]

Contemporary Issues in Indian Agriculture: Agricultural sustainability and environmental concerns including

soil degradation, salinity, waterlogging and biodiversity loss. Climate change and agriculture: impacts on crops, water resources and livelihoods. Food security, nutrition security and rural livelihoods. Agrarian distress, indebtedness and farmer vulnerability. Regional disparities in agricultural development.

Unit-V: [12 Hours]

Emerging Trends and Innovations in Agriculture: Precision farming and use of Information and Communication Technology (ICT) in agriculture. Remote sensing, GIS and drones in farm management. Role of biotechnology, hybrid seeds and GM crops. Organic farming, natural farming and sustainable agriculture. Agricultural marketing, supply chains, e-NAM and value chains. Contract farming, agro-processing and future prospects of Indian agriculture.

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.
Morgan, W. B., & Munton, R. J. C. (1971). *Agricultural Geography*. Methuen & Co.
Tarrant, J. R. (1974). *Agricultural Geography*. David & Charles.
Symons, L. (1970). *Agricultural Geography*. G. Bell & Sons.

Course Code : **MGG211** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Population & Settlement Geography**

Course Objectives:

- To understand the concepts, scope, and theories of population, settlement, and urban geography.
- To examine population dynamics, migration, rural settlements, urbanization, and spatial organization of human settlements.
- To analyze urban issues, planning approaches, and sustainable development with special reference to India.

Course Outcomes (COs):

- CO1: Explain the meaning, nature, scope, sources of data, and theories of population geography, including ideas of Thomas Robert Malthus.
- CO2: Describe fertility, mortality, migration, population-resource relationships, and demographic issues in India.
- CO3: Analyze the origin, types, patterns, morphology, hierarchy, and transformation of rural settlements.
- CO4: Apply concepts of urban geography, urbanization, land use models of Ernest Burgess, Homer Hoyt, and Chauncy Harris, along with functional classification of towns.
- CO5: Assess urban problems, transport, smart cities, planning approaches, resilience, climate adaptation, and emerging metropolitan regions in India.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓				✓	✓					
CO3 Apply Models	✓	✓	✓			✓						✓
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓					
CO5 Research & create	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Foundations of Population Geography: Meaning, nature, scope and development of population geography. Sources of population data: census, sample surveys and vital statistics. Distribution, density and growth of population. Population composition: age, sex, literacy, occupation and workforce structure. Theories of population: Thomas Robert Malthus and Neo-Malthusian theory, Optimum population theory, Demographic Transition Theory, Marxian views on population.

Unit-II: [12 Hours]

Population Dynamics and Human Mobility: Fertility: determinants, measures and trends. Mortality: determinants, measures and trends. Migration: determinants, measures and types. Theories of migration: Ernst Georg Ravenstein's Laws of Migration, Push–Pull Theory, Gravity Model of Migration. Population projections and demographic dividend. Population policies and family welfare programmes.

Unit-III: [14 Hours]

Population, Resources and Development: Population-resource relationship and carrying capacity. Population and economic development. Population, environment and sustainable development. Human Development Index (HDI) and quality of life indicators. Population issues in India: ageing, youth population, unemployment, gender imbalance and regional disparities. Emerging demographic challenges: climate-induced migration and demographic change.

Unit-IV: [12 Hours]

Settlement Geography Geography: Meaning, nature and scope of settlement geography. Origin and evolution of human settlements. Factors influencing location and distribution of settlements. Rural settlements: types, patterns and morphology. House types and building materials. Rural service centres and central place functions.

Unit-V: **[12 Hours]**

Rural Settlements and Regional Development: Settlement hierarchy. Theories of settlement location and distribution. Rural transformation and rural-urban linkages. Rural infrastructure and service centres. Sustainable rural development and rural planning. Applications of Remote Sensing and GIS in settlement studies.

References:

Binde, S. and Kanitkar, T. (2000). *The Principle of Population Studies*. Himalaya Publishing House.
Chandna, R. C. (2015). *Geography of Population*. Rawat Publications, New Delhi.
Hassan, M. I. (2015). *Population Geography*. Rawat Publications, Jaipur.
Premi, M. K. (2006). *Demography and Its Exposition*. Jwahar Publishers, New Delhi.
Majumdar, P. K. (2010). *Fundamentals of Demography*. Rawat Publications, Jaipur.
Mukherji, S. (2013). *Migration in India*. Rawat Publications, Jaipur.
Mourya, S. D. (2017). *Population Geography*. Pravalika Publications, Allahabad.
Muhammad, I. H. (2007). *Population Geography*. Rawat Publications, Jaipur.
Newbold, K. B. (2017). *Population Geography: Tools and Issues*. Rawat Publications.
Dyson, T. (2010). *Population and Development*. Rawat Publications, Jaipur.
Gould, W. T. S. (2009). *Population and Development*. Routledge (Taylor & Francis Group).

Course Code : **MGG 211** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Web Mapping & Geo-Visualization**

Course Objectives:

- To understand the concepts, scope, and theories of population, settlement, and urban geography.
- To examine population dynamics, migration, rural settlements, urbanization, and spatial organization of human settlements.
- To analyze urban issues, planning approaches, and sustainable development with special reference to India.

Course Outcomes (COs):

- To CO1: Explain the meaning, scope, architecture, technologies, and data standards used in web mapping and Web GIS.
- CO2: Apply interactive web map development techniques using Leaflet, Mapbox, geocoding, routing, and spatial queries.
- CO3: Analyze geo-visualization methods including thematic maps, animated maps, dashboards, story maps, and 3D terrain visualization.
- CO4: Describe web mapping services such as WMS, WFS, WCS, mobile mapping, open data systems, and OpenStreetMap.
- CO5: Assess applications of web mapping in urban planning, disaster management, transport, tourism, smart cities, IoT integration, Artificial Intelligence, and digital twins.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓	✓	✓	✓							
CO3 Apply Models	✓	✓	✓	✓	✓		✓			✓		✓
CO4 Analyse & evaluate	✓	✓				✓						
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Introduction to Web Mapping: Meaning, nature, scope and significance of web mapping. Evolution of digital cartography and online mapping. Fundamentals of web mapping architecture including client-server systems. Web mapping technologies including HTML, CSS, JavaScript and APIs. Geospatial data formats and standards including GeoJSON, KML, GML, Shapefile and TopoJSON. Introduction to Web GIS and cloud-based geospatial platforms.

Unit-II: [12 Hours]

Interactive Web Map Development: Principles of designing effective web maps. User interface and user experience in web cartography. Creating interactive maps using Leaflet. Layer control, legends, pop-ups and navigation tools. Using Mapbox for advanced web mapping. Handling geospatial data from local and online sources. Geocoding, routing and basic spatial queries in web mapping.

Unit-III: [14 Hours]

Geo-Visualization Techniques: Principles of data visualization and visual communication. Cartographic design for digital maps. Thematic mapping including choropleth, graduated symbol, dot density, heat maps and flow maps. Time-enabled and animated maps. 3D visualization using WebGL. Terrain visualization and virtual globes. Story maps, dashboards and narrative cartography.

Unit-IV: [10 Hours]

Web Services, Mobile Mapping and Open Data: Integration of web mapping services including Google Maps, Bing Maps and open-source platforms. Web Map Service (WMS), Web Feature Service (WFS) and Web Coverage Service (WCS). Mobile-friendly web maps and responsive design. GPS-enabled mobile mapping applications. Open data sources and volunteered geographic information. Crowdsourcing platforms including

OpenStreetMap.

Unit-V: **[12 Hours]**

Applications, Case Studies and Emerging Trends: Applications of web mapping and geo-visualization in urban planning, disaster management, environmental monitoring, transport planning, tourism and governance. Real-time dashboards and crisis mapping. Smart city applications and location-based services. Case studies of successful web mapping projects. Integration with GIS, Remote Sensing, IoT and Artificial Intelligence. Emerging trends in immersive mapping, digital twins and future geospatial visualization systems.

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.

Course Code : **CCC 213** Course Type : **CCC** No. of Credits : **4.00** No. of Hours : **30T + 60L**	**Course Title** **Introduction to Artificial Intelligence and Machine Learning**

Course Objectives:

- Provide To provide students with a strong foundation in the concepts, principles, and applications of Artificial Intelligence, including problem solving, knowledge representation, machine learning, and intelligent systems.
- To develop programming skills in Python, enabling students to write programs, apply control structures, functions, lists, and strings, and solve computational problems effectively.
- To enable students to understand and apply AI techniques such as machine learning, natural language processing, computer vision, and reasoning methods for solving real-world problems.

Course Outcomes (COs):

By the end of the course, students can be able to;

- **CO1:** Explain the fundamental concepts, characteristics, and applications of Artificial Intelligence and intelligent agents.
- **CO2:** Apply problem-solving and searching techniques, including uninformed, informed, and constraint satisfaction approaches, to AI problems.
- **CO3:** Demonstrate knowledge representation, logical reasoning, probabilistic reasoning, and automated planning techniques in AI systems.
- **CO4:** Analyze basic machine learning models and AI applications such as NLP, speech recognition, and computer vision.
- **CO5:** Develop Python programs using functions, control structures, strings, and lists to solve computational and AI-related problems.

COs /POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	–	–	1	–	–	–	–	–	–	2
CO2	3	3	2	1	2	–	–	–	–	–	–	2
CO3	3	3	2	2	2	–	–	–	–	–	–	2
CO4	3	3	2	2	3	–	–	–	–	–	–	2
CO5	3	2	3	2	3	–	–	–	1	1	_	2

Course Outline:

Unit-I: **[18 Hours]**

Introduction To Artificial Intelligence: Definition – 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; Path planning; Constraint Satisfaction Problems (CSP).

Unit-II: **[16 Hours]**

Knowledge Representation: Logical Agents– Propositional and first order Predicate logic - inference - Knowledge representation and Automated Planning– Uncertain Knowledge and Reasoning: Quantifying uncertainty– probabilistic reasoning**.**

Unit-III: **[16 Hours]**

Machine learning & AI Applications: 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 - Language Models - Machine Translation; Speech Recognition; Computer Vision - Image classification.

Unit-IV: **[20 Hours]**

Python Programming: Introduction-The Python Programming Language, History, features, Installing Python, Running Python program, Debugging: Syntax Errors, Runtime Errors, Semantic Errors – Experimental Debugging, Formal and Natural Languages, The Difference between Brackets, Braces, and Parentheses. Variables and Expressions: Values and Types - Variables, Variable & Keyword Type conversion - Operator and Operands – Expressions – Interactive – Mode and script Mode, Order of Operations. Conditional Statements: if, if- else, nested if –else -Looping: for, while, nested-loops. Control statements: Terminating loops, skipping specific conditions.

Unit-V: **[20 Hours]**

Functions: Function Calls, Type Conversion Functions, Math Functions, Adding New Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters. Strings: Strings, String Slices, Strings are immutable, and Searching–Looping–and counting String methods - the in operator–String Comparison – String operations Lists: Values and Accessing Elements, Lists are mutable, traversing a List, Deleting elements from List–, Built-in List Operators, Concatenation, In Operator, Built-in List functions and methods.

Suggested Readings:

M.Tim Jones, Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, NC.; 1 st Edition, 2008.
Burkahard A Meier, Python GUI programming Cookbook, Packt Publication 2nd Edition.
S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition 2022.

References:

Barry, P., Head first Python: A brain-friendly guide. " O'Reilly Media, Inc.". Lutz, 2016.
Lavika Goel, Artificial Intelligence: Concept and Applications, Willy, 2021
Mark Lutz, Learning python: Powerful object-oriented programming. "O'Reilly Media, Inc.", 2013.
Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.

SEMESTER-III

Course Code : **MGG 301** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Geography of India & Regional Planning**

Course Objectives:

- To understand the physical, cultural, population, and economic geography of India.
- To examine regional structure, planning concepts, development theories, and spatial disparities in India.
- To analyze contemporary issues of environment, resources, agriculture, industry, and sustainable regional development.

Course Outcomes (COs):

- CO1: Explain the relief, physiographic divisions, climate, drainage, soils, vegetation, and biodiversity of India.
- CO2: Describe the historical evolution of regions, linguistic and cultural diversity, population distribution, migration, urbanization, and settlement patterns in India.
- CO3: Analyze land use, agricultural regions, Green Revolution, mineral resources, industries, energy, transport, trade, and globalization in the Indian economy.
- CO4: Apply concepts of regional planning, regionalization, growth theories, and rural-urban planning approaches in the Indian context.
- CO5: Assess regional disparities, backward regions, environmental issues, sustainable development, and the Indian Peninsula as a planning region.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓						✓					✓
CO2 Explain & interpret	✓	✓				✓						✓
CO3 Apply Models	✓	✓	✓	✓		✓	✓					
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓			✓	✓	
CO5 Research & create	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Physical Geography of India: Relief, geology and physiographic divisions of India. Himalayan region, Northern Plains, Peninsular Plateau, Coastal Plains and Islands. Climate and climatic regions of India. Climate classifications with reference to Wladimir Köppen, Glenn Trewartha and Thornthwaite's modified classification. Drainage systems and water resources. Soils, natural vegetation and biodiversity of India.

Unit-II: [12 Hours]

Population, Culture and Regional Structure of India: Historical evolution of regions and boundaries since the British period. Linguistic and cultural regions of India. Languages, religions and cultural diversity. Population growth, density and distribution. Population problems, migration and urbanization. Settlement patterns and regional demographic variations. Regional identity and socio-cultural integration.

Unit-III: [14 Hours]

Economic Geography of India: Land use patterns and agricultural regions. Agro-climatic and agro-ecological regions. Sustainable agriculture, Green Revolution and role of biotechnology in agriculture. New trends in Indian agriculture and agricultural policy. Mineral resource regions and industrial regions. Industrial policies and trends of industrialization. Energy resources and emerging energy scenario in India. Transport, trade and impact of globalization on Indian economy.

Unit-IV: [10 Hours]

Regional Planning and Development: Meaning, scope and objectives of regional planning. Historical evolution of regional planning. Concepts of region, regionalization and planning regions. Theories of regional development

and growth. Factors influencing economic growth and regional decline. Population dynamics, migration, employment, income and poverty in regional contexts. Rural and urban regional planning approaches.

Unit-V: **[12 Hours]**

Regional Disparities, Environment and Case Studies: Regional disparities in India and uneven development. Backward regions and planning strategies. Environmental issues and sustainable development. Natural resource management, sustainable land use planning and environmental impact assessment. Contemporary regional issues in India. Case study of the Indian Peninsula as a planning region: physical divisions, population, agriculture, resources, industries and development problems.

References:

Agarwal, S. K. (2012). *Regional Development and Planning in India: Selected Essays by V. Nath*.

Bhat, L. S. (1973). *Regional Planning in India*. Statistical Publishing Society.

Chand, M., & Puri, V. K. (2012). *Regional Planning in India*. Vikas Publishing House, New Delhi.

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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.

Course Code : **MGG 302** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Advanced Geospatial Analysis**

Course Objectives:

- To understand geospatial data management, spatial data models, and advanced geospatial database systems.
- To examine GIS modelling, decision support systems, spatial sampling, and interpolation techniques.
- To analyze applied geospatial methods for hazard management, environmental monitoring, and planning.

Course Outcomes (COs):

- CO1: Explain the concepts, significance, standards, metadata, topology, and spatial data models used in geospatial data management.
- CO2: Describe advanced geospatial data types, data acquisition methods using LiDAR, UAVs, remote sensing, and cloud-based storage systems.
- CO3: Apply GIS modelling principles, suitability analysis, multi-criteria decision analysis, and GIS-based decision support systems.
- CO4: Analyze spatial sampling methods and interpolation techniques such as IDW, spline, trend surface analysis, and kriging.
- CO5: Assess applications of geospatial analysis in drought mapping, earthquake hazard zonation, soil erosion studies, hydrological analysis, agriculture, urban planning, and environmental management.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓			✓							✓
CO3 Apply Models	✓	✓	✓	✓	✓		✓					
CO4 Analyse & evaluate	✓	✓	✓	✓	✓		✓					✓
CO5 Research & create	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Geospatial Data Management and Spatial Data Models: Meaning, nature and significance of geospatial data management. Data formats and geospatial standards. Spatial data models including raster, vector and hybrid models. Non-spatial data models and attribute database structures. Topology concepts and topology models. Grid model, TIN (Triangulated Irregular Network) model and network model. Metadata, interoperability and data quality management.

Unit-II: [12 Hours]

Advanced Spatial Data and Data Preprocessing: Advanced spatial data types including 3D data, temporal data and spatio-temporal datasets. Data acquisition from satellite imagery, LiDAR, UAVs and remote sensing sources. Data cleaning, transformation and integration. Handling large datasets and improving data quality. Data storage, retrieval and cloud-based geospatial databases.

Unit-III: [14 Hours]

GIS Modelling and Decision Support Systems: Concept and principles of GIS modelling. Basic elements of GIS models including inputs, processes, outputs and feedback. Coupling methods in modelling including loose coupling and tight coupling. Multi-criteria decision analysis and suitability modelling. Decision Support Systems and GIS-based decision support systems. GIS applications in disaster management and planning support.

Unit-IV: [10 Hours]

Spatial Sampling and Interpolation: Concept of spatial sampling and various sampling schemes including random, systematic, stratified and cluster sampling. Surface generation methods. Comparison of global and local

interpolation methods. Spatial interpolation techniques including Inverse Distance Weighting (IDW), spline interpolation and trend surface analysis. Introduction to kriging methods.

Unit-V: [12 Hours]

Applied Geospatial Analysis: GIS-based drought analysis and vulnerability mapping. GIS for earthquake disaster management and hazard zonation. GIS for soil erosion and sediment estimation. Terrain and hydrological analysis using DEM. Applications in agriculture, watershed management, urban planning and environmental monitoring.

References:

Heywood, I., Cornelius, S., & Carver, S. (2019). *An Introduction to Geographical Information Systems*. Pearson.

Aronoff, S. (1989). *Geographic Information Systems: A Management Perspective*. WDL Publications.

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Ghosh, A., & Rushton, G. (1987). *Spatial Analysis and Location-Allocation Models*. Van Nostrand Reinhold.

Singh, R. B. (2018). *Space Technology for Disaster Mitigation in India*. Springer.

Course Code : **MGG 303** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Advanced Spatial Statistics and Modelling**

Course Objectives:

- To understand the principles, concepts, and significance of spatial statistics and geostatistics.
- To examine interpolation, spatial regression, modelling, and simulation techniques for spatial analysis.
- To analyze statistical software applications for geospatial, environmental, and planning studies.

Course Outcomes (COs):

- CO1: Explain the concepts of spatial statistics, spatial data structures, autocorrelation, ESDA, Moran's I, Geary's C, and hotspot analysis.
- CO2: Describe geostatistical principles including variogram, semivariogram modelling, spatial dependence, and anisotropy.
- CO3: Apply kriging methods such as Ordinary Kriging, Universal Kriging, and Indicator Kriging, and compare them with deterministic interpolation methods.
- CO4: Analyze spatial regression, Geographically Weighted Regression, spatial lag/error models, agent-based models, cellular automata, and simulation approaches.
- CO5: Assess the use of R, Python, and SPSS for data analysis in environmental, urban, health, climate, and meteorological applications.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓				✓							✓
CO2 Explain & interpret	✓	✓			✓							✓
CO3 Apply Models	✓	✓	✓	✓	✓							
CO4 Analyse & evaluate	✓	✓	✓	✓	✓		✓					✓
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Spatial Statistics and Exploratory Spatial Data Analysis: Meaning, scope and significance of spatial statistics. Spatial data types and structures. Spatial autocorrelation and pattern analysis. Exploratory Spatial Data Analysis (ESDA). Moran's I and Geary's C statistics. Point pattern analysis and hotspot detection.

Unit-II: [12 Hours]

Advanced Spatial Data and Data Preprocessing: Principles of geostatistics. Variogram and covariance functions. Definition and properties of semivariogram. Empirical variogram construction. Modelling the variogram. Spatial dependence and anisotropy. Applications of geostatistics in environmental and resource studies.

Unit-III: [14 Hours]

Kriging and Advanced Interpolation Methods: Kriging techniques including Ordinary Kriging, Universal Kriging and Indicator Kriging. Comparison of kriging with deterministic interpolation methods. Accuracy assessment of interpolation surfaces. Applications in rainfall estimation, groundwater studies and pollution mapping.

Unit-IV: [10 Hours]

Spatial Regression, Modelling and Simulation: Spatial regression models. Geographically Weighted Regression (GWR). Spatial lag and spatial error models. Types of spatial models including agent-based models and cellular automata. Building and validating spatial models. Monte Carlo simulation and scenario-based modelling. Applications in land use change and environmental impact simulation.

Unit-V: [12 Hours]

Statistical Software and Advanced Applications: Introduction to statistical software including R, Python and SPSS. Data manipulation and cleaning. Data analysis using R including descriptive statistics and visualization.

Data analysis using Python using NumPy, Pandas, Matplotlib and SciPy. Case studies in environmental applications, urban and regional planning, public health, climate and meteorology.

References:

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Miller, A. B., & Smith, C. D. (2019). *Geospatial Analysis in Practice: Case Studies and Applications*. University of Chicago Press.

Course Code : **MGG 311** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Advanced Surveying Techniques**

Course Objectives:

- To understand the principles, methods, and modern technologies of advanced surveying.
- To examine surveying instruments, field data collection, project design, and data processing techniques.
- To analyze applications of advanced surveying in engineering, planning, mapping, and geospatial studies.

Course Outcomes (COs):

- CO1: Explain the concepts, scope, classification, principles, and error adjustment methods in advanced surveying.
- CO2: Describe the functioning and applications of total stations, theodolites, EDM, GPS, GNSS, RTK, DGPS, laser scanning, and LiDAR technologies.
- CO3: Apply field survey planning, control point establishment, data collection, UAV-assisted surveys, and quality control procedures.
- CO4: Analyze survey project design, execution, resource management, legal aspects, ethics, and safety measures in surveying operations.
- CO5: Assess the interpretation and presentation of survey results through maps, profiles, contour maps, reports, and applications in urban planning, transport, construction, mining, disaster management, and environmental studies.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓			✓							✓
CO3 Apply Models	✓	✓	✓	✓	✓			✓	✓			
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Fundamentals of Advanced Surveying: Meaning, nature, scope and significance of surveying. Historical development and modern trends in surveying. Principles of plane and geodetic surveying. Classification of surveys including topographic, cadastral, engineering and hydrographic surveys. Modern surveying methods and digital surveying systems. Principles of triangulation, trilateration and traverse surveys. Errors in surveying, sources of error, error analysis and adjustment techniques.

Unit-II: [12 Hours]

Surveying Instruments and Technologies: Principles, components and uses of total stations and theodolites. Electronic Distance Measurement (EDM) techniques. Global Positioning System (GPS) fundamentals and applications in surveying. Global Navigation Satellite Systems (GNSS) and satellite positioning methods. Real-Time Kinematic (RTK) and Differential GPS (DGPS). Laser scanning principles and terrestrial laser scanning applications. LiDAR data acquisition, processing and applications in terrain and urban mapping.

Unit-III: [14 Hours]

Field Data Collection and Processing: Field survey procedures and planning of field operations. Reconnaissance, control point establishment and field measurements. Data collection techniques and field protocols. Use of digital devices, mobile mapping and UAV-assisted surveys. Data downloading, cleaning, transformation and integration. Use of software for survey data processing and analysis. Quality control measures for ensuring accuracy, precision and reliability of field data.

Unit-IV: [10 Hours]

Survey Project Design and Execution: Designing and planning surveying projects. Project objectives, methodology and scheduling. Resource allocation and project management in surveying operations. Conducting fieldwork: best practices, ethics and safety measures. Managing field teams, logistics and documentation. Legal

and administrative aspects of land and engineering surveys.

Unit-V: **[12 Hours]**

Data Interpretation, Reporting and Applications: Analysis and interpretation of survey results. Preparation of maps, plans, profiles and contour maps. Visualization of data through maps, charts and digital models. Survey report writing and technical documentation. Applications of advanced surveying in urban planning, transportation, construction, mining, disaster management and environmental studies. Case studies of modern surveying projects using GNSS, LiDAR and geospatial technologies.

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.

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Zeiler, M., & Murphy, J. (2020). *Modelling Our World: The Esri Guide to Geodatabase Concepts* (2nd ed.). Esri Press.

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Course Code : **MGG 311** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Environmental Geography & Bio-Geography**

Course Objectives:

- To understand the concepts, scope, and interdisciplinary nature of environmental geography.
- To examine human-environment interactions, ecosystem dynamics, biodiversity, and ecological processes.
- To analyze environmental problems, sustainable development, and management strategies for future planning.

Course Outcomes (COs):

- CO1: Explain the meaning, scope, approaches, and theoretical perspectives of environmental geography, including determinism, possibilism, and neo-determinism.
- CO2: Describe human-environment interactions, adaptation, resource use, environmental perception, and impacts of human activities on the Earth.
- CO3: Analyze ecosystem structure, energy flow, trophic levels, food chains, nutrient recycling, succession, and ecosystem resilience.
- CO4: Assess biogeochemical cycles, biodiversity values, threats, conservation strategies, protected areas, and indigenous ecological knowledge.
- CO5: Evaluate sustainable development, United Nations Sustainable Development Goals, climate change, pollution, environmental impact assessment, and community-based resource management.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓				✓	✓					✓
CO3 Apply Models	✓	✓		✓			✓					✓
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓	✓				
CO5 Research & create	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Introduction to Environmental Geography: Meaning, definitions, nature and scope of environmental geography. Development and interdisciplinary nature of environmental geography. Role of geography in environmental studies. Components of environment: physical, biological and cultural. Man-environment relationship and changing perspectives. Determinism, Possibilism and Neo-determinism. Contemporary environmental thought and human responsibility toward nature.

Unit-II: [12 Hours]

Human-Environment Interaction: Concept, components and types of human-environment interaction. Human adaptation and adjustment to environment. Human impact on Earth through agriculture, urbanization, industrialization and technology. Resource use and environmental change. Environmental perception and behavioural responses. Environmental problems arising from population growth and economic activities.

Unit-III: [14 Hours]

Ecosystem Dynamics and Ecological Processes: Concept of ecosystem: structure, function and processes. Components of ecosystems: producers, consumers and decomposers. Patterns of energy flow within ecosystems. Principles of ecology and branches of ecology. Ecosystem metabolism including photosynthesis and respiration. Trophic levels, food chains and food webs. Decomposition processes and nutrient recycling. Ecosystem stability, resilience and succession. Biogeochemical cycles and their environmental significance.

Unit-IV: [10 Hours]

Environmental Governance: Concept, principles, and evolution of environmental governance. Environmental policies and legislation in India. Global environmental agreements and institutions. Role of government, NGOs, and local communities. Environmental governance challenges: climate change, biodiversity loss, and pollution.

Unit-V: **[10 Hours]**

Sustainable Development and Environmental Management: Concept and principles of sustainable development. Relationship between development, economic growth and environmental sustainability. United Nations Sustainable Development Goals and their environmental relevance. Climate change, pollution, land degradation and resource depletion. Environmental impact assessment, conservation planning and natural resource management. Role of policy, technology and community participation in sustainable futures.

References:

Esteva, G. (1997). 'Development'. In W. Sachs (Ed.), *The Development Dictionary* (pp. 8–34). Orient Longman.

Gadgil, M., & Guha, R. (1995). *Ecology and Equity: The Use and Abuse of Nature in Contemporary India*. Oxford University Press.

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Hassenzahl, D. M., Hager, M. C., & Berg, L. R. (2018). *Visualizing Environmental Science* (5th ed.). Wiley.

Ramakrishnan, P. S. (1992). *Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India*. UNESCO, Man and the Biosphere Series.

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Course Code : **MGG 311** Course Type : **Elective** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Urban Geography & Planning**

Course Objectives:

- To understand the concepts, scope, patterns, and processes of urban geography and urbanization.
- To examine the origin, growth, structure, social environment, and problems of cities.
- To analyze urban planning, governance, renewal programmes, and geospatial applications with special reference to India.

Course Outcomes (COs):

- CO1: Explain the meaning, nature, scope, definitions, hierarchy, and trends of urbanization in the world and India.
- CO2: Describe the origin, historical growth, morphology, land use structure, economic functions, and metropolitan development of cities.
- CO3: Analyze contemporary urban processes such as suburban sprawl, edge cities, gentrification, social inequality, poverty, migration, and urban livability.
- CO4: Assess urban environmental problems, sustainability challenges, and renewal programmes such as Jawaharlal Nehru National Urban Renewal Mission, Smart Cities Mission, and AMRUT.
- CO5: Evaluate urban planning, infrastructure, housing, transport, land use, governance, and applications of Remote Sensing, GIS, and spatial technologies in smart city management.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓											✓
CO2 Explain & interpret	✓	✓										✓
CO3 Apply Models	✓	✓		✓		✓	✓					✓
CO4 Analyse & evaluate	✓	✓	✓	✓		✓	✓	✓			✓	✓
CO5 Research & create	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Course Outline:

Unit-I: [12 Hours]

Foundations of Urban Geography: Meaning, nature and scope of urban geography. Definitions of town, city, metropolis, metropolitan region and megacity. Development of urban geography as a branch of geography. Trends and patterns of urbanization in the world and India. Concepts of urban, urbanization, urbanism and urban ecology. National urban system and hierarchy of cities. Urbanization policies and emerging urban transitions.

Unit-II: [12 Hours]

Origin, Growth and Structure of Cities: Origin and growth of urban settlements. Historical perspectives on world urbanization. Evolution of cities from ancient to modern periods. Spatial and temporal patterns of metropolitan development in India. Urban morphology and land use models with reference to Ernest Burgess, Homer Hoyt and Chauncy Harris. Functional classification of towns. Rank-size rule and primate city concept.
. Basic and non-basic functions of cities. Urban economy and structure of employment. Central business district, suburban centres and peri-urban growth.

Unit-III: [14 Hours]

Contemporary Urban Processes and Social Environment: Suburban sprawl, smart growth, exurbs and edge cities. New towns, satellite towns and gated communities. Gentrification, green cities and urban livability index. Social environment of the city including social stratification, class diversity, segregation and inequality. Urban poverty, crowding, crime, homelessness and migrant communities. Cities as centres of innovation and cultural diversity.

Unit-IV: [10 Hours]

Urban Problems and Urban Renewal: Urban environmental problems including heat island effect, drainage, sewerage, sanitation, solid waste, traffic congestion, pollution and public health. Urban ecological footprint and sustainability challenges. Urban resilience and climate change adaptation strategies. Urban renewal and urban

redevelopment in India. Role of Jawaharlal Nehru National Urban Renewal Mission (JNNURM), Smart Cities Mission, AMRUT and Housing for All programmes.

Unit-V: [12 Hours]

Urban Planning and Geospatial Applications: Concepts of developed and underdeveloped urban economies. Intra-regional and inter-regional planning. Urban planning policies and governance. Urban infrastructure planning including water supply, sanitation, wastewater disposal and solid waste management. Urban traffic and transportation planning. Planning for urban housing, land use, land valuation and real estate development. Application of Remote Sensing, GIS and spatial technologies in urban planning, monitoring and smart city management.

References:

Carter, H. (2002). *Urban Geography* (4th ed.). Arnold-Heinemann, New Delhi.

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Tewari, V., Weinston, J., & Prakash Rao, V. L. S. (1986). *Indian Cities: Ecological Perspectives*. Concept Publishing Company, New Delhi.

Course Code :CCC313 Course Type : CCC No. of Credits : 2.00 No. of Hours : 30	**Course Title** **Building Mathematical Ability and Financial Literacy**

Course Objectives:

The main objectives of this course are:

- Solving skills through mathematical reasoning, quantitative aptitude, and data interpretation, enabling them to apply these concepts in academic, professional, and real-life scenarios.
- Familiarize students with investment options, banking structures, financial institutions, taxation, insurance, and the roles of RBI and SEBI in the financial system.
- Enable students to make informed financial decisions through understanding of investment planning, risk management, digital payments, and awareness of financial frauds.

Course Learning Outcomes (COs):

By the end of the course, students can be able to;

- **CO1:** Enhance logical thinking and decision-making through structured problem-solving.
- **CO2:** Demonstrate competence in fractions, simple and compound interest ratio and proportion, and percentage-based problems.
- **CO3:** Calculate mean, median, and mode to summarize data effectively. Present data using bar charts, pie charts, and line charts for clear communication.
- **CO4:** Prepare budgets, track expenses, manage savings, and set financial goals using basic money management principles.
- **CO5:** Evaluate financial risks, use digital payment systems securely, and adopt appropriate strategies for financial planning and risk reduction.

COs /POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓	–	–	–	–	–	–	–	–	–	–	–
CO2 Explain & interpret	✓	✓	–	–	–	–	–	✓	–	–	–	–
CO3 Apply Models	✓	✓	✓	–	✓	–	–	–	–	–	–	–
CO4 Analyse & evaluate	–	✓	–	✓	–	✓	✓	–	–	–	–	✓
CO5 Research & create	–	–	✓	✓	✓	–	✓	✓	–	–	–	–

Course Outline:

Unit-I **[7 Hours]**

Logical Reasoning: Number series, letter series, coding-decoding, problems on ages. **Basic Set Theory**: Operations on sets, Venn diagrams, and cardinality of sets.

Unit-II **[5 Hours]**

Mathematical aptitude: Fractions, time and work, time and distance, ratio and proportion, percentage, profit and loss, discount, simple interest, compound interest, mensuration.

Unit-III **[6 Hours]**

Basic Statistics: Sources and classification of data, data interpretation, quantitative and qualitative data, graphical representation (bar chart, pie chart, line chart), mean, median, and mode for ungrouped data.

Unit-IV **[5 Hours]**

Foundations of Financial Literacy: Introduction to financial literacy and its process and structure, personal finance, income, expenditure, savings, and budgeting, financial goals, financial discipline, money management skills, awareness of financial frauds, basic budgeting and expense tracking activities.

Unit-V **[7 Hours]**

Financial Institutions: Banking system and credit process, recent innovations in the banking system, Reserve Bank of India role and functions, monetary policy tools. **Capital Market;** Primary market, secondary market, financial decision-making,SEBI. **Digital Finance:** Digital payments system and digital currency.

Suggested Readings:

Arihant, (2019). *Teaching and Research Aptitude (General Paper 1)*. Arihant Publication (India) Limited.
Jain, L. & Vashistha, K. C. (2024). *Teaching and Research Aptitude (General Paper 1)*. Upkar Prakashan Agra.
Lewis, M. K. (2000). *Monetary economics*. Oxford University Press, New York.

References:

Aggarwal, R.S. (n.d). *Quantitative Aptitude*. S. Chand.
C Rangarajan. (1991). *Indian economy: Essays in money and finance*. UBS Publishers' Distributors Ltd.
Lewis, M. K. (2000). *Monetary economics*. Oxford University Press.

SEMESTER-IV

Course Code: **MGG 401** Course Type: **Core** No. of Credits: **4** No. of Hours: **60**	**Course Title** **Research Methodology in Geography**

Course Objectives:

- To understand the principles, processes, and ethical foundations of research in geography and geoinformatics.
- To examine qualitative, quantitative, and geospatial research methods, sampling, and analytical techniques.
- To analyze research design, proposal writing, report preparation, and applications of statistical and GIS software.

Course Outcomes (COs):

- CO1: Explain the meaning, scope, types, approaches, and ethical considerations of research in geography and geoinformatics.
- CO2: Describe the process of identifying research problems, conducting literature review, formulating hypotheses, and preparing research proposals.
- CO3: Apply qualitative and quantitative research methods including interviews, surveys, questionnaires, coding, descriptive statistics, and data visualization.
- CO4: Analyze research designs, sampling techniques, GIS database preparation, spatial modelling, and the use of Remote Sensing, GIS, and GNSS in research.
- CO5: Assess dissertation and report writing, citation practices, journal communication, and the use of R, Python, SPSS, QGIS, and ArcGIS.

COs/POs Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓	-	-	✓	-	-	-	✓	-	-	-	✓
CO2 Explain & interpret	✓	✓	-	✓	-	-	-	✓	-	-	-	✓
CO3 Apply Models	✓	✓	-	✓	✓	-	-	-	-	✓	-	-
CO4 Analyse & evaluate	✓	✓	✓	✓	✓	-	✓	-	-	-	-	✓
CO5 Research & create	✓	✓	✓	✓	✓	-	-	✓	-	✓	-	✓

Course Outline:

Unit-I: **[12 Hours]**

Introduction to Research Methods: Meaning, nature, scope and significance of research. Objectives of scientific research and role of research in geography and geoinformatics. Overview of the research process and methodology. Types of research including basic, applied, exploratory, descriptive and analytical research. Different perspectives in geographic research including positivist, behavioural, humanistic and critical approaches. Ethical considerations in geographic research including plagiarism, informed consent, confidentiality and responsible data use.

Unit-II: **[12 Hours]**

Research Problem and Proposal Development: Identification and selection of research problems. Sources of research problems in physical geography, human geography and geospatial sciences. Formulation of research questions, objectives and scope of study. Literature review: sources, methods and review writing. Preparation of research design and conceptual framework. Writing research proposals including title, rationale, objectives, methodology, timeline and expected outcomes. Hypothesis formulation and testing.

Unit-III: **[14 Hours]**

Qualitative and Quantitative Research Methods: Qualitative research methods and their relevance in geography. Techniques including interviews, focus groups, case studies, participant observation and content analysis. Qualitative data coding and interpretation. Quantitative research methods including surveys,

questionnaires and schedule methods. Measurement scales and data collection tools. Data tabulation, descriptive statistics and introduction to inferential statistics. Data visualization using tables, charts and graphs.

Unit-IV: [10 Hours]

Research Design, Sampling and Geospatial Analysis: Research design including cross-sectional, longitudinal, experimental and comparative designs. Sampling techniques in geographic research including random, systematic, stratified and cluster sampling. Primary and secondary data sources. GIS data manipulation and spatial database preparation. Spatial interpolation and modelling techniques. Use of Remote Sensing, GIS and GNSS in geographic research. Mapping and spatial presentation of research outputs.

Unit-V: [12 Hours]

Report Writing and Applications: Structure of dissertation, thesis and research report. Citation styles, referencing and bibliography preparation. Use of statistical and geospatial software including R, Python, SPSS, QGIS and ArcGIS. Presentation of results through maps, charts and tables. Writing journal articles and research communication. Contemporary trends in geographic research and interdisciplinary applications.

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 : **MGG402** Course Type : **Core** No. of Credits : **4** No. of Hours : **60**	**Course Title** **Statistical Methods in Geography**

Course Objectives:

- To understand the principles, concepts, and importance of statistics in geography and geoinformatics.
- To examine probability, sampling, estimation, hypothesis testing, correlation, and regression techniques.
- To analyze the use of statistical software and applications of statistics in geographic and geospatial studies.

Course Outcomes (COs):

- CO1: Explain the meaning, scope, data types, descriptive statistics, measures of central tendency, dispersion, and data visualization methods.
- CO2: Describe probability concepts, common probability distributions, sampling methods, sampling distributions, and the Central Limit Theorem.
- CO3: Apply estimation procedures, confidence intervals, hypothesis testing, t-tests, chi-square tests, ANOVA, and non-parametric tests.
- CO4: Analyze correlation, regression, residuals, and their applications in population, climate, agriculture, and regional studies.
- CO5: Assess the use of R, SPSS, Python, and spreadsheet tools for statistical analysis in geography, GIS, remote sensing, and environmental research.

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1 Recall & define	✓	-	-			-	-	-	-	-	-	✓
CO2 Explain & interpret	✓	✓	-	✓		-	-	-	-	-	-	✓
CO3 Apply Models	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓
CO4 Analyse & evaluate	✓	✓	-	✓	✓	-	-	-	-	-	-	✓
CO5 Research & create	✓	✓	-	✓	✓	-	-	-	-	-	-	✓

Unit-I: **[12 Hours]**

Fundamentals of Statistics: Meaning, definition, scope and importance of statistics in geography and geoinformatics. Types of data: qualitative and quantitative, primary and secondary, discrete and continuous data. Classification and tabulation of data. Descriptive statistics and frequency distributions. Measures of central tendency including mean, median and mode. Measures of dispersion including range, variance, standard deviation and coefficient of variation. Data visualization through histograms, bar charts, pie charts, line graphs and box plots.

Unit-II: **[12 Hours]**

Probability, Sampling and Inferential Statistics: Basic concepts of probability and probability rules. Random variables and probability distributions. Common distributions including Binomial, Poisson and Normal distributions. Sampling methods including random, systematic, stratified and cluster sampling. Sampling distributions and standard error. Central Limit Theorem and its significance. Point and interval estimation. Construction of confidence intervals for means and proportions. Concepts of hypothesis testing, null and alternative hypotheses, Type I and Type II errors, p-values and significance levels.

Unit-III: **[14 Hours]**

Estimation and Hypothesis Testing: Parametric and non-parametric statistical methods. One-sample, independent sample and paired sample t-tests. Chi-square tests and Analysis of Variance (ANOVA). Mann-Whitney U test and rank-based methods. Correlation analysis including Pearson's product moment correlation and Spearman's rank correlation. Simple linear regression and multiple regression analysis. Applications of statistical techniques in geographic research.

Unit-IV: **[10 Hours]**

Advanced Statistical Techniques and Spatial Analysis: Correlation analysis and interpretation. Pearson's product moment correlation and Spearman's rank correlation. Simple linear regression and multiple regression

analysis. Residual analysis and model interpretation. Logistic regression and its applications. Time series analysis and trend analysis in geography. Cluster analysis and regional classification. Principal Component Analysis (PCA) and dimensionality reduction. Introduction to spatial relationships and statistical modelling in geography. Applications in climate studies, population analysis, urban studies and environmental assessment.

Unit-V: [12 Hours]

Statistical Software and Geographic Applications: Use of statistical software including R, SPSS, Python and spreadsheet tools for statistical analysis. Data entry, cleaning and management. Descriptive and inferential statistical analysis using software. Preparation of tables, charts and graphs. Applications of statistics in geography, Remote Sensing, GIS, environmental studies and socio-economic research.

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.

Field, A., Miles, J., & Field, Z. (2012). *Discovering Statistics Using R*. SAGE Publications.

Gelman, A., Hill, J., & Vehtari, A. (2020). *Regression and Other Stories*. Cambridge University Press.

Grolemund, G., & Wickham, H. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning with Applications in R* (2nd ed.). Springer.

Johnson, R. A., & Wichern, D. W. (2019). *Applied Multivariate Statistical Analysis* (6th ed.). Pearson.

Kerns, G. J. (2010). *Introduction to Probability and Statistics Using R*. G. Jay Kerns.

Lantz, B. (2019). *Machine Learning with R* (3rd ed.). Packt Publishing.

McKinney, W. (2017). *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*. O'Reilly Media.

Montgomery, D. C., & Runger, G. C. (2018). *Applied Statistics and Probability for Engineers* (7th ed.). Wiley.

Shmueli, G., Bruce, P. C., Yahav, I., Patel, N. R., & Lichtendahl, K. C. (2017). *Data Mining for Business Analytics: Concepts, Techniques, and Applications with JMP Pro*. Wiley.

Vander Plas, J. (2016). *Python Data Science Handbook: Essential Tools for Working with Data*. O'Reilly Media.

Wickham, H., & Grolemund, G. (2017). *R for Data Science*. O'Reilly Media.