

தமிழ்நாடு மத்தியப்
பல்கலைக்கழகம்



**CENTRAL
UNIVERSITY OF
TAMIL NADU**

तमिलनाडु केन्द्रीय
विश्वविद्यालय

ESTABLISHED BY AN ACT OF PARLIAMENT IN 2009

M.Sc. GEOGRAPHY PROGRAMME CURRICULUM STRUCTURE

(w.e.f. Academic Year 2025-2026)



**Department of Geography
School of Earth Sciences
Central University of Tamil Nadu
Thiruvarur - 610 005**

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VISION

To be the leading Geography Department in the country and attain excellence in geography teaching and research

MISSION

- M1 - Provide an enhanced educational atmosphere to the students through blending of teaching and research that fosters the geographic knowledge, skills, and experiences.
- M2 - Prepare students to solve societal problems and inspire them to become cognizant decision-makers and leaders.
- M3 - Engage local, regional, national and global communities through demand-based collaborative research.
- M4 - Establish Centre for Advanced Geographical Research with innovative techniques, instrumentation, and infrastructure.

PROGRAMME OUTCOMES

- PO1 - Prepare students to demonstrate proficiency in theoretical and applied realms of geography.
- PO2 - Make the students understand the contemporary environmental issues and underlying cause-effect relationships.
- PO3 - Provide the ability to evaluate as well as solve geographic problems effectively through geospatial technologies.
- PO4 - Enable students to work towards sustainable environment through both an independent and collaborative system.
- PO5 - Prepare the students to apply their skills in professional careers for their career advancement.

**PROGRAMME SPECIFIC LEARNING OUTCOMES**

After the successful completion of M.Sc., Geography, the student will be able to

- PSO1 - Explain the planet's physical processes and human interactions at varying spatio-temporal scales.
- PSO2 - Demonstrate proficiency in handling geospatial tools and techniques for solving spatial problems and employment opportunities
- PSO3 - Appreciate the relevance of geographical aspects and provide geographic insights on important societal issues.
- PSO4 - Identify current research trends within the breadth and depth of geography and produce meaningful scholarly contributions.
- PSO5 - Create community awareness and demonstrate ethics in conducting geographical research.

GRADUATE ATTRIBUTES

Through M.Sc., Geography, the student will be able to acquire:

- Critical thinking and observation power
- Skills to handle geospatial tools and techniques
- Ability to perform spatial analysis
- Communication and teamwork skills
- Attitude to conduct scientific research projects
- Values of environmental ethics and sustainability
- Paths for self-directed and life-long learning

PROGRAMME MAPPING**Programme Outcomes to Mission Statements**

	PO1	PO2	PO3	PO4	PO5
M1	x	x	x	x	x
M2		x	x	x	x
M3		x	x	x	x
M4	x	x	x	x	x

Programme Specific Learning Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5
PSO1	x	x	x	x	
PSO2	x		x		x
PSO3	x	x	x	x	x
PSO4	x	x	x	x	x
PSO5		x		x	x



PROGRAMME STRUCTURE							
Sl. No.	Seme ster	Categ ory	Course Code	Course Title	Credit	Assessment	
						CIA	ESE
First Year							
1	I	CC	GEO252011	Geomorphology	4	40	60
2	I	CC	GEO252012	Social and Cultural Geography	4	40	60
3	I	CC	GEO252013	Population and Settlement Geography	4	40	60
4	I	CC	GEO252014	Remote Sensing	4	40	60
5	I	CC	GEO252015	Geographical Thought	3	40	60
6	I	CCP	GEO252016	Cartographic Techniques - Practical	2	100	
7	I	CCP	GEO252017	Image Interpretation - Practical	2	100	
Total					23	700	
Total Credit Points Earned = 23 x 6 (NCrF Level PGI)					138		
8	II	CC	GEO252021	Climatology	4	40	60
9	II	CC	GEO252022	Geography of India	4	40	60
10	II	CC	GEO252023	Regional Planning and Development	3	40	60
11	II	CC	GEO252024	Geographic Information Science	3	40	60
12	II	CCP	GEO252025	Survey Methods - Practical	2	100	
13	II	CCP	GEO252026	GIS - Practical	2	100	
14	II	SEC	GEO25SE01	Field Work	2	100	
15	II	SEC	GEO25SE02	Academic Writing (or) Related MOOC	2	40	60
16	II	OE	**	Open Elective	3	40	60
Total					25	900	
Total Credit Points Earned = 25 x 6 (NCrF Level PGI)					150		
17	II	VAC	GEO25VA01	Basics of Programming for Geospatial Applications	2	40	60

NOTE:

** In the place of Open Elective (OE), the students can choose any open elective course, with at least three credits, offered by the University Departments.

CCP: Core Course Practical	CC: Core Course
SEC: Skill Enhancement Course	OE: Open Elective
DSE: Discipline Specific Elective	SS: Soft Skill
VAC: Value Added Course	



Sl. No.	Seme ster	Categ ory	Course Code	Course Title	Credits	Assessment	
						CIA	ESE
Second Year							
18	III	CC	GEO252031	Hydrology and Oceanography	4	40	60
19	III	CC	GEO252032	Economic and Political Geography	4	40	60
20	III	CC	GEO252033	Models in Geography	4	40	60
21	III	CCP	GEO252034	Quantitative Techniques - Practical	2	100	
22	III	CCP	GEO252035	Geospatial Analysis - Practical	2	100	
23	III	DSE (any one)	GEO25EC01 GEO25EC02 GEO25EC03 GEO25EC04 ##	Environment and Sustainable Development Disaster Risk Reduction Applied Geomorphology Urban GIS MOOC	4	40	60
24	III	SS	GEO25ON01	Internship	2	100	
25	III	OE	**	Open Elective	3	40	60
Total					25	800	
Total Credit Points Earned = 25 x 6.5 (NCrF Level PG2)					162.5		
26	IV	CC	GEO252041	Dissertation	12	100	
27	IV	CC	GEO25ON02	Research Methodology (or) Related MOOC	3	40	60
28	IV	CC	GEO25ON03	Research Ethics (or) Related MOOC	3	40	60
29	IV	DSE (any one)	GEO25ON06 GEO25ON07 GEO25ON08 GEO25ON09 GEO25ON10 ##	Climate Change and Social Wellbeing Urban Sustainability Watershed Management Wetland Management Geospatial Analysis and Modelling MOOC	3	40	60
Total					21	400	
Total Credit Points Earned = 21 x 6.5 (NCrF Level PG2)					136.5		
Grand Total					94	2800	
Grand Total of Credit Points Earned					587		

NOTE:

In the place of MOOC, the students shall choose relevant MOOC courses at Postgraduate level through UGC recognized online educational platforms. The course contents shall be reviewed by the Department coordinator(s) and approved by the internal members of the BoS. The students shall undertake UGC SWAYAM exam and transfer the marks/ credits or appear for the exam conducted by the CUTN, whichever is applicable.

Students who do their fourth semester dissertation outside the campus shall attend the core courses (CC) and Discipline Specific Elective (DSE) courses online. However, the end semester examination for these courses will be conducted at the department.

**EVALUATION SCHEME**

The Choice-Based Credit System (CBCS) is adopted for M.Sc., Geography programme that offers flexibility to the students to choose the electives. Each course in the programme is assigned with a fixed number of credits based on the contents to be learned and it is evaluated by the course instructor(s). The evaluation of the internal component of the courses is continuous and the minimum passing mark for all the courses is 50%.

Evaluation of Theory Courses

All theory courses shall carry a Continuous Internal Assessment (CIA) component to the extent of 40 marks and End Semester Examination (ESE) for 60 marks.

Components	Weightage (%)
Test(s) / Quiz / Project / Case Study	20
Assignment / Seminar / Interaction / Field Work	20
End Semester Exam	60

Evaluation of Laboratory Courses

The Continuous Internal Assessment (CIA) will be the only component for Laboratory Courses. No separate examination will be conducted.

Components	Weightage (%)
Lab Exercises / Assignments	80
Field Work / Case Study / Interaction / Timely Submission	20

Evaluation of Dissertation / Internship / Field Work

The thesis/report will be supervised and assessed by the internal members. Students must present their thesis/report in a viva-voce which will be conducted at the end of the semester.

Components	Weightage (%)
Internal Mark by the internal/external supervisor(s)	40
External Mark awarded by the examiner(s)	40
Viva-Voce	20

ATTENDANCE:

A minimum of 75% attendance is mandatory for appearing in end semester exam and successful completion of practical / dissertation / internship / field work courses. The University's regulations will be governed in case of relaxations in minimum requirement of attendance.



END SEMESTER EXAMINATION – QUESTION PAPER PATTERN

Programme: M.Sc. Geography

Duration: 3 Hours

Course Code: XXX

Maximum Marks: 60

Course Title: XXX

Date: XXX

Section-A [10 Marks]

The questions to be asked hereunder are objective-types or definition/short types to test the students' remembrance and understanding of domains. Equal weights will be given to all the units.

Section-B [20 Marks]

The questions to be asked hereunder are paragraph types with choices or either-or-types. At least one question will be asked from each unit. One or two question(s) will be asked each to test the students' ability to understand, apply, analyse, evaluate, and creative cognitive domains.

Section-C [30 Marks]

The questions to be asked hereunder are essay types. One or two question(s) will be asked each to test the students' ability to analyse, evaluate, and creative cognitive domains



SYLLABUS

SEMESTER - I



Credits: 4

Course Code: GEO252011

GEOMORPHOLOGY

Learning Outcomes:

After completion of this course, the students will be able to:

- 1. understand the physical earth systems and controls of geomorphic processes*
- 2. describe the exogenic and endogenic processes and their importance in landform development*
- 3. identify geomorphological units and apply geomorphological skills in geographical research*

Unit - I

Basic Concepts: Geological time scale - Evolution of geomorphic ideas – Fundamental concepts in geomorphology

Unit - II

Endogenic Processes: Internal structure and Isostasy – Plate tectonics – Crustal formation and deformation – Volcanism – Earthquakes

Unit - III

Exogenic Processes: Weathering and mass movement – Fluvial processes and landforms - Fluvial geomorphic cycle - Slope development theories

Unit - IV

Landscapes: Aeolian landforms - Glacial processes and glacio-fluvial landscapes - Karst landscapes – Coastal landforms

Unit - V

Process Geomorphology: Morphogenetic regions – Dynamic equilibrium in geomorphology – Tectonics, climate and landform development – Quaternary geomorphology

A field trip will be arranged for the interested students to recognize landforms and to understand the characteristics of different geomorphic units.



REFERENCES:

1. Thornbury, W. D. (2019): Principles of Geomorphology, Third Edition, New Age International Publishers.
2. Huggett, R.J. (2007): Fundamentals of Geomorphology, Routledge.
3. Kale, V. and Gupta, A. (2018): Introduction to Geomorphology, Orient Black Swan
4. Summerfield M.A. (2013): Global Geomorphology, Routledge.
5. Goudie, A.S. and Viles, H.A., (2016): Geomorphology in the Anthropocene, Cambridge University Press.
6. Lobeck A.K. (1939): Geomorphology, McGraw-Hill Company.
7. Von Engel, O.D. (1957): Geomorphology, The Macmillan Company
8. Mc Geary, D. and Plummer, C. C., (1994): Earth Revealed, W. C. B. Publishers.
9. Ritter, D.F., Kochel, R.C. and Miller, J.R., (2002): Process Geomorphology, Waveland Press.
10. Bierman, P. R. and Montgomery, D. R., (2014): Key concepts in geomorphology, Freeman and Company Publishers.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2		x		x	
CO3			x	x	x



Credits: 4

Course Code: GEO252012

SOCIAL AND CULTURAL GEOGRAPHY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand human values, social ethics, welfare, wellbeing, inclusion, and exclusion, and other important concepts.*
- 2. identify neutrality in social and cultural issues and demonstrate a sense of appreciation and respect for the diversity of perspectives, worldviews, and cultures.*
- 3. explain the evolution and dynamics of social and cultural phenomena over time.*
- 4. evaluate and correlate different theories with contemporary social and cultural issues.*

Unit - I

Social Geography: Nature and Scope – Introduction to Social Geography; Geographies of Welfare and Wellbeing – Concept of Social Wellbeing, Human Development Index; Social Geography of Health and Healthcare Systems – Global and Indian Perspectives; Social Networks and Community Dynamics; Urban and Rural Social Landscapes.

Unit - II

Social Geographies of Inclusion and Exclusion – Slums, Gated Communities; Social Stratification and Segregation – Class, Caste, and Ethnic Segregation; Issues of Social Justice and Equity – Access to Resources and Opportunities, Gender and Social Inequality; Social Mobility and Change – Case Studies from Different Regions (e.g., Dharavi in India, Favelas in Brazil, Gated Communities in the USA).

Unit - III

Cultural Geography: Nature and Scope – Introduction to Cultural Geography; Concept of Culture – Definitions and Approaches; Cultural Theory – Symbolic Interactionism, Structural Functionalism; Cultural Landscape – Definition and Significance; Cultural Landscapes of India; Cultural Identity and Representation – Spatial Dimensions of Cultural Practices.

Unit - IV

Cultural Integration and Globalization – Global Trends and Local Responses; Cultural Regions of India – Caste, Class, Religion, Gender, Language and Their Spatial Underpinnings with Reference to India; Regional Cultures and Cultural Diffusion – Patterns of Cultural Interaction and Exchange; Globalization and Cultural Hybridization – Impact of Globalization on Local Cultures; Cultural Policy and Management – Strategies and Challenges.

Unit - V

Interconnectedness and Recent Trends in Social and Cultural Geography – Interconnections between Social and Cultural Geography; Concept of Space in Social and Cultural Contexts – Place-Making, First, Second, and Third Space; Recent Trends – Digital and Virtual Cultures, Migration and Transnationalism; Case Studies on Global and Local Scales – Urbanization and Cultural Transformation, Social Movements and Cultural Change.

**REFERENCES:**

1. Anderson, K., Domosh, M., Pile, S., & Thrift, N. (Eds.) (2003): Handbook of cultural geography. SAGE Publications.
2. Appadurai, A. (1996): Modernity at large: Cultural dimensions of globalization. University of Minnesota Press.
3. Atkinson, D., Jackson, P., Sibley, D., & Washbourne, N. (Eds.). (2005): Cultural geography: A critical dictionary of key concepts. I.B. Tauris.
4. Castells, M. (1997). The power of identity. Wiley-Blackwell.
5. Cook, I., Crouch, D., Naylor, S., & Ryan, J. R. (Eds.). (2000): Cultural turns/geographical turns: Perspectives on cultural geography. Prentice Hall.
6. Desai, V., & Potter, R. B. (2014). The companion to development studies. Routledge.
7. Harvey, D. (1990): The condition of postmodernity: An enquiry into the origins of cultural change. Wiley-Blackwell.
8. Harvey, D. (2006): Spaces of global capitalism: A theory of uneven geographical development. Verso.
9. Lefebvre, H. (1991): The production of space. Blackwell.
10. Mitchell, D. (2000): Cultural geography: A critical introduction. Wiley-Blackwell.
11. Murray, W. E., & Overton, J. (2014): Geographies of globalization. Routledge.
12. Pile, S., & Thrift, N. (Eds.). (1995): Mapping the subject: Geographies of cultural transformation. Routledge.
13. Roy, A. (2011): Slumdog cities: Rethinking urban informality in the global south. Routledge.
14. Soja, E. W. (1996): Thirdspace: Journeys to Los Angeles and Other Real-and-Imagined Places. Wiley-Blackwell.
15. Tomlinson, J. (1999): Globalization and culture. University of Chicago Press.
16. Valentine, G. (2001): Social geographies: Space and society. Prentice Hall.
17. UNDP (2021): Human Development Report.
<https://hdr.undp.org/system/files/documents/global-report-document/hdr2023-24reporten.pdf>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2	x	x			
CO3	x	x	x		x
CO4	x	x	x	x	



Credits: 4

Course Code: GEO252013

POPULATION AND SETTLEMENT GEOGRAPHY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. get the knowledge of human aspects of geography.*
- 2. learn concepts of population geography, settlement geography, economic geography, and contemporary issues that are relevant in the present context.*
- 3. think in spatial terms to explain what has occurred in the past as well as using geographic principles to understand the present and plan for the future.*
- 4. critically evaluate the contemporary issues for achieving the sustainable development goals.*

Unit - I

Nature, scope and significance of Population and Settlement Geography, Different Schools of Thoughts in Population Studies, Approaches to study Settlement Geography

Unit – II

Sources of Data with reference to India; Population Size, Distribution and Growth – Spatial Patterns; Population Dynamics: Fertility, Mortality and Migration – Measures, Determinants and Implications - Age Sex Pyramid - World Population Growth (prehistoric to modern period), Population Composition and Characteristics, Population Policies in Developed and Developing Countries.

Unit - III

Types of Rural Settlements (types, patterns, and distribution) – Classification of Urban Settlements; Trends and Patterns of Urbanization, Changing Urban Forms, Concepts of Megacities, Global Cities and Edge Cities,; settlement planning with reference to India

Unit - IV

Theories of Origin of Towns (Gordon Childe, Henri Pirenne, Lewis Mumford), Urban Systems - Primate city, Rank-size rule, Models of Urban Land Use Models - Central Place Theories (Christaller and Losch) - Theories of Growth – Malthusian theory - Demographic Transition models - Law of Migration, Optimum Theory of Population

Unit - V

Contemporary Issues - Aging of population - Declining sex ratio – Demographic transition in India- Demographic Dividend - Refugee crisis in India, National Population Policy 2000 - Contemporary Problems of Rural Settlements, Problems of urbanisation and remedies, Social Segregation in the City, Manifestation of Poverty in Cities, Sustainable development of cities.



REFERENCES:

1. Ambrose P. (1970): Concepts in Geography Vol.-I Settlement Pattern, Longman.
2. Barrett H. R., (1995): Population Geography, Oliver and Boyd.
3. Bhende A. and Kanitkar T., (2000): Principles of Population Studies, Himalaya Publishing House.
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5. Clarke J. I., (1965): Population Geography, Pergamon Press, Oxford.
6. Daniel, P.A. and Hopkinson, M.F., (1989) The Geography of Settlement, Oliver
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18. Singh, R.Y., (2000): Geography of Settlements, Rawat Publication.

Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2	x	x			
CO3	x			x	x
CO4	x	x	x	x	x



Credits: 4

Course Code: GEO252014

REMOTE SENSING

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the basic concepts of electromagnetic radiation, its interaction with the earth's surface and atmosphere.*
- 2. understand resolution properties to interpret, process, and evaluate remotely sensed images.*
- 3. apply knowledge of image processing principles strategically to new problems.*
- 4. evaluate the applicability of remote sensing technologies as a monitoring tool for studying certain landscape phenomenon and spatial problems.*

Unit - I

Introduction to Remote Sensing: Concepts, Components, Electro Magnetic Radiation & Spectrum, Theories of EMR; Types of Remote Sensing: Based on Energy source and Electro-Magnetic Spectrum.

Unit - II

Energy Interaction with Atmosphere & Earth Surface: Reflection, Absorption, Transmission, Scattering: Rayleigh, Mie and Non-selective; Absorption, and Refraction; Atmospheric Windows. Spectral Signature: Interaction with soil, water, and vegetation, and other features.

Unit - III

Platforms, Sensors, Orbits: Types of platform - Types of sensors: FOV, IFOV, Active and Passive, Satellite Orbits - Resolution and its types: Spatial, Spectral, Radiometric, and Temporal.

Unit - IV

Image Colour Composites: False Colour Composite; Natural Colour Composite; Vegetation Indices; Elements of Image Interpretation. Remote Sensing Data Products: Legacy and Recent Developments.

Unit - V

Advanced Sensing: Principles and Applications of Hyperspectral Remote Sensing, Field and Imaging Spectrometry, UAV Remote Sensing.

Project: Image interpretation and applications



REFERENCES:

1. Borengasser, M. and Hungate, W. S., and Watkins, R., (2008): Hyperspectral remote sensing: principles and applications, 1st Edition, CRC Press, Boca Raton, FL.
2. Lillesand, T. M., Kiefer, R. W., and Chipman, J. W., (2008): Remote Sensing and Image Interpretation, John Wiley & Sons
3. Jensen, J. R., (2005): Introductory Digital Image Processing, Prentice Hall
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Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2	x		x		
CO3		x	x	x	x
CO4		x	x	x	x



Credits: 3

Course Code: GEO252015

GEOGRAPHICAL THOUGHT

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. get an insight into the historical evolution of the subject of geography. It will help in creating the philosophical foundation of the subject.*
- 2. understand contemporary modern views incorporated will inculcate critical thinking.*
- 3. Develop both inductive and deductive reasoning to attain holistic thinking about geographic systems.*
- 4. critically evaluate the nature of geography as spatial science with changing space and time.*

Unit - I

Evolution of Geographic Thought: Changing Paradigms in Geography: Environmentalism, Possibilism, Areal differentiation, spatial organization

Unit - II

Pre-Modern – Early Origins of Geographical Thinking with reference to the Classical and Medieval Philosophies (Greek, Roman and Arab Geographers), Development of geographical thought during Dark Age.

Unit - III

Modern – Evolution of Geographical Thinking and Disciplinary Trends in Germany, France, Britain, United States of America.

Indian Geography: Evolution of Geography in India, Progress and Contributions in Indian Geography, Life and works of Indian Geographers, Geographical Societies

Unit - IV

Philosophical Debates in Contemporary Geography: Dichotomy between Environmental Determinism and Possibilism, Systematic and Regional, Digital vs. Analog and Ideographic and Nomeothetic.

Unit - V

Recent Trends - Quantitative Revolution and its impact, Behaviourism, Systems Approach, Radicalism, Feminism; Towards Post Modernism – Changing Concept of Space in Geography, Future of Geography. Critical understanding of positivism, Marxism and Postmodernism.



REFERENCES:

1. Arentsen M., Stam R. and Thuijss R. (2000): Post-modern Approaches to Space, ebook
2. Bhat, L.S. (2009): Geography in India (Selected Themes), Pearson
3. Black, J. (2003). Visions of the World: A History of Maps, Mitchell Beazley.
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17. Soja, Edward (1989): Post-modern Geographies, Verso, London. Reprinted 1997: Rawat Publications.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x			
CO2	x	x			
CO3	x		x	x	
					x



Credits: 2

Course Code: GEO252016

CARTOGRAPHIC TECHNIQUES - PRACTICAL

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. develop the basic skills of mapmaking and map interpretation*
- 2. acquire knowledge about scale, projections, topographical maps, and slope analysis.*
- 3. represent geographic data as well as analyse information from a spatio-temporal perspective.*

Ex. 1: Map Design

- Colour and Patterns
- Size of Lettering
- Layout

Ex. 2: Map Symbolization

- Point symbols and dot maps
- Line symbols and flow maps
- Distribution maps

Ex. 3: Interpretation of Maps

- Marginal and extra-marginal information
- Weather maps, SOI maps, NATMO maps, Hydrographic charts
- Interpretation of Physical and Cultural features

Ex. 4: Construction of Profiles

- Cross Profile of selected landforms
- Longitudinal profile
- Slope Analysis

Ex. 5: Settlement Analysis

- Identification of settlement types
- Settlement pattern
- Network density analysis



REFERENCES:

1. Robinson A. H. (2009): Elements of Cartography, John Wiley and Sons.
2. Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., and Muehrcke, J.O. (2011): Map Use: Reading, Analysis, Interpretation, 7th Edition, ESRI Press.
3. Mishra, R. P. (2014): Fundamentals of Cartography (Second Revised and Enlarged Edition), Concept publication.
4. Sarkar, A. (2015): Practical geography: A systematic approach. Orient Black Swan Private Ltd.
5. Singh, R. L., Singh, R. P. B. (2008): Elements of Practical Geography, Kalyani Publishers.
6. Vaidyanadhan, R., and Subbarao, K.V. (2014): Landforms of India from Topomaps and Images, Geological Society of India.

WEBSITES:

- Geological Survey of India: www.gsi.gov.in
- Indian National Cartographic Association: www.incaindia.org
- Indian Naval Hydrographic Department: www.hydrobharat.nic.in
- National Bureau of Soil Survey and Land Use planning: www.nbsslup.in
- Survey of India: www.surveyofindia.gov.in

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x		x
CO2					
CO3	x		x	x	x



Credits: 2

Course Code: GEO252017

IMAGE INTERPRETATION - PRACTICAL

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. augment knowledge and skills of image interpretation and mapping, and have experience with image processing software.*
- 2. develop analytical workflows to derive products and extract information from remote sensing images for a broad range of applications.*
- 3. apply image processing and interpretation skills independently to a real-world situation.*
- 4. develop satellite data processing and analysis skills which is helpful for the employability of the students.*

Ex. 1: Image Visualization and Interpretation

- Visual interpretation keys
- Visual interpretation of satellite images
- Introduction to stereo images
- Image interpretation using mirror stereoscope

Ex. 2: Digital Image Analysis

- Introduction to ENVI software
- Satellite Data Visualization
- Exploring Metadata

Ex. 3: Image Pre-processing

- Radiometric correction
- Atmospheric correction
- Geometric correction

Ex. 4: Image Enhancement

- Contrast Enhancement
- Image Sharpening
- Density Slicing
- Low pass and High pass filtering

Ex. 5: Image Classification

- Unsupervised Classification
- Supervised classification
- Accuracy Assessment



REFERENCES:

1. Campbell, J. B., and Wynne, R. H. (2011): Introduction to Remote Sensing, 5th Edition, The Guilford Press.
2. Gibson, P., and Power, C. H. (2000): Introductory Remote Sensing: Digital Image Processing and Applications, Routledge Publisher.
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4. Imagine (2009): Tour Guide Imagine, Leica Geosystem GIS & Mapping, Atlanta.
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6. Lillisand, T. M., and Kiefer, P. W. (2007): Remote Sensing and Image Interpretation, 6th Edition, John Wiley & Sons.
7. Richards, J. A., and Jia, X. (2005): Remote Sensing Digital Image Analysis: An Introduction, 4th Edition, Springer –Verlag.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x		x
CO2	x		x	x	x
CO3	x	x	x		x
CO4			x	x	x



SEMESTER – II



Credits: 4

Course Code: GEO252021

CLIMATOLOGY

Learning Outcomes:

After completion of this course, students will able to:

- 1. understand the basic concepts in weather and climate.*
- 2. explain the weather patterns, causes of atmospheric instability and disturbances, and climate variability*
- 3. analyse atmospheric circulation systems as well as their interconnections and driving forces*
- 4. conduct studies using climate data and apply interpretation skills.*

Unit - I

Introduction to Climatology: Atmospheric composition, mass and structure - Solar radiation and the global energy budget - Atmospheric moisture budget: humidity, evaporation, condensation and precipitation

Unit - II

Atmospheric Instability: adiabatic temperature changes, condensation level, air stability and instability - Cloud formation - Precipitation processes - Thunderstorms

Unit - III

Atmospheric motion: principles and local winds - Global pressure and wind belts - General Circulation - Atmospheric general circulation models

Unit - IV

Tropical systems: Intertropical convergence, tropical disturbances, Asian monsoon, El Niño–Southern Oscillation

Unit - V

Mid-latitude systems: air masses - frontogenesis and frontal characteristics, Mesoscale convective systems - Climate classification - Climatic change



REFERENCES:

1. Barry, R.G., and Chorley, R.J., (2003): Atmosphere, Weather and Climate (11th Ed.), Routledge.
2. Christopherson, R. W., and Birkeland, G. H. (2012): Geosystems: An Introduction to Physical Geography (8th Ed.), Pearson Education, New Jersey.
3. Lal, D. S. (2005): Climatology, Sharda Pustak Bhawan, Allahabad.
4. Lutgens, F.K., Tarbuck E.J. and Tasa D. (2009): The Atmosphere: An Introduction to Meteorology (11th Ed.), Prentice Hall.
5. Strahler, A. H., and Strahler, A. N. (2001): Modern Physical Geography (4th Ed.), John Wiley and Sons, Inc., New York.
6. Trewartha, G.T. (1954): An Introduction to Climate, McGraw-Hill.
7. Waugh D. (2005): Geography: An Integrated Approach, Nelson Thornes, Cheltenham.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x			
CO2		x			x
CO3		x	x		x



Credits: 4

Course Code: GEO252022

GEOGRAPHY OF INDIA

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. Understand the physical and environmental setting of India, including physiographic divisions, monsoons, and natural resources.*
- 2. Evaluate population and settlement characteristics and their impact on social and cultural structures.*
- 3. Analyze the development patterns in agriculture, industry, and trade and the regional disparities therein.*
- 4. Assess contemporary environmental issues affecting India using geographical reasoning*
- 5. Apply concepts of geopolitical and economic strategies in understanding India's internal and external challenges*

Unit - I

Physical Environment of India: Major physiographic regions and their characteristics - Drainage systems: Himalayan and Peninsular - Indian climate: Seasonal weather characteristics, climatic divisions - Mechanism and origin of Indian Monsoon, Jet Streams -Himalayan Cryosphere: Glaciers and permafrost zones.

Unit - II

Natural Resources and Environmental Issues: Soil types and distribution, Natural vegetation and ecological zones - marine resources - mineral: distribution and utilization - Energy resources: conventional and non-conventional - Issues of environmental degradation: deforestation, desertification, and pollution - Resource conservation strategies and policies.

Unit - III

Agriculture and Industrial Development: Cropping patterns, productivity and yield of major food crops - Agro-climatic zones - Green Revolution and its socio-economic/ecological impacts - Livestock, poultry, aquaculture and dry farming - Industrial development since independence: policies, SEZs, industrial regions - Role of multinationals and liberalisation

Unit - IV

Population, Settlements and Cultural Aspects: Growth and distribution of population: age, sex, literacy, workforce - Population policies and health indicators - Rural and urban settlement types and morphology - Urbanisation: metro cities, smart cities, slums and challenges - Cultural diversity: religion, language, ethnicity, tribal regions - Migration trends: intra-state, inter-state, international

Unit - V

Transport, Trade, Development and Geopolitics: Transport networks: railways, roadways, airways, waterways, pipelines - Internal and external trade: composition, direction, balance - Regional planning and development: backward regions, watershed management, Five-Year Plans - Political aspects: interstate disputes, reorganization, boundary issues - Geopolitics of South Asia and Indian Ocean realm.



REFERENCES:

1. Ayres, A., (2018): Our Time Has Come, How India is Making Its Place in the World.
2. Deshpande, C. D., (1992): India: A Regional Interpretation, ICSSR.
3. Khullar, D. R. (2018): India A Comprehensive Geography, Kalyani Publications.
4. Menon, S., (2018): Inside the Making of India's Foreign Policy, Penguin Random House India Private Limited.
5. Sharma, T.C., (2013): Economic Geography of India. Rawat Publication.
6. Singh, A., Kaushiva, P., (2014): Geopolitics of the Indo-Pacific, KW Publishers.
7. Singh, R. L., (1971): India: A Regional Geography, National Geographical Society of India.
8. Singh, R. B., Schickhoff, U., and Suraj M., (Eds.) (2016): Climate Change, Glacier Response, and Vegetation Dynamics in the Himalaya, Springer.
9. Singh, R. B., (2014): Urban Development Challenges, Risk & Resilience in Asian Mega Cities, Springer.
10. Spate, O. H. K., and Learmonth A. T. A., (1967): India and Pakistan: A General and Regional Geography, Methuen.
11. Tirtha, R., (2002): Geography of India, Rawat Publications.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x		x
CO2	x	x	x		x
CO3	x	x	x	x	x
CO4	x	x		x	
CO5	x	x		x	



Credits: 3

Course Code: GEO252023

REGIONAL PLANNING AND DEVELOPMENT

Learning Outcomes

Upon completing this course, the students will be able to:

- 1. understand the concept, nature and need of regional planning and development.*
- 2. gain knowledge on methods and techniques used in planning and development.*
- 3. apply the spatial dimension of planning and development to study spatial problems.*

Unit - I

Concept of Region, Types and Methods of Delineation of Regions; Need for Regional Planning, Factors determining Regional Planning, Regional Planning Approaches.

Unit – II

Theories of Regional Development and Development Strategies - Study of Major Theories of Regional Development, including those proposed by F. Perroux, G. Myrdal, A.R. Hirschman, and J. Friedman and others.

Unit - III

Regionalization strategies for India, including Physiographic, Climatic, Agricultural, Industrial and Planning regions. Regional Planning in India and Planning Approaches.

Unit - IV

Review of India's regional planning experiences, including inter-state planning and regional policies/schemes implemented in Five-Year Plans. Regional planning for specific areas such as metropolitan regions, satellite towns, urban green belts; hill areas, tribal areas, and drought-prone regions.

Unit - V

Contemporary Issues and Future Directions - Examination of regional disparities in India, regionalism and conflicts, indicators of development and policy measures to address imbalances. The impact of Globalization and Sustainable Development Goals (SDGs).



REFERENCES:

1. Abler, R., Adams, J. S., and Gould, P., (1971): Spatial Organization: The Geographer's View of the World, Prentice-Hall Inc.
2. B.I.S.R (1978): 'The Role of Fiscal Incentives in Reducing Regional Imbalances: Some Comparison', New Delhi.
3. Choudhary, B. (2014): Regional Development and Planning in India. Geography and You.
4. Glasson, J. (1974): 'An Introduction to Regional planning, Hutchinson & Co., London.
5. Harvey, D., (1969): Explanation in Geography, Edward Arnold Publishers Ltd.
6. Minahull, R. (1968): Regional Geography. Hutchinson. Co., Ltd., London.
7. Misra, R.P et.al (1974): Regional Development Planning in India', Vikas Publishers, New Delhi.
8. O.E.C.D (1970): The Regional Factor in Economic Development
9. Rajiv R. Thakur, Ashok K. Dutt, Sudhir K. Thakur, George M. Pomeroy, (2020: Urban and Regional Planning and Development: 20th century forms and 21st century Transformation. Springer Publication.
10. Saikia, S. (2012): "An introduction to Regional Planning and Development in India" (1st Ed). LAP Lambert Academic Publishing.
11. Sen. L.K. (ed.) (1972): Reading in Micro Level Planning and Rural Growth Centres, NICD, Hyderabad.
12. Thakur, B., Sharma, H. S., Misra, S., Chottopadhyay S., and Singh S., (2017): Regional Development Theory and Practice (Felicitation Volumes to Prof. R.P. Mishra). Concept Publishing Company Pvt. Ltd. New Delhi

Mapping of Program outcomes with course outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	x
CO2			x	x	
CO3			x	x	x



Credits: 3

Course Code: GEO252024

GEOGRAPHIC INFORMATION SCIENCE

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the fundamental concepts of geographic information systems.*
- 2. apply the concept of spatial data and underlying principles to identify spatial problems.*
- 3. analysing the spatial datasets and produce map output.*
- 4. design and develop research projects involving geospatial processes and data.*

Unit - I

Introduction to GIS: Definition, and Elements of GIS; Spatial Data and its organization, Components, Spatial Data Infrastructure; Development of GIS technology; theoretical models and framework for GIS, representation of geographic data.

Unit - II

Coordinate systems, Datum, Scale, Resolution, Map projection; Data Input, Storage and Editing; Nature of geographic data: Spatial and Attribute Digitization; GIS databases - Storage and manipulation; Data Quality – Errors in geospatial data, Accuracy and Precision.

Unit - III

Concept of vector and raster based models; Tessellations, Topology – Elements, Planar and Non-Planar topology; Geodatabase – Components and types; Representation of composite features, DEM, Raster Data Structure, Compression and Conversion.

Unit - IV

Basic Spatial Analysis: Spatial Queries, Map algebra, Neighbourhood analysis; Proximity analysis and buffers; Overlays Analysis – raster and vector based overlay and their applications; Interpolation, Network Analysis.

Unit - V

Web GIS - Practical Report: Presentation of GIS output - Prepare a report consisting of five exercises using any GIS Software on above mentioned themes.

**REFERENCES:**

1. Burrough, P.A., and McDonnell, R.A. (1998): Principles of Geographic Information Systems, Oxford University Press.
2. Chang, K. T. (2006): Introduction to Geographic Information Systems, Tata McGraw-Hill.
3. De Mers, Michael N. (1999): Fundamentals of Geographic Information Systems, John Wiley & Sons.
4. Environmental Systems Research Institute (ESRI) (1997): Getting to know Arc View GIS, Cambridge: Geoinformation International.
5. Heywood, I. et al. (2004): An Introduction to Geographic Information Systems, Pearson Education.
6. Huisman O., and de by R. A. (2009): Principles of Geographic Information Systems – An Introductory Textbook, The International Institute for Geo-Information Science and Earth Observation (ITC).
7. Konecny, G. (2014): Geoinformation: Remote Sensing, Photogrammetry, and Geographic Information Systems (2nd Edition), CRC Press.
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10. Reddy, A. M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication.
11. Sarkar, A. (2015) Practical geography: A systematic approach. Orient Black Swan Private Ltd.
12. Singh, R. B. and Murai, S. (1998): Space-informatics for Sustainable Development, Oxford and IBH Publications.
13. Wolf, P. R., and Dewitt, B. A. (2000): Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1			x		x
CO2		x	x		x
CO3			x	x	x
CO4	x		x		x



Credits: 2

Course Code: GEO252025

SURVEY METHODS - PRACTICAL

Learning Outcomes:

Upon successful completion of the course, students will be able to:

- 1. acquire knowledge to handle a range of surveying instruments*
- 2. collect topographic data using DGPS and total stations.*
- 3. prepare base maps and reports*

Ex.1: Traditional Survey

- Chain Survey
- Plane Table Survey
- Clinometer / Prismatic Compass Survey

Ex.2: GNSS Data Collection

- Point features
- Line features
- Polygon features

Ex.3: DGNSS Survey

- Preparation and Base Station Setup
- Static Survey
- Kinematic Survey

Ex.4: Total Station survey

- Station setup –Levelling and Resection
- Angle and Distance measurement
- Area and Volume calculation
- Triangulation and Traversing

Ex.5: Base Map Preparation

- Case Study



REFERENCES:

1. Ghilani, C. D., and Wolf, P. R. (2012): Elementary Surveying: An Introduction to Geomatics, 13th Ed., Pearson Education, Inc., New Jersey.
2. Mitchell, C.W. (1991): Terrain Evaluation, London Scientific and Technical Co., John Wiley & Sons Inc. New York.
3. Punmia, B. C., Ashok, J. K., and Arun, K. J. (2005): Surveying-1, Vol. 1, Laxmi Publications, New Delhi.
4. Rampal, K. K. (2011): Surveying, Pragati Prakashan, Meerut.
5. Worthinton, B. D. R., and Gant, R. (1975): Techniques in Map Analysis, Macmillan, London.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x	x	x
CO2				x	x
CO3	x		x	x	x



Credits: 2

Course Code: GEO252026

GIS - PRACTICAL

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the scale, projection, and coordinate systems, appropriate use of vector and raster data structures and basics of data capture, storage, analysis, and output in a GIS.*
- 2. use GIS software to do georeferencing, digitization, symbolization, layout of map and spatial analysis.*
- 3. critically think and evaluate the physical, social, and environment-related research problems through the acquired geospatial practical knowledge.*
- 4. acquire GIS practical skills which is helpful for them to fetch good employment opportunities.*

Ex. 1: Structuring geographic data

- Vector and raster data formats
- Building Geodatabase
- Create feature class
- Adding fields and domains

Ex. 2: Explore spatial and attribute data

- RDBMS - Primary key and foreign key
- Joining and Relating the attributes
- Exploring Field calculator and Feature geometry tools
- Aggregating spatial and attribute data

Ex. 3: Spatial referencing

- Choose a map projection
- Set-up a custom coordinate system
- Coordinate transformations
- Georeference a raster image

Ex. 4: Digitizing and editing geographic data

- Digitize point, line and polygon features
- Use advanced edit tools
- Spatially adjust features

Ex. 5: Map symbolization and layouting

- Symbolizing geographic data
- Creating choropleth maps, point maps
- Create map layouts



REFERENCES:

1. Allen, D. W. (2011): GIS Tutorial 2: Spatial Analysis Workbook for ArcGIS10, ESRI Press.
2. Allen D. W., and Coffey, J. M. (2011): GIS Tutorial 3: Advanced Workbook for ArcGIS10, ESRI Press.
3. Chang, K. T. (2006): Introduction to Geographic Information Systems. 3rd Edition, McGraw Hill.
4. Mitchell, A. (1999): GIS Analysis – Volume 1: Geographic Patterns and Relationships, ESRI Press.
5. Mitchell, A. (2009): GIS Analysis – Volume 2: Spatial measurements and Statistics, ESRI Press.
6. Willpen L. G., and Kurland, K. S. (2011): GIS Tutorial 1: Basic Workbook for ArcGIS10, ESRI Press.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x		x
CO2			x		x
CO3		x	x		x
CO4			x		x



Credits: 2

Course Code: GEO25SE01

FIELD WORK***Learning Outcomes:****Upon completing this course, the students will be able to:*

1. identify geographical patterns and problems
2. understand the linkage between theory/lab and field
3. conduct field oriented research and demonstrate field data collection.

During the first/second semester, students need to undergo a field work and prepare a report.

The duration, location, and mode of the visit will be decided by the faculty in-charge.

Rubrics for Evaluation

Component	Criteria	Weight
Field	Involvement in pre-field work planning	10
	Active participation in the field work	25
Report	Observations – Physical aspects	10
	Observations – Human aspects	10
	Field photographs / sketches / maps	10
	Neatness and structure of the report	10
	Plagiarism	5
Presentation	Presentation skills	10
	Q&A	10
Total		100

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	x
CO2	x	x	x	x	x
CO3	x	x	x	x	x



Credits: 2

Course Code: GEO25SE02

ACADEMIC WRITING

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand important aspects of academic culture and communication.*
- 2. develop more productive, effective writing with healthier, more positive approaches.*

Unit - I

Writing an Academic Essay: Analyse the Prompt - Gathering the Information – Organizing the Materials – Draft Your Essay

Unit - II

Developing an Academic Essay: Construction of Thesis Statement - Organising the Paragraphs – Making the Writing Coherent - Usage of appropriate words in academic essay - Avoid Redundancy

Unit - III

Reporting Research Findings: Result interpretation; Proofreading an essay or report – Typographical Errors – Grammatical Errors – Academic Integrity – Citations and Plagiarism

Unit - IV

Preparation of Presentation: Oral and poster presentations; Preparing the visual aids – use of Common Language – Rehearsing the presentation - Confident Delivery of presentations - Answer Questions Competently

Unit – V

Practicing Academic Writings: Communicating through Email - Scientific CV Writing – Preparation of Project Proposals and Research Statements



REFERENCES:

1. Bailey, S. (2015): Academic Writing for International Students of Business (Second Edition), Routledge Publications.
2. Becker, H. S. (1986): Writing for Social Scientists: How to Start and Finish Your Thesis, Book or Article, University of Chicago Press.
3. Lee, K.C., Goh, H., Chan, J., and Yang, Y. (2007): Effective college writing: A process genre approach, McGraw-Hill Publications.
4. Murray, R. and Moore, S. (2006): The Handbook of Academic Writing: A Fresh Approach, McGraw-Hill Publications.
5. Oshima, A., and Hogue, A. (2006): Writing academic English, Pearson Publications.
6. Tupas, T. R. F., Cook, C., and Ismail, N. B. T. (2009): Communicating in the University Culture, Centre for English Language Communication, National University of Singapore.
7. Zemach, D. E. and Rumisek, L. A. (2005): Academic Writing: from Paragraph to Essay, Macmillan Publications.
8. Wesiman, H. (1996): Basic technical reporting, Prentice Hall Publications.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x			x	x
CO2				x	x



Credits: 2

Course Code: GEO25VA01

BASICS OF GEOSPATIAL PROGRAMMING

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- 1. Understand the structure and functioning of databases for geospatial applications.*
- 2. Identify open-source spatial data repositories, libraries, and cloud-based platforms and apply geospatial programming libraries*
- 3. Demonstrate fundamental programming skills in R, Python and GEE for statistical and spatial data analysis.*

Unit - I

Introduction to DBMS and RDBMS - Role of DBMS in geospatial applications - Spatial data models and storage structures

Unit - II

Spatial Data Sources: Repositories, Libraries - Open-source plotting tools: Leaflet, D3.js, Matplotlib - Overview of cloud-based GIS platforms: ArcGIS Online, GEE

Unit - III

Introduction to R: Data types and data structures - Statistical modules and geospatial packages - Visualization and analysis of vector/raster data

Unit - IV

Python fundamentals: variables, loops, conditionals - NumPy, Pandas, GeoPandas for geospatial data - Jupyter Notebook for interactive geospatial workflows

Unit - V

GDAL/OGR for raster and vector data manipulation - Introduction to GEE interface and scripting environment - Accessing and visualizing satellite data – GEE Basic image processing: NDVI, classification, change detection



REFERENCES:

1. Mitchell, J. C. (2003): Concepts in Computer Programming, Cambridge University Press.
2. Zuur A.F., Ieno, E.N., and Meesters, E.H.W.G. (2009): A Beginner's Guide to R, Springer Publications.
3. Lee, K. D. (2011): Python Programming Fundamentals (2nd Ed.), Springer Publications.
4. Hunt, J. (2019): A Beginners Guide to Python 3 Programming, Springer Publications.
5. McClain, B. P. (2022): Python for Geospatial Data Analysis, O'Reilly Media Inc.

ONLINE LEARNING RESOURCES:

- <https://rspatial.org/intr/index.html>
- <https://www.jessesadler.com/post/gis-with-r-intro/#gis-resources>
- https://onsgeo.github.io/geospatial-training/docs/intro_to_gis_in_r#course-instructions
- <https://developers.google.com/earth-engine/tutorials/tutorials>
- <https://www.geeksforgeeks.org/python-api-tutorial-getting-started-with-apis/>
- <https://courses.spatialthoughts.com/python-foundation.html>
- <https://medium.com/planet-stories/a-gentle-introduction-to-gdal/>
- <https://courses.spatialthoughts.com/gdal-tools.html>
- <https://gdal.org/gdal.pdf>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x		x
CO2			x		
CO3			x		x



SEMESTER – III



Credits: 4

Course Code: GEO252031

HYDROLOGY AND OCEANOGRAPHY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the fundamental components of hydrological cycle and water resource evaluation.*
- 2. explain the comprehend practices of integrated watershed management and groundwater management.*
- 3. analyse oceanic circulation systems as well as their interconnections and driving forces.*
- 4. understand the origin and distribution of marine resources and provide essential background for further studies in ocean and marine environment.*

Unit - I

Hydrological Cycle: Systems Approach in Hydrology, Hydrological Input and Output, Physical Process and Estimation - Anthropogenic Intervention in Hydrological cycle - Problems of Regional Hydrology

Unit - II

Water Resources Evaluation: Surface runoff, Groundwater Occurrence and Movement – Hydrograph Analysis - Watershed Approach: Watershed Modelling, Integrated Watershed Management, Water Quality

Unit - III

Oceanography: Configuration of ocean floor, temperature, salinity and density of ocean water - Circulation of oceanic waters: waves, tides and currents, Currents of the Atlantic, Pacific and Indian oceans

Unit - IV

Ocean Resources: Types and Theories of Origin and Distribution - Marine Deposits – Fishing – Conservation of Ocean Resources

Unit - V

Coastal and Marine Ecosystems: Ocean Habitats - Mangroves, Coral Reefs, Natural and Anthropogenic Impacts - Deep Sea Ecology



REFERENCES:

1. Christopherson, R. W., and Birkeland, G. H. (2012): Geosystems: An Introduction to Physical Geography (8th Edition), Pearson Education.
2. Karanth, K. R. (1988): Ground Water: Exploration, Assessment and Development, Tata-McGraw Hill.
3. Lawrence, S. D. (2008): Physical Hydrology, Waveland Press.
4. Mitchell, C.W. (1991): Land Evaluation, John Wiley & Sons Inc.
5. Pinet, P. R. (2012): Invitation to Oceanography, 6th Edition, Jones & Bartlett Learning.
6. Rajora, R. (2002): Integrated Watershed Management, Rawat Publications.
7. Sharma, R. C., and Vatal, M. (1970): Oceanography for Geographers, Chaitanya Publishing House.
8. Stewart, R. (2009): Introduction to Physical Oceanography, Orange Grove Books.
9. Strahler, A. H., and Strahler, A. N. (2001): Modern Physical Geography (4th Edition), John Wiley and Sons, Inc.
10. Tideman, E. M. (1999): Watershed management – Guidelines for Indian Conditions, Omega Scientific Publishers.
11. Todd, D. K. (1959): Groundwater Hydrology, McGraw Hill Book Company.
12. Ward, and Trimble (2004): Environmental Hydrology, Lewis Publishers, CRC Press.
13. Waugh, D. (2005): Geography: An Integrated Approach, Nelson Thornes.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x			
CO2	x	x		x	
CO3	x	x	x		x
CO4	x	x		x	



Credits: 4

Course Code: GEO252032

ECONOMIC AND POLITICAL GEOGRAPHY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand and describe the key concepts and theories in economic and political geography.*
- 2. analyse the spatial distribution of economic activities and their impact on global and regional geographies.*
- 3. evaluate political structures, theories, and their influence on geopolitical dynamics.*
- 4. examine the interconnectedness of economic and political factors and assess their implications for contemporary global issues.*

Unit - I

Economic Geography: Nature, Scope, and Development, its significance, and evolution; Economic Systems – Capitalism, Socialism, Mixed Economies; Global Economic Patterns – Globalization, Trade, Economic Integration; Regional Economic Development – Economic landscapes and disparities in various regions (e.g., East Asia, Sub-Saharan Africa); Agricultural Systems of the World – Overview of global agricultural systems and land use models, including their economic implications.

Unit - II

Economic Geography Theories and Models – Overview of key theories such as Location Theory, Central Place Theory, and Economic Base Theory; Models of Economic Development – Analysis of Rostow's Stages of Growth, Dependency Theory; Examination of spatial distribution patterns, agglomeration economies, Understanding the impact of global economic integration on local economies; Resource Management – Economic implications of resource allocation and management.

Unit - III

Political Geography: Nature, Scope, and Development & significance, Concept of Nation and State – Attributes of State – Federalism and Multilevel Governance; Electoral Reforms in Various Countries – Comparative analysis of electoral reforms and their impact on democratic processes; Determinants of Electoral Behavior – Factors influencing voting patterns and electoral outcomes; Laws of International Boundaries and Frontiers.

Unit - IV

Geopolitical Theories & Regional Cooperation – Organic state Theory, Heartland Theory, and Rimland Theory and their relevance to contemporary geopolitics. Regional Organizations and Conflicts – Roles and impacts of SAARC, ASEAN, OPEC, EU, NATO, BRICS, SCO, and QUAD; Conflicts over Natural Resources – Geopolitical aspects of resource-driven conflicts and regional responses.

Unit - V

Interconnectedness and Recent Trends in Economic and Political Geography - Analysis of contemporary trends such as Political economy, digital economies, global governance issues, and their implications; Globalization and Local Impacts – Examination of the effects of globalization on local economies and political systems.

**REFERENCES:**

1. Agnew, J. (2003): Geopolitics: Re-Visioning World Politics. Routledge.
2. Cloke, P., Crang, P., and Goodwin, M. (2014): Introducing Human Geographies. Routledge.
3. Cox, K. R., Low, M., and Robinson, J. (2008): The SAGE Handbook of Political Geography. SAGE Publications.
4. Dicken, P. (2015): Global Shift: Mapping the Changing Contours of the World Economy. Guilford Press.
5. Flint, C., and Taylor, P. J. (2007): Political Geography: World-Economy, Nation-State, and Locality. Pearson.
6. Gallaher, C., et al. (2009): Key Concepts in Political Geography. SAGE Publications.
7. Gregory, D., Johnston, R., Pratt, G., Watts, M. J., & Whatmore, S. (2009): The Dictionary of Human Geography. Wiley-Blackwell.
8. Harvey, D. (2005): A Brief History of Neoliberalism. Oxford University Press.
9. Held, D., McGrew, A., Goldblatt, D., and Perraton, J. (1999): Global Transformations: Politics, Economics, and Culture. Stanford University Press.
10. Johnston, R. J., Taylor, P. J., & Watts, M. (2002): Geographies of Global Change: Remapping the World. Wiley-Blackwell.
11. Kelly, P. F. (2013): Economic Geography: A Contemporary Introduction. Wiley-Blackwell.
12. Rodrigue, J.-P., Comtois, C., and Slack, B. (2020): The Geography of Transport Systems. Routledge.
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<https://documents1.worldbank.org/curated/en/645741468339541646/pdf/World-development-report-2015-mind-society-and-behavior.pdf>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2	x	x		x	
CO3	x	x	x		x
CO4	x	x	x	x	



Credits: 4

Course Code: GEO252033

MODELS IN GEOGRAPHY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand fundamental concept and function of models, and four traditions in geography.*
- 2. gain knowledge on measurement and classification models and their applications.*
- 3. apply the spatial interaction and spatial diffusion models to study spatial problems.*

Unit - I

Introduction to models: Function of models, Procedural problems of use of models, Types of model, Models and Paradigms in Geography

Unit - II

Four Traditions in geography: Spatial tradition, Area Studies tradition, Man-Land tradition, and Earth Science tradition – Criticisms

Unit - III

Observation Models: Measurement Models - Nominal, Ordinal, Interval and multidimensional, application and validation, Measurements in geography – Classification: logic and purpose, properties and procedure for classification, quantitative techniques

Unit - IV

Spatial interaction models: Complementarity, Intervening opportunity, and Transferability - Potential models and Gravity models – Network and Flow Models

Unit - V

Spatial Diffusion: Dynamics of Spatial Pattern, Levels, Scales, and Cones of Resolution. Location Allocation problems, Recent trends in Spatial Organization



REFERENCES:

1. Abler, R., Adams, J. S., and Gould, P. (1971): Spatial Organization: The Geographer's View of the World, Prentice-Hall Inc.
2. Chorley, R. J., and Haggett, P. (Eds.) (2013): Socio-Economic Models in Geography, Routledge.
3. Chorley, R. J., and Haggett, P. (Eds.) (2013): Integrated Models in Geography, Routledge.
4. Harvey, D. (1969): Explanation in Geography, Edward Arnold Publishers Ltd.
5. Husain, M. (2016): Models in Geography, Rawat Publications.
6. Pattison, W. D. (1964): The Four Traditions of Geography, Journal of Geography, Vol. 63 (5), pp. 211–216.
7. Peet, R. (1998): Modern Geographical Thought, Blackwell Publishers Ltd.
8. Robinson J. L. (1976): A New Look at the Four Traditions of Geography, Journal of Geography, Vol. 75 (9), pp. 520-530.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x			x	
CO2	x			x	
CO3	x			x	x



Credits: 2

Course Code: GEO252034

QUANTITATIVE TECHNIQUES - PRACTICAL

Learning Outcomes

Upon completing this course, the students will be able to:

- 1. acquaint themselves with the distinctiveness of quantitative techniques in geography.*
- 2. gain knowledge about frequency distribution, uni-variate, bi-variate, and multi-variate analysis*
- 3. understand software tools such as MS Excel, SPSS etc. which are essential for the analysis of spatial statistics.*
- 4. identify specific statistical techniques where they can be used for data analysis.*

Unit - I

Introduction to Statistical Techniques and Uni-variate analysis: Frequency Distribution, types, Measures of Central Tendency, Measures of Dispersion, Skewness, and Kurtosis.

Unit - II

Bi-Variate: Correlation – linear correlation, Karl Pearson's correlation coefficient and Spearman's rank correlation, regression analysis, measures of inequality; Lorenz curve and Gini's coefficient.

Unit - III

Multi-Variate Analysis: Multiple correlation, multiple regression, principal component analysis, factor analysis, cluster analysis.

Unit - IV

Statistical Tests of Significance: Introduction to hypothesis testing, 't' test, 'f' test, z test, sign test, Chi square (X^2) test, and ANOVA test.

Unit - V

Statistical Software: MS Excel, SPSS and R - Geographic data entry, storing and data file handling, generating new variables, running statistical procedures, constructing graphical displays, output viewer; recent trends in quantitative techniques.



REFERENCES:

1. Cressie, N. A. C. (1991): Statistics for Spatial Analysis, Wiley.
2. Eldon, D. (1983): Statistics in Geography: A Practical Approach, Blackwell.
3. Gregory, S. (1978): Statistical Methods and the Geographer (4th Edition), Longman.
4. Haining, R. P. (1990): Spatial Data Analysis in the Social and Environmental Science, Cambridge University Press.
5. Hammond R., and McCullagh, P. S. (1978): Quantitative Techniques in Geography, Oxford University Press
6. Jain, R. (2018): Statistical Analysis in Microsoft Excel and SPSS, Universal Academic Books Publishers and Distributors.
7. James, E. B., and Barber, G. M. (1996): Elementary Statistics for Geographers, the Guieford Press.
8. Khan, N. (2010): Quantitative Methods in Geographical Research, Concept Publishing Co.
9. Lokesh, J. (2020): Data Analysis Using SPSS, SAGE Publications India Pvt Ltd.
10. Mathews, J. A., (1987): Quantitative and Statistical Approaches to Geography: A Practical Manual Pergamon.
11. Mc Grew, Jr., and Cahrles, B. M. (1993): An Introduction to Statistical Problem Solving in Geography, W.C. Brocan Publishers.
12. Najma, K. (1998): Quantitative Methods in Geographical Research, Concept Publishing Company.
13. Pal, S. K. (1998): Statistics for Geoscientists: Techniques and Applications, Concept Publishing Company.
14. Peter, J. T. (1977), Quantitative Methods in Geography, Houghton Mifflin Company.
15. Sarkar, A. (2013): Quantitative Geography Techniques and Presentations, Orient Blackswan.
16. Wei, W. S. (1990): Time Series Analysis: Variate and Multivariate Methods, Addison Wesley Publishing.
17. Yeates, M. (1974): An Introduction to Quantitative Analysis in Human Geography, Mc Grawhill.

Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	X				x
CO2	X				x
CO3					x
CO4	X		x		x



Credits: 2

Course Code: GEO252035

GEOSPATIAL ANALYSIS - PRACTICAL

Learning Outcomes

Upon completing this course, the students will be able to:

- 1. gain knowledge on theoretical background involved in contemporary remote sensing data processing techniques*
- 2. proficiently interpret high resolution multi-source remote sensing data and critically evaluate the extracted information*
- 3. critically think and evaluate spatial research problems through the acquired geospatial practical knowledge.*
- 4. acquire proficiency in remote sensing and GIS practical skills using both open-source and commercial software which is helpful for them to fetch good employment opportunities.*
- 5. formulate the research objective which requires robust data for the better understanding of environment related problems*

Ex. 1: Multispectral Image Analysis

- Image Indices
- Band Math
- Change Detection
- Textural parameters

Ex. 2: Advanced Image Classification

- Classification using Machine Learning Algorithms
- Random Forest, SVM

Ex. 3: Hyperspectral Data Analysis

- Field Spectroradiometer data collection and processing
- Pre-processing of Hyperspectral image
- Feature Reduction
- Hyperspectral Indices

Ex.4: Spatial interpolation

- Thiessen Polygons
- IDW
- Kriging

Ex. 5: Vector based spatial analysis

- Vector operations (Extract, Overlay, Proximity, Generalization)
- Model Builder



Ex. 6: Raster based spatial analysis

- Local Operations
- Focal Operations
- Raster calculator

Ex. 7: Introduction to SAGA GIS Image processing software

- Exploring tools in SAGA GIS
- Mosaicking and subsetting images
- Conversion tools

Ex. 8: Introduction to QGIS software

- Exploring spatial tools in QGIS
- Exploring map document
- Conversion tools

Ex. 9: Web GIS Services

- Web GIS Services
- Exploring Bhuvan

Ex. 10: Spatial Data Publishing

- Publish the spatial data using ArcGIS Server
- Google Earth Engine

**REFERENCES:**

1. Borengasser, M., and Hungate, W. S., and Watkins, R. (2008): Hyperspectral remote sensing: principles and applications, 1st Edition, CRC Press, Boca Raton, FL.
2. Eismann, Michael T. (2012): Hyperspectral Remote Sensing, SPIE Press Monograph Vol. PM210. ISBN: 9780819487872.
3. Hanssen, R. F. (2001): Radar Interferometry: Data Interpretation and Error Analysis, 1st Edition, Springer Netherlands.
4. Jensen, J. R. (2006): Introductory Digital Image Processing: A Remote Sensing Perspective, 3rd Edition, Prentice-Hall Inc., New Jersey.
5. Richards, J. A. (2009): Remote Sensing with Imaging Radar, Springer-Verlag Berlin Heidelberg.
6. Richards, J. A., and Xiuping, J. (2005): Remote Sensing Digital Image Analysis: An Introduction, 4th Edition, Springer –Verlag, Berlin.
7. Tso, B., and Mather, P. M. (2012): Classification Methods for Remotely Sensed Data, 2nd Edition, CRC Press, Boca Raton, FL.
8. Thenkabail, P. S., Lyon, J. G., and Huete, A. (2011): Hyperspectral Remote Sensing of Vegetation. CRC Press, Boca Raton, FL.
9. Ulaby, F. T., Moore, R. K., and Fung, A. K. (1981): Microwave Remote Sensing: Active and Passive; Volume I: Microwave Remote Sensing Fundamentals And Radiometry, Artech House Publishers, Norwood, MA.
10. Van Der Meer, F. D., and De Jong, S. M. (2002): Imaging Spectrometry: Basic Principles and Prospective Applications, Kluwer Academic Publishers, New York.
11. Varshney, P. K., and Arora, M. K. (2004): Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data, 1st Edition, Springer-Verlag Berlin Heidelberg.
12. Woodhouse, I. H. (2006): Introduction to Microwave Remote Sensing, CRC Press, Boca Raton, FL.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				x
CO2			x	x	x
CO3	x		x	x	x
CO4	x	x	x	x	x
CO5	x	x	x	x	x



Credits: 4

Course Code: GEO25EC01

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the distinctiveness of geographic environment as a field of learning.*
- 2. develop a keen interest in the subject in terms of the key components and functions, and processes of different aspects of the environment and pursue it for further research.*
- 3. develop sustainable management strategies for different ecosystems, to address environmental challenges and promote conservation.*

Unit - I

Concepts of Environment and Sustainable Development: Meaning, multi-disciplinary nature, components, functions, and processes of geographic environment. resources, development and concept of sustainability, sustainable development and its significance.

Unit - II

Forest and Mountain Ecosystems: Types, processes, patterns and biodiversity - problems and sustainable management of forest and mountain ecosystems.

Desert Ecosystem: Processes, patterns, desertification and sustainable management strategies for desert ecosystems.

Unit - III

Sustainable Coastal Ecosystem: Processes, problems and management of coastal areas; mangroves, coastal pollution, sea-ground water interaction in coastal zones, integrated coastal zone management (ICZM).

Sustainable Urban Ecosystems: Urban environments, problems, urban micro climates, urban heat islands, role of urban green & blue spaces and their management.

Unit - IV

Climate change and Global warming: Trends and patterns of global temperatures, their implications, UNFCCC reports, global and national action plans to counter climate change and adaptations.

Unit - V

Global, National Legislation and recent developments: Environment and sustainable development legislation in India and the world; global conventions, policies and flagship programmes, goals, targets, achievements and the future scenarios, recent advancements.



REFERENCES:

1. Chandana, R. C., (2002): Environmental Geography, Kalyani Publishers.
2. Cloudsley, J. L. T., (2001): Ecology of Desert Environments, Scientific Publishers.
3. Cunningham, W. P., and Cunningham, M. A., (2004): Principles of Environmental Science: Inquiry and Applications, Tata McGraw Hill.
4. Das, R.C., et. al., (1998): The Environmental Divide: The Dilemma of Developing Countries, A.P.H. Publications.
5. Goudie A., (2001): The Nature of the Environment, Blackwell.
6. Mal, S., and Singh, R. B. (Eds.) (2009): Biogeography and Biodiversity. Rawat Publication.
7. Martin J. O., (2018): Introduction to Sustainable Development, SAGE Publications India Pvt Ltd.
8. Miller, G. T., (2004): Environmental Science: Working with the Earth, Thomson Brooks Cole.
9. Munn, T., (Ed.) (2001): Encyclopedia of Global Environmental Change, John Wiley & Sons.
10. Odum, E. P. et. al, (2005): Fundamentals of Ecology, Cengage Learning India.
11. Saxena, H. M., (1999): Environmental Geography, Rawat Publications.
12. Singh, R. B., and Prokop, P. (Eds.) (2015): Environmental Geography of South Asia, Springer.
13. Singh, S., (1997): Environmental Geography, Prayag Pustak Bhawan.
14. Smith, T. M., and Smith, R. L., (2012): Elements of Ecology (8th Edition), Pearson Education Inc.
15. Yadav S., Bharati, R. P., (2013): Forest Management and Conservation, D.P.S. Publishing House.
16. <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2	x	x	x	x	x
CO3	x			x	x



Credits: 4

Course Code: GEO25EC02

DISASTER RISK REDUCTION

Learning Outcomes:

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

- 1. Understand the conceptual aspects of disaster risk reduction*
- 2. Apply various approaches and models in disaster risk reduction*
- 3. Acquire knowledge on specific actions for disaster risk reduction and develop analytical skills in decision making*
- 4. Evaluate the disaster management strategies and facilitate the action plans using geospatial tools and techniques*

Unit - I

Understanding Disasters - Concepts and Types of disasters (natural and man-made), Factors and Significance of disasters – Trends in disasters - Physical, social, economic and environment impacts of disaster

Unit - II

Vulnerability - Concepts and Types of vulnerabilities - Factors and Significance of Vulnerability - Methods and approaches in vulnerability assessment – Coping Capacity – Resilience

Unit – III

Risk Assessment – Risk Analysis techniques – Problems in Risk Assessment – Assessment of Risks for different types of disasters – Participatory Risk Assessment - Community based approaches

Unit - IV

Disaster Risk Management – Prediction and Warning - Early warning systems – Response and Recovery – Mitigation and Prevention - Preparedness and Planning - Role of Geoinformatics in disaster risk reduction

Unit - V

National and International efforts on disaster risk reduction - National Disaster Management Policy - Institutional efforts for disaster management in India – Sendai Framework for Disaster Risk Reduction: Targets, Priorities for Action, and Guiding Principles



REFERENCES:

1. Bhattacharya, T., (2012): Disaster Science and Management, McGraw Hill India Education Pvt. Ltd.
2. Disaster Management Guidelines, GOI-UND Disaster risk program (2009 – 2012).
3. Damon, P. Copola, (2006): Introduction to International Disaster Management, Butterworth Heineman.
4. Government of India, (1997): Vulnerability Atlas of India, revised ed., building materials & technology promotion council, ministry of urban development.
5. Gupta, A. K., and Nair, S. S. (2011). Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi.
6. Kapur, A. (2010): Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi.
7. Nelson, C., Lurie, N., Wasserman, J., Zakowski, S., (2007): Conceptualizing and defining public health emergency preparedness, A M J Public Health.
8. Robbins, P., hintz, J., moore, S. A., (2014). Environment and society: A critical introduction 2nd edition, Wiley.
9. Singhal, J. P. (2010): Disaster Management, Lakshmi Publications.
10. WHO, (1999): Rapid health Assessment protocols for emergency, Geneva

POLICY DOCUMENTS:

1. Government of India: Disaster Management Act, Govt. of India, New Delhi 2005
2. Government of India: National Disaster Management Policy, 2009

Mapping of Program outcomes with course outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x		x	
CO2	x	x		x	
CO3			x	x	x
CO4			x	x	x



Credits: 4

Course Code: GEO25EC03

APPLIED GEOMORPHOLOGY

Learning Outcomes:

After completion of this course, the students will be able to

- 1. understand basics of fluvial-coastal forms and processes and likely changes resulting from those processes*
- 2. assess geomorphic dynamics for better landscape and environmental management*
- 3. apply advanced methods and techniques in analysis of geomorphic data*

UNIT - I

River basin analysis: Drainage patterns - Channel types and morphological classification - Longitudinal profiles, baselevel and graded streams

Tutorial-1: Strahler's method of stream ordering, Hypsometric curve and longitudinal profiles

UNIT - II

River sediment dynamics: Modifications in river flow - Dynamics of floodplains and river confluences

Tutorial-2: Sampling river bed sediments and Granulometric analysis

UNIT - III

Delta systems: types, morphology and dynamics - Estuaries: formation, types, estuarine circulation and mixing

Tutorial-3: Extraction of delta features from DEM

UNIT - IV

Coastal processes: destructional and constructional - Coastal sediments: textural parameters, magnetic susceptibility and geochemistry

Tutorial-4: Subsurface sediment sampling and textural analysis

UNIT - V

Quaternary geomorphology: Dating techniques - Record of climatic and sea-level change - Relict landforms - Human impacts on the fluvial system

Tutorial-5: Flood hazard mapping

FIELD STUDY: Student will expose to different geomorphic systems and techniques of field data collection.



REFERENCES:

1. Gupta, A. (2011): Tropical Geomorphology. Cambridge University Press.
2. Huggett, R.J. (2007): Fundamentals of Geomorphology, Routledge.
3. Rhoads, L. Bruce. (2020): River Dynamics-Geomorphology to Support Management. Cambridge University Press.
4. Summerfield, M. A. (1991): Global Geomorphology – An introduction to study of landforms. Pearson Education Limited.
5. Thornbury, W. D. (2019): Principles of Geomorphology, Third Edition, New Age International Publishers.
6. <https://www.tulane.edu/~sanelson/eens1110/streams.htm>
7. <https://www.sciencedirect.com/science/article/abs/pii/S0070457107100054>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	x
CO2		x	x	x	x
CO3		x	x	x	x



Credits: 4

Course Code: GEO25EC04

URBAN GIS

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. gain knowledge of the basic characteristics of urban environments, their common social and physical structures, and issues.*
- 2. design a professional-grade, visually-balanced, cartographically complete maps*
- 3. analyze the spatial processes and explore the spatial relationships in urban areas.*
- 4. apply geospatial techniques in the urban environment.*
- 5. create a spatial decision support system for sustainable urban management.*

Unit - I

Urban definition, Urban terminology, Site and Situation with examples, Structure of cities- Classic land use models, Size and scale of cities, Urban Growth, Urban environmental problems, and issues

Unit - II

Urban as a system of systems, Urban infrastructure, Urban green space and blue space, Urban governance, Urban planning and Smart Cities, Sustainable Urban Development

Unit - III

Urban remote sensing, Urban GIS, Spatial Data: Raster and Vector, Attributes and metadata, Sources of data, Spatial Analysis, and Spatial Decision Support System. Recent Trends in Urban GIS

Unit - IV

Applications of GIS in the urban environment: Time enabled geospatial analysis, Network analysis, Site suitability analysis, Poverty and Crime analysis, Urban health, Conservation of green space, water resources, Urban modelling, and Urban disasters

Unit - V

Case Studies: Field trip to expose different land use structures in urban areas, Group Project work on any one of the GIS applications in selected cities, Systematic review of Urban GIS research papers on various themes



REFERENCES:

1. Burrough, P. A., and Mc Donnell, R. A., (1998): Principles of Geographic Information Systems, Oxford University Press.
2. Census Handbooks, Census of India.
3. Chang, K. T., (2006): Introduction to Geographic Information Systems, Tata McGraw-Hill.
4. De Mers, M. N., (1999): Fundamentals of Geographic Information Systems, John Wiley & Sons.
5. Environmental Systems Research Institute (ESRI), (1997): Getting to know Arc View GIS, Cambridge: Geoinformation International.
6. Ghosh, S. (1998): Introduction to Settlement Geography by, Orient Longman, 1998
7. Heywood, I. et. al., (2004): An Introduction to Geographic Information Systems, Pearson Education.
8. Johnson, J. H., (2013): Urban Geography: An Introductory Analysis, 2nd Edition, Fisher W. B. (Ed.), Pergamon Oxford Geographies.
9. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W., (2001): Geographic Information Systems and Science, Wiley.
10. Maantay J., and Ziegler J., (2006): GIS for the Urban Environment, ESRI press.
11. Singh, R.B. (Ed.), (1991): Environmental Monitoring: Application of Remote Sensing and GIS, Geocarto Int. Centre.
12. Singh, R.B. and Murai, S. (Eds.), (1998): Space Informatics for Sustainable Development, Oxford & IBH Publications.
13. Sulochana S., Kumar D. (Eds.) (2023): Geoinformatics for Sustainable Urban Development. ISBN 9781003331001, Taylor and Francis Publishers.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	
CO2	x	x	x	x	x
CO3		x	x	x	x
CO4		x	x	x	x
CO5		x	x	x	x



Credits: 2

Course Code: GEO25ON01

INTERNSHIP***Learning Outcomes:****Upon completing this course, the students will be able to:*

1. *understand the organizational concepts and working culture.*
2. *acquire practical skills and offers opportunities to meet people and build a network that will help with future education or employment.*
3. *adapt effectively to changing conditions and demonstrate effective management of personal behaviour, ethics and attitudes.*

After completing the first two semesters, students need to undergo an internship in outside institution/industry/NGO with a mandate to work as a member of a research group in a project in close association with the subject matter experts. The students shall apply for the internship in consultation with their mentors. The period of internship should be two to four weeks. The students need to submit a report (maximum of 10 pages) covering the aspects of a) industry/organization background, customs and practices b) intern duties and individual responsibility c) professional skills gathered and d) usefulness and career networking.

Getting Attendance/ Internship completion Certificate from the host institution is mandatory.

Rubrics for Evaluation

Component	Criteria	Weight
Institution	Reputation/relevance of the institution	20
Report	Professional skills gathered	40
	Neatness and structure of the report	30
	Plagiarism	10
Total		100

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x			x	x
CO2			x	x	x
CO3				x	x



SEMESTER – IV



Credits: 12

Course Code: GEO252041

DISSERTATION

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. identify and define research problem and parameters.*
- 2. collect and analyse the data in a systematic and scientific manner.*
- 3. formulate and carry out independent research in the general field of geography.*
- 4. write a scientific research report, thesis, and research proposal.*

Students need to carry out dissertation work in the Department or in a reputed academic/scientific institution or industry, write a thesis and defend it at the end. The thesis will be supervised and assessed by internal/external members. The students should select a specific topic from the following broad areas for conducting the research work.

- | | |
|--------------------------------------|--------------------------------------|
| a) Applied Geomorphology | k) Sustainable Tourism |
| b) Applied Climatology | l) Urban resilience |
| c) Integrated Watershed Management | m) Urban Planning and Sustainability |
| d) Coastal Zone Management | n) Rural and Regional Development |
| e) Biodiversity and Conservation | o) Remote Sensing |
| f) Environmental Impact Assessment | p) GIS and Location Analytics |
| g) Agriculture and Land Use Planning | q) Spatial Decision Support System |
| h) Human Health and Wellbeing | r) Climate Change |
| i) Demography and Social Wellbeing | s) Disaster Risk Reduction |
| j) Energy Resources | t) Sustainable Development Goals |

The thesis should be between 60 and 100 pages including maps, tables, diagrams and graphs. The ideal structure of thesis is a) Introduction, b) Objectives c) Study Area, d) Materials and Methods, e) Results and Discussion, f) Summary and Conclusion, g) References, and h) Supplementary Materials.



RUBRICS FOR THE ASSESSMENT OF M.Sc. DISSERTATION

Assessment	Criteria		Marks
Internal Marks (Awarded by the internal and/or external supervisor)	Attendance (Regularity)		10
	Independence (Self-motivation)		10
	Skills and Knowledge (On the topic)		10
	Interaction (Promptness)		10
External Marks Awarded by the examiners (average of examiners)	Mid-term Presentation		10
	Report	Presentation of Chapters	10
		Research Findings	10
		Relevance of Maps / Figures / Tables	5
		Citation & References	5
	Viva Voce	Presentation Skills	10
		Q & A	10
Total Marks			100

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1			X	X	X
CO2			X	X	X
CO3	X	X	X	X	X
CO4	X		X	X	X



Credits: 3

Course Code: GEO25ON02

RESEARCH METHODOLOGY

Learning Outcomes:

Upon completing this course, students will be able to:

- 1. acquaint with the basic knowledge about research in terms of; research design, data collection, analysis, and report writing.*
- 2. get an idea about the scientific processes and ethics of quality research.*
- 3. develop a keen interest in research and use the knowledge for future research.*

Unit - I

Research Methodology overview - Procedure of Scientific research – Classification of Research - Review of Literature, Logical Reasoning, Defining a Research Problem

Unit - II

Formulating Hypothesis, Research Design, Measurement of Scales, Sampling - Need for Sampling, Methods of sampling and Size of Sampling

Unit - III

Methods of Primary and Secondary Data collection; Conducting questionnaire surveys and Pilot Study; Mobile and GNSS based surveys - Processing of Data - Jurimetrics - Data Display: tables, graphs, maps, visualizations - Reliability and validity of data

Unit - IV

Report Writing - Preparation of Research Reports - Layout, Structure and Language of typical reports, Story maps - Citation methods: Foot note, Text note, End note.

Unit - V

Indexing and Citation databases – Journal impact factor - Citation rules: Blue book, OSCOLA, MLA, APA and Chicago - Scientometrics - Reference Management Software.



REFERENCES:

1. Chorley, R.J. and P. Haggett (ed) (1967): Models in Geography, Methuen, London
2. Gomez, B. and Jones, J. P. (2010): Research Methods in Geography: A Critical Introduction, John Wiley and Sons, Sussex.
3. Goode, W and P.K, Hatt (1962): Methods in Social Research, Mc Graw Hill, .Tokyo
4. Har Prasad (1992): Research Methods and Techniques in Geography, Rawat Publications, New Delhi.
5. Harvey, D. (1971): Explanation in Geography, Edward Arnold, London.
6. Kothari, C. R. (1994): Research Methodology: Methods and Techniques, Wishwa Prakashan.
7. Minshull, R. (1975): Introduction to Models in Geography. Longman London.
8. Misra H.N. and V.P. Singh (1998): Research Methodology in Geography: Social, Spatial and Policy Dimensions, Rawat Publications New Delhi.
9. Montello, D., and Sutton, P. (2013): An Introduction to Scientific Research Methods in Geography and Environmental Studies, SAGE Publications, California.
10. Sheskin, I.M. (1987): Survey Research for Geographers Scisntific Publisher, Jodhpur.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x			x	x
CO2			x	x	x
CO3			x	x	x



Credits: 3

Course Code: GEO25ON03

RESEARCH ETHICS

Learning Outcomes

After completion of this course, the research scholar will be able to

- 1. understand the basics of philosophy of science and ethics, research integrity, and publication ethics*
- 2. identify plagiarism, research misconduct and predatory publications*
- 3. apply integrity in data collection, publication, and collaboration*

Unit – I

Introduction to Research Ethics: moral philosophy, nature of moral judgments and reactions - Intellectual honesty and research integrity

Unit – II

Scientific misconduct: fabrication, falsification, plagiarism - Anti-plagiarism software - Ethical review for human and animal studies - Informed consent for data collection - Privacy and confidentiality of data

Unit – III

Publication ethics - Publication misconduct - Selective reporting and misrepresentation of data - Best practices/standards setting initiatives and guidelines - Conflicts of interest - Collaborative research and authorship – Peer review integrity

Unit – IV

Open access publications and initiatives - Article Processing Charges (APC) and equity concerns - Predatory publications in open access - Redundant publications - Citation manipulation - Research retraction and ethical implications

Unit – V

Emerging technologies and ethical challenges - Ethics of using AI in Research - Detection of AI-generated content and ethical disclosure -



REFERENCES

1. Alexander Bird (2006). Philosophy of Science. Routledge
2. Chaddah, P. (2019). Ethics in Competitive Research: Do not get scooped, do not get plagiarized.
https://www.researchgate.net/publication/331470963_Ethics_in_Competitive_Research_Do_not_get_scooped_do_not_get_plagiarized
3. David B. Resnik (2020). What Is Ethics in Research & Why Is It Important?
<https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
4. INSA, Ethics in Science Education, Research and Governance.
https://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. Jeffrey Beall (2012). Predatory publishers are corrupting open access. Nature, 489, 179. <https://www.nature.com/news/predatory-publishers-are-corrupting-open-access-1.11385>
6. Resnik DB (2005). The Ethics of Science–An Introduction. Taylor & Francis-elibrary

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4
CO1		x	x	
CO2		x	x	
CO3			x	x



Credits: 3

Course Code: GEO25ON06

CLIMATE CHANGE AND SOCIAL WELL-BEING

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the concepts of climate change and environmental problems and their associated societal problems*
- 2. acquire knowledge on concepts and integrated geographical approaches to achieve social wellbeing*
- 3. utilize spatial data as well as analyse information to acquire information on climate change and public health issues*

Unit - I

Fundamentals of Climate Change -Definition and Scope of Climate Change; Historical Context and Evolution of Climate Change; Greenhouse Effect and Global Warming; Climate Systems and Feedback Mechanisms; Anthropogenic and Natural Causes of Climate Change.

Unit - II

Impacts of Climate Change - Physical Impacts: Sea Level Rise, Extreme Weather Events; Ecological Impacts: Biodiversity Loss, Ecosystem Changes; Socio-economic Impacts: Agriculture, Water Resources, Economy; Public Health Impacts: Diseases, Heat Stress, Air Quality; Case Studies of Climate Change Impacts in Different Regions.

Unit - III

Concepts of Social Well-being - Understanding Social Well-being: Definitions and Indicators; Social Well-being and Quality of Life; Impact of Environmental Changes on Social Well-being; Social Equity and Climate Justice; Vulnerability and Resilience in Communities.

Unit - IV

Climate Change and Social Well-being Interactions - Interconnections between Climate Change and Social Well-being; Climate-induced Migration and Displacement; Social Groups at Risk: Vulnerability and Adaptation; Community Resilience and Adaptation Strategies; Policy Responses and Community Initiatives.

Unit - V

Role of Geospatial Technologies in Climate Change and Social Well-being - Monitoring and Mapping Climate Change using Remote Sensing; Spatial Analysis of Climate Data using GIS; Mapping Vulnerability and Social Impacts of Climate Change.



REFERENCES:

1. Maslin, M. (2014): Climate Change: A Very Short Introduction. Oxford University Press.
2. Sundaresan, J., et al. (2014): Geospatial Technologies and Climate Change. Springer.
3. Mearns, R., & Norton, A. (Eds.). (2010). The Social Dimensions of Climate Change. World Bank Publications.
4. Intergovernmental Panel on Climate Change (2021): Climate Change 2021: The Physical Science Basis. Retrieved from <https://www.ipcc.ch/report/ar6/wg1/>
5. IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
6. https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf
7. United Nations Framework Convention on Climate Change (UNFCCC) (2023): Annual Report on Climate Action. Retrieved from <https://unfccc.int/report>
8. World Health Organization (2022): Climate Change and Health: Impacts, Vulnerabilities, and Adaptation Strategies. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>
9. NASA Earth Observatory (2024): Earth's Vital Signs. Retrieved from <https://earthobservatory.nasa.gov/>
10. ESRI (Environmental Systems Research Institute). GIS and Climate Change. Retrieved from <https://www.esri.com/en-us/what-is-gis/overview>
11. NASA Earth Observatory. Earth Science. Retrieved from <https://earthobservatory.nasa.gov/>

Mapping of Program outcomes with course outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x		x	x	x
CO2	x	x	x	x	
CO3			x		x



Credits: 3

Course Code: GEO25ON07

URBAN SUSTAINABILITY

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. have a holistic understanding of cities through the lens of environmental and social sustainability.*
- 2. understand both the environmental and infrastructural aspects of cities, as well as issues of human development, urban societies, public policy, and social equity.*
- 3. acquire a foundation in sustainability concepts and skills for research and professional practices.*
- 4. prepare themselves to serve as social change agents in future roles as scholars, urban planners, designers, entrepreneurs, public servants, and advocates to address the most pressing issues of urban development and its human impacts in cities around the world.*

Unit - I

Urban Sustainability: Definition, Conceptual Foundations of Urban Sustainability, Indicators of Urban Sustainability, Three Pillars of Sustainability: Environment, Economic and Society; Sustainability Practices - Urban Agriculture

Unit - II

Urban land use planning: Objectives and Principles of Urban planning; Different Land use planning norms, Environmental aspects of land use planning, Role of URDPFI guidelines in Town planning, Land use Structures, Government policies of urban development, Case studies

Unit - III

Urban challenges: Urban Poverty: Slums, Urban Sprawl, Environmental Resources, Urban Governance, Urban resilience, Management of urban services: Urban Green Space, Water Supply, Power supply, Health & Sanitation, Drainage, Roads, Urban Transport, Urban Housing, Urban Waste (Solid, liquid) Management and urban disasters

Unit - IV

Urban Schemes and Programs at the National Level: National Mission on Sustainable Habitat (NMSH)2021-30; Affordable Rental Housing Complexes (ARHCs) for Urban Migrants/Poor, Smart Cities, AMRUT, Heritage City Development and Augmentation Yojana (HRIDAY), Urban transport, PMAY, NEUDP etc.

Unit - V

Role of Geoinformatics in urban Sustainability, Case studies, Field Visits, Report Submission.



REFERENCES:

1. Burrough, P. A., and Mc Donnell, R. A., (1998): Principles of Geographic Information Systems, Oxford University Press.
2. Census Handbooks, Census of India.
3. Chang, K. T., (2006): Introduction to Geographic Information Systems, Tata McGraw-Hill.
4. De Mers, M. N., (1999): Fundamentals of Geographic Information Systems, John Wiley & Sons.
5. Environmental Systems Research Institute (ESRI), (1997): Getting to know Arc View GIS, Cambridge: Geoinformation International.
6. Ghosh, S. (1998): Introduction to Settlement Geography by, Orient Longman, 1998
7. Heywood, I. et. al., (2004): An Introduction to Geographic Information Systems, Pearson Education.
8. Johnson, J. H., (2013): Urban Geography: An Introductory Analysis, 2nd Edition, Fisher W. B. (Ed.), Pergamon Oxford Geographies.
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10. Maantay J., and Ziegler J., (2006): GIS for the Urban Environment, ESRI press.
11. Singh, R.B. (Ed.), (1991): Environmental Monitoring: Application of Remote Sensing and GIS, Geocarto Int. Centre.
12. Singh, R.B. and Murai, S. (Eds.), (1998): Space Informatics for Sustainable Development, Oxford & IBH Publications.
13. Sulochana S., Kumar D. (Eds.) (2023): Geoinformatics for Sustainable Urban Development. ISBN 9781003331001, Taylor and Francis Publishers.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	
CO2	x	x	x	x	x
CO3		x	x	x	x
CO4		x	x	x	x



Credits: 3

Course Code: GEO25ON08

WATERSHED MANAGEMENT

Learning Outcomes:

Upon completing this course, the students will be able to:

- 1. understand the fundamental components of the hydrological cycle and comprehend practices of integrated watershed management*
- 2. use watershed based models and methods to quantitatively measure and estimate the resources degradation*
- 3. evaluate the degradation status of land and water resources and draw appropriate conservation techniques so as to attain sustainable development*
- 4. read watershed related publications and critically analyse the approach adopted*

Unit - I

Basic Concepts: Watershed Approach – Watershed delineation - Watershed characteristics - Watershed modelling

Unit - II

Functions of watershed - Objectives of watershed Management - Sustainable watershed management: objectives, plans and programmes - Participatory approach - Watershed prioritization

Unit - III

Land Resources Management: Soil surveys - Soil erosion: causes, effects, estimation and control measures - Soil moisture: methods of estimation

Unit - IV

Land evaluation: land utilization, land capability classification and land suitability analysis - Land use planning - Drought management - Case studies

Unit - V

Water Resources Management: Water conservation and harvesting - Groundwater suitability analysis - Flood management - Case studies

Students need to undertake field visits and prepare a report



REFERENCES:

1. Tideman, E.M., (1999): Watershed management - Guidelines for Indian Conditions, Omega Scientific Publishers, New Delhi
2. Lyon, J.G., (2003): GIS for Water Resource and Watershed Management, Taylor and Francis, New York.
3. Todd, D.K., (1959): Groundwater Hydrology, McGraw Hill Book Company, New York.
4. Lawrence, S.D. (2008): Physical Hydrology, Waveland Press.
5. Ward and Trimble (2004): Environmental Hydrology, Lewis Publishers, CRC Press.
6. Davidson, Donald A. (1992): The evaluation of land resources, Longman Scientific, London.
7. FAO, (1976): A Framework for Land Evaluation, Soils Bulletin 32, FAO, Rome.
8. FAO (1996): Guidelines for Land-use Planning, FAO Development Series 1, FAO, Rome.
9. Murty, JVS (1994): Watershed Management in India, Wiley Eastern Ltd., New Delhi.
10. Rajesh Rajora (2002): Integrated Watershed Management, Rawat Publications, New Delhi

ONLINE RESOURCES:

<https://www.fao.org/land-water/land/sustainable-land-management/en/>

<https://elearning.fao.org/course/view.php?id=649>

<https://elearning.fao.org/course/view.php?id=454>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x	x	x	x
CO2		x	x	x	x
CO3		x	x	x	x
CO4		x	x	x	x



Credits: 3

Course Code: GEO25ON09

WETLAND MANAGEMENT

Learning Outcomes:

After completion of this course, the students will be able to:

- 1. understand the significance and threats to wetlands in climate change perspective*
- 2. map and monitor the wetland characteristics at global to local scale*
- 3. explore latest geospatial time series tools and techniques for wetland monitoring*

Unit - I

Wetlands – Definition, Classification, and Distribution – Wetland Biogeochemistry – Ecological Functions – Wetlands and Climate Change

Unit - II

Wetland Ecosystems – Natural and Anthropogenic Impacts – Wetland Restoration and Conservation – Policies and Legal Framework – Ramsar Convention – Blue Carbon Initiative

Unit - III

Wetland Identification and Mapping – Regional and Local Assessment Methods – Wetland Vegetation – Field Surveying methods – Wetland Water Quality Assessment

Unit - IV

Geospatial Tools and Techniques – Remote Sensing Time Series Analysis – Change Detection – Surface Hydraulics of Wetlands – Vegetation Phenology – Estimation of Biophysical Variables

Unit - V

Open Source Tools and Algorithms for Wetland Mapping and Monitoring – Global Water Pack – LandTrendr – TIMESAT – Google Earth Engine Packages – Case Studies



REFERENCES:

1. Keddy, P. A. (2010): Wetland Ecology: Principles and Conservation, Cambridge University Publications
2. Mitsch, W. J., and Gosselink, J. G., (2015): Wetlands (Fifth Edition), Wiley Publications.
3. LePage, B. A., (2011): Wetlands: Integrating Multidisciplinary Concepts, Springer.
4. Lyon, J. G. (2005): Wetland Landscape Characterization, Ann Arbor Press.
5. Weng, Q. (2011). Advances in Environmental Remote Sensing: Sensors, Algorithms, and Applications, CRC Press.
6. Awange, J.L., and Kiema, J.B.K. (2013): Environmental Geoinformatics: Monitoring and Management, Springer.
7. Purkis, S., and Klemas, V. (2011): Remote Sensing and Global Environmental Change, John Wiley & Sons Publications.
8. Ban, Y. (2016): Multitemporal Remote Sensing: Methods and Applications, Springer.
9. Liang S., (2004): Quantitative Remote Sensing of Land Surfaces, John Wiley & Sons Publications.
10. Kuenzer, C., Dech, S., and Wagner, W. (2015): Remote Sensing Time Series: Revealing Land Surface Dynamics, Springer.
11. Machiwal, D., and Jha, M.K. (2012): Hydrologic Time Series Analysis, Springer.
12. Kumar, L., and Mutanga, O. (2019): Google Earth Engine Applications, MDPI Publication.

ONLINE RESOURCES:

- <https://data.jrc.ec.europa.eu/dataset/jrc-gswe-global-surface-water-explorer-v1>
- <https://web.nateko.lu.se/timesat/timesat.asp>
- https://openmrv.org/web/guest/w/modules/mrv/modules_2/landtrendr#1-background
- <https://geetimeseriesexplorer.readthedocs.io/en/latest/content.html>

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x	x			
CO2			x	x	
CO3			x	x	x



Credits: 3

Course Code: GEO25ON10

GEOSPATIAL ANALYSIS AND MODELLING

Learning Outcomes:

After completion of this course, the students will be able to:

1. *Understand the conceptual framework of geospatial analysis and modelling.*
2. *Evaluate spatial modelling tools for urban, environmental, and resource-based applications.*
3. *Apply multi-criteria decision-making and spatial analysis techniques in solving real-world problems.*
4. *Use open-source and proprietary GIS platforms to implement suitability analysis.*
5. *Design and implement a suitability modelling project using geospatial datasets.*

Unit I – Fundamentals of Geospatial Modelling

Introduction to spatial analysis and modelling – concepts, scope, and classification - Components of geospatial models: input, process, output - Raster and vector-based modelling approaches - Model building process: conceptualization to implementation

Unit II – Spatial and Decision-Making Techniques

Spatial Decision Support System (SDSS) - Multi-Criteria Decision Making (MCDM): Analytical Hierarchy Process (AHP), Fuzzy AHP - Weighted Linear Combination (WLC)

Unit III – Geospatial Suitability Modelling

Suitability analysis: concepts, scope, and relevance - Process of suitability modelling - Factor and constraint mapping - Steps in suitability analysis - Model validation and performance evaluation

Unit IV – Machine Learning Techniques

Machine Learning Overview - Artificial Neural Networks (ANN) - Cellular Automata and Markov Chain - Logistic Regression - Predictive Modelling using R, Python and GIS platforms

Unit V – Case Studies

LU/LC prediction, habitat mapping, crime analysis, business site selection, disaster evacuation planning



REFERENCES:

1. Burrough, P.A., & McDonnell, R.A. (1998). Principles of Geographical Information Systems. Oxford University Press.
2. Malczewski, J. (1999). GIS and Multicriteria Decision Analysis. John Wiley & Sons.
3. Eastman, J.R. (2012). IDRISI Manual and Tutorials (Free with Clark Labs software).
4. Longley, P.A., Goodchild, M.F., Maguire, D.J., & Rhind, D.W. (2015). Geographic Information Systems and Science. Wiley.
5. Zeng, W., Liu, Y., & Stein, A. (2020). Geospatial Artificial Intelligence: Emerging Trends and Future Directions. Springer.
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7. Weng, Q. (2011). Advances in Environmental Remote Sensing: Sensors, Algorithms, and Applications. CRC Press.

Mapping of Program Outcomes with Course Outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	x				
CO2		x	x		
CO3			x	x	
CO4			x		x
CO5	x	x		x	x