

University of Mumbai

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Academic Authorities,
Meetings & Services (AAMS)
Room No. 128, M. G. Road, Fort,
Mumbai - 400 032.
Tel. 022-68320033

Re- accredited with A ++ Grade (CGPA 3.65) by NAAC
Category- I University Status awarded by UGC

No. AAMS_UGS/ICC/2025-26/53

Date : 25th June, 2025.

To,
The Head,
Department of Geography, 1st Floor,
Lokmanya Bal Gangadhar Tilak Bhavan,
Vidyanagari, Santacruz (E),
Mumbai - 400 098.

Sub :- M.A / M.Sc (Geography and Geospatial Technologies) Two year (Sem I & II).

Madam,

I am to invite your attention to Ordinances, Regulations and Syllabus relating to the M.A / M.Sc (Geography and Geospatial Technologies) under Faculty of Interdisciplinary Studies are hereby informed that the recommendations made by the Board of Studies in Geography at its meeting held on 13th May, 2025, and subsequently passed by the Board of Deans at its meeting held on 19th May, 2025 vide Item No. 8.5(N) have been accepted by the Academic Council at its meeting held on 20th May, 2025, vide Item No.8.27(N) and subsequently approved by the Management Council at its meeting held on 24th May, 2025, vide Item No.10 and that in accordance therewith, in exercise of the powers conferred upon the Management Council under Section 74(4) of the Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017) the following program with Ordinance for Title of the Program, Eligibility and Regulation numbers for Duration of Program, Intake Capacity, Scheme of Examinations, Standard of Passing and Credit Structure along with syllabus of M.A / M.Sc(Geography and Geospatial Technologies)(Sem I & II) (Appendix - 'A') have been introduced and the same have been brought into force with effect from the academic year **2025-26**.

The New Ordinances & Regulations as per NEP 2020 is as follows :-

Sr. No	Name of the Program	Ordinance no. for Title	Ordinance no. for Eligibility	
A	P.G Diploma in Geography and Geospatial Technologies	O.IMP - 45 A	O.IMP - 46 A	Two year
B	M. A / M. Sc (Geography and Geospatial Technologies)	O.IMP - 45 B	O.IMP - 46 B	
C	M. A / M. Sc (Geography and Geospatial Technologies)	O.IMP - 45 C	O.IMP - 46 C	One year

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Date : 25th June, 2025.

: 2 :

Regulation Nos	
Duration	R. IMP - 111
Intake Capacity	R. IMP - 112
Scheme of examination	R. IMP - 113
Standard of Passing	R. IMP - 114
Credit Structure	R. IMP - 115 A
	R. IMP - 115 B
	R. IMP - 115 C
	R. IMP - 115 D

(Dr. Prasad Karande)
REGISTRAR

A.C/8.27(N)/20/5/2025
M.C/10/24/5/2025

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans
- 2) The Dean, Faculty of Interdisciplinary Studies,
- 3) The Chairman, Board of Studies in Geography,
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Board of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Co - Ordinator, MKCL

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	Faculty of Humanities, Offg. Dean 1. Prof.Anil Singh Dranilsingh129@gmail.com Offg. Associate Dean 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
	Faculty of Commerce & Management, Offg. Dean, 1 Prin.Ravindra Bambardekar principal@model-college.edu.in Offg. Associate Dean 2. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in 3. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 4. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology Offg. Dean 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in Offg. Associate Dean 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, Offg. Dean 1. Dr. Anil K. Singh aksingh@trcl.org.in Offg. Associate Dean 2. Prin. Chadrashekhhar Ashok Chakradeo cachakradeo@gmail.com 3. Dr. Kunal Ingle drkunalingle@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW directr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

As Per NEP 2020

University of Mumbai



Title of the program

- | | | |
|---|---|----------------|
| A- P.G. Diploma in Geography and Geospatial Technologies | } | 2025-26 |
| B- M.A. / M.Sc. (Geography and Geospatial Technologies) (Two Year) | | |
| C- M.A. / M.Sc. (Geography and Geospatial Technologies) (One Year) - | | 2027-28 |

(for University Department of Geography)

**Syllabus for
Semester – Sem I & II**

Ref: GR dated 16th May, 2023 for Credit Structure of PG

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program O: <u>IMP- 45 A</u>	A	P.G. Diploma in Geography and Geospatial Technologies
	O: <u>IMP- 45 B</u>	B	M.A. / M.Sc. (Geography and Geospatial Technologies) (Two Year)
	O: <u>IMP- 45 C</u>	C	M.A. / M.Sc. (Geography and Geospatial Technologies) (One Year)
2	Eligibility O: <u>IMP-46 A</u>	A	Graduates in Geography and / or equivalent degree from any faculty from the recognised universities
	O: <u>IMP-46 B</u>	B	Graduates in Geography and / or equivalent degree from any faculty from the recognised universities
	O: <u>IMP-46 C</u>	C	Graduate with 4 year U.G. Degree (Honours / Honours with Research) with Specialization in concerned subject or equivalent academic level 6.00 OR Graduate with four years UG Degree program with maximum credits required for award of Minor degree is allowed to take up the Post graduate program in Minor subject provided the student has acquired the required number of credits as prescribed by the concerned Board of Studies.
3	Duration of program	A	1 Year
		B	2 Year

	R: <u>IMP- 111</u>	C	1 Year
4	R: <u>IMP- 112</u> Intake Capacity	75	
5	R: <u>IMP- 113</u> Scheme of Examination	NEP 50% Internal 50% External, Semester End Examination Individual Passing in Internal and External Examination	
6	Standards of Passing R: <u>IMP- 114</u>	40%	
7	Credit Structure <u>R: IMP- 115 A</u> <u>R: IMP- 115 B</u> <u>R: IMP- 115 C</u> <u>R: IMP- 115 D</u>	Attached herewith	
8	Semesters	A	Sem. I & II
		B	Sem. I, II, III& IV
		C	Sem. I & II
9	Program Academic Level	A	6.0
		B	6.5
		C	6.5
10	Pattern	Semester	
11	Status	New	
12	To be implemented from Academic Year Progressively	A	2025-26
		B	
		C	2027-28

Sd/-

**Sign of the BOS
Chairman
Dr. Rajaram B. Patil
Board of Studies in
Geography**

Sd/-

**Sign of the
Offg. Associate
Dean
Dr. C.A.Chakradeo
Faculty of
Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. Kunal Ingle
Faculty of
Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Dean
Prof. A. K. Singh
Faculty of
Interdisciplinary
Studies**

(As per NEP 2020)

PREAMBLE

1. Introduction:

Geography is interdisciplinary subject that integrates natural sciences and social science to create an interface for both the streams to converge and produce an integrated sphere of knowledge. Geography has yet another unique dimension and that is the application of Geospatial technologies which has further enhanced the scope of geography. The combined knowledge of Geography and Geospatial technologies has enabled geographers to emerge confidently in various fields of research, analysis, planning and implementation. Taking into consideration the recent advancements in Geography and Geospatial Technology, the department aims at offering the knowledge and training under four heads :

- Physical Geography,
- Human Geography,
- Applied Geography and
- Geospatial technologies

The Masters of Arts and Masters of Science in Geography offers combination of sub disciplines belonging to these four categories. The choices are given to students to select various papers under these categories.

Sub disciplines of Earth System Science is largely based to study:

- Various geomorphic systems and processes.
- Various astrophysical and geological processes that produce and shape the features of earth.
- Evolution of atmospheric, environmental, oceanic and terrestrial systems and study genesis and development of various land forms, oceanic currents and ecosystems in general.
- The changes and transformations in natural elements and assess their impact on life.
- Natural disasters – their mitigation, adaptation and proposed resilience measures.

Sub disciplines of Human Geography helps:

1. To understand the interaction and interconnectedness between the human and physical systems to understand how they shape landscapes and cultures together.
2. To explore the spatial patterns of development and organisation of various kinds of economic, socio-cultural and political activities across various scales
3. The study the spatial variations and intersectionalities that shapes a complicated pattern of demography, migration, culture, politics that shapes everyday life.
4. To study the processes of exclusion, marginalisation, polarisation at social, societal, political and economic levels
5. To suggest various planning and policy measures at regional, local and national level
6. To analyse the impact of media, telecommunication, etc. on society
7. To inculcate the comprehensive understanding of human systems and encourage to arrive at appropriate suggestions

Applied Geography

1. To understand the impact of anthropogenic interventions on earthen systems like environment, atmosphere, etc. and resources like water, energy and so on

2. To track the evolutionary development of various resources, factors and processes that impact the state of resources and their connectedness with the social wellbeing
3. To strike for equitable efficient, optimum utilisation and distribution of resources
4. To promote the values of sustainable and eco-friendly pattern of production, consumption and distribution

Geospatial technologies

1. Understanding the basic principles of remote sensing and GIS
2. Application of geospatial technologies in various fields of Physical Geographical Analysis
3. Application of geospatial technologies in various fields of Human Geography and Ecology
4. Environmental Resource Mapping
5. Mapping, monitoring, planning and management of various spaces - urban, rural, and tribal

The interdisciplinary and multidisciplinary approaches in learning, research, explorations and solutions with the central role geography would play in near future the department has planned Masters in Geography with specialisations in following broad categories

- A. Earth System Science
- B. Urban and Regional Development and Planning
- C. Climate Change Science and Sustainability Studies
- D. Human Geography and the Human Systems
- E. Geospatial Technologies

2. Aims and Objectives:

The University of Mumbai is committed *to always remain inclusive and quality conscious, and with deep conviction that knowledge not only improves the quality of life, but leads to good character, to capitalize on our inherent advantages to generate skilled manpower for nation building through excellent teaching, attracting talent, fostering creativity, research, and innovation.*

The Department of Geography offers two-year M.A.(Geography) and M.Sc. (Geography). The Vision and Mission of the discipline specific outcomes following the larger aims and objectives are:

- Culminating the integrated understanding of Place, Space and Time through *Integrating classroom teaching, laboratory exercises, and study tours to correlate the theoretical phenomenon with ground reality by fieldwork.*
- To offers integrated and multidisciplinary knowledge, understanding and output.
- Quality, inclusivity and multiplicity through
 - Research
 - Skill and capacity building
 - Nurture finest professionals and individuals through participation in various academic, extra and co-curricular activities
- Technical and scientific attitudes and professional skills

3. Learning Outcomes:

Students who complete the course will understand the following

- The students will attain professional skills required in the industry, research, and academia.
- Develop critical understanding, scientific attitude and analytical skills
- Be aware and sensitised about universal values and ethics, professionalism and rational approach through the most appropriate curriculum

4. Any other point (if any):

- During the course work students will be provided hands on training on vital skills of land survey, Cartography, remote sensing and GIS in terms of technological acquaintances which will create opportunities for them in terms of employment opportunities. Students will be sent for on-job training for acquiring the professional skills.
- Students would also work with government / public institutions and administrative offices, non-governmental organization and other such institutions on various social, economic, political issues, problems and solutions as a part of on-job training.
- Students will be provided internship at various industries, non-governmental organisations and public and administrative institutions and so on.
- The curriculum is designed in such a manner that the students would earn 34 credits for specialization out of total 88 credits.
- Collaborate with national and international educational and research institutions, non-governmental organisations, researchers/industries for the development of high-end new generation technologies like AI.

Special Note : The postgraduate programs M.A. (Geography and Geospatial Technologies) and M.Sc. (Geography and Geospatial Technologies) in regular mode are equivalent. This course is exclusively designed for the University Department of Geography. The course will be exclusively implemented by the Department of Geography, University of Mumbai as a standalone course.

5. Credit structure of the program (Sem I, II, III & IV)

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Post Graduate Programs in University

Parishista 1

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT / FP	RP	Cum . Cr.	Degree
			Mandatory*	Electives Any one					
I	6.0	Sem I	GEOG 501 Advanced Concepts in Physical Geography – I (4*) (TH) GEOG 502 Modern Perspectives in Human Geography – I (4*) (TH) GEOG 503 Principles of Remote Sensing and GIS (4*) (TH) GEOG 505 Practical Components of Geoinformatics (2*) (PR)	GEOG 506 (01 to 11) Specialisations Credits 4 A. Earth Systems Science - I B. Urban and Regional Planning - I C. Climate Change Science and Sustainability Studies - I D. Human Geography and the Human Systems - I E. Geospatial Technologies - I	GEOG 504 Research Methodology in Geography and Geospatial Technologies (4*) (PR)			22	PG Diploma (after 3 Year Degree)
		Sem II	GEOG 507 Advanced Concepts in Physical Geography –II (4*) (TH) GEOG 508 Modern Perspectives in Human Geography – II (4*) (TH) GEOG 509 Tools and Techniques of Geographical and Spatial Analysis - I (4*) (PR) GEOG 511 Modern Land Surveying and mapping methods (2*) (PR)	GEOG 512 (01 to 11) Specialisations Credits 4 A. Earth System Science - II B. Urban and Regional Planning - II C. Climate Change Science and Sustainability Studies - II D. Human Geography and the Human Systems - II E. Geospatial Technologies - II	GEO G 510 4*			22	
		Cum. Cr. For PG Diploma		28	8	4	4	-	44

Exit option: PG Diploma (44 Credits) after Three Year UG Degree									
II	6.5	Sem III	GEOG 601 Advanced Concepts in Physical Geography- III (4*) (TH) GEOG 602 Modern Perspectives in Human Geography - III (4*) (TH) GEOG 603 Tools and Techniques of Geographical and Spatial Analysis - II (4*) (PR) GEOG 604 Landuse and land cover Change Analysis through Geospatial Data and technologies (2*) (PR)	GEOG 606 Specialisations 4* A. Earth System Science - III B. Urban and Regional Planning - III C. Climate Change Science and Sustainability Studies - III D. Human Geography and the Human Systems - III E. Geospatial Technologies - III			GEOG 605 Dissertation 4*	22	PG Degree After 3-Yr UG
		Sem IV	GEOG 607 Advanced Concepts in Physical Geography- IV (4*) (TH) GEOG 608 Modern Perspectives in Human Geography- IV (4*) (TH) GEOG 609 Tools and Techniques of Geographical and Spatial Analysis - III (4*) (PR)	GEOG 611 Specialisations - Credits 4 A. Earth System Science - IV B. Urban and Regional Planning - IV C. Climate Change Science and Sustainability Studies - IV D. Human Geography and the Human Systems - IV E. Geospatial Technologies - IV			GEOG 610 Dissertation 6*	22	
	Cum. Cr. for 1 Yr PG Degree		26	8			10	44	
Cum. Cr. for 2 Yr PG Degree		54	16	4	4	10	88		

Sign of the HOD
Prof. Sanjukta Sattar

Sign of the Dean
Prof. (Dr.) Anil Kumar Singh

M.A. / M.Sc. (Geography and Geospatial Technologies)
Semester I

Subject Code	Course Title	Category	Credits	Hours
GEOG 501	Advanced Concepts in Physical Geography – I	Mandatory (Theory)	4	60
GEOG 502	Modern Perspectives in Human Geography – I	Mandatory (Theory)	4	60
GEOG 503	Principles of Remote Sensing and GIS	Mandatory (Theory)	4	60
GEOG 504	Research Methodology in Geography and Geospatial Technologies	Mandatory (Practical)	4	120
GEOG 505	Practical Components in Geoinformatics	Mandatory (Practical)	2	60
	Earth System Science (Specialisation I)			
GEOG 50601	Hydrology I - Integrated Watershed Planning and Sustainable Management	Elective (Theory)	4	60
GEOG 50602	Coastal Systems and Geospatial Technology	Elective (Theory)	4	60
GEOG 50603	Unstable Terrains, Changing Climate and Disaster Management	Elective (Theory)	4	60
	Urban and Regional Planning (Specialisation II)			
GEOG 50604	Fundamentals of Urban and Regional Planning - I	Elective (Theory)	4	60
	Climate Change and Sustainability Studies (Specialisation III)			
GEOG 50605	Science and Theory of Climate Change	Elective (Theory)	4	60
	Human Geography and the Human Systems (Specialisation IV)			
GEOG 50606	Global Perspectives in Geopolitics	Elective (Theory)	4	60
GEOG 50607	Geography of Tourism and Recreation	Elective (Theory)	4	60
GEOG 50608	Population Geography – I	Elective (Theory)	4	60
GEOG 50609	Geography of Society and Culture – I	Elective (Theory)	4	60
	Geospatial Technologies (Specialisation V)			
GEOG 50610	Fundamentals of Earth Observation	Elective (Theory)	4	60
GEOG 50611	Digital Cartography - Visualization and Dissemination of Geodata	Elective (Theory)	4	60

M.A. / M.Sc. (Geography)
Semester II

Subject Code	Course Title	Category	Credits	Hours
GEOG 507	Advanced Concepts in Physical Geography – II	Mandatory (Theory)	4	60
GEOG 508	Modern Perspectives in Human Geography – II	Mandatory (Theory)	4	60
GEOG 509	Tools and Techniques of Geographical and Spatial Analysis – I	Mandatory (Practical)	4	120
GEOG 510	On-the-job Training / Internship	Mandatory (Practical)	4	120
GEOG 511	Modern Land Surveying and Mapping Methods	Mandatory (Practical)	2	60
Earth System Science (Specialisation I)				
GEOG 51201	Hydrology - II Hydrology and Water Intelligence	Elective (Theory)	4	60
GEOG 51202	Morphodynamics of Fluvial Systems	Elective (Theory)	4	60
GEOG 51203	Seismic Hazard Management	Elective (Theory)	4	60
Urban and Regional Planning (Specialisation II)				
GEOG 51204	Fundamentals of Urban and Regional Planning - II	Elective (Theory)	4	60
Climate Change and Sustainability Studies (Specialisation III)				
GEOG 51205	Climate Change Mitigation to Sustainability	Elective (Theory)	4	60
Human Geography and the Human Systems (Specilisation IV)				
GEOG 51206	Indian Foreign Policy	Elective (Theory)	4	60
GEOG 51207	Fundamentals of Tourism Development and Planning	Elective (Theory)	4	60
GEOG 51208	Population Geography – II	Elective (Theory)	4	60
GEOG 51209	Geography of Society and Culture – II	Elective (Theory)	4	60
Geospatial Technologies (Specialisation V)				
GEOG 51210	Geospatial Information Processing	Elective (Theory)	4	60
GEOG 51211	Applied Remote Sensing and GIS in Earth System Studies	Elective (Theory)	4	60

GEOG 51212	Advanced Geospatial Analysis	Elective (Theory)	4	60
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Baskets of electives:

Semester	Course Code	Course Name	Credits
I	GEOG 50601	Hydrology - I Integrated Watershed Planning and Sustainable Management	4
I	GEOG 50602	Coastal Systems and Geospatial Technology	4
I	GEOG 50603	Unstable Terrains, Changing Climate and Disaster Management	4
I	GEOG 50604	Fundamentals of Urban and Regional Planning-I	4
I	GEOG 50605	Science and Theory of Climate Change	4
I	GEOG 50606	Global Perspectives in Geopolitics	4
I	GEOG 50607	Geography of Tourism and Recreation	4
I	GEOG 50608	Population Geography - I	4
I	GEOG 50609	Geography of Society and Culture - I	4
I	GEOG 50610	Fundamentals of Earth Observation	4
I	GEOG 50611	Digital Cartography - Visualization and Dissemination of Geodata	4
II	GEOG 51201	Hydrology - II Hydrology and Water Intelligence	4
II	GEOG 51202	Morphodynamics of Fluvial Systems	4
II	GEOG 51203	Seismic Hazard Management	4
II	GEOG 51204	Fundamentals of Urban and Regional Planning - II	4
II	GEOG 51205	Climate Change Mitigation to Sustainability	4
II	GEOG 51206	Indian Foreign Policy	4
II	GEOG 51207	Fundamentals of Tourism Development and Planning	4
II	GEOG 51208	Population Geography – II	4
II	GEOG 51209	Geography of Society and Culture – II	4
II	GEOG 51210	Geospatial Information Processing	4
II	GEOG 51211	Applied Remote Sensing and GIS in Earth System Studies	4
II	GEOG 51212	Advanced Geospatial Analysis	4

Guidelines and Instructions

1. Kindly refer to the nomenclature used in the curriculum

DSC – Discipline Specific Core	CIE – Class Internal Evaluation
DSE – Discipline Specific Electives	ESE – External Semester Evaluation

2. 50 marks Internal (CIE) and 50 External (ESE) evaluations will be done.

- 3. Students are expected to complete on-the-job training as it is a compulsory component under the National Educational Policy 2020.**
- 4. Every student need to complete Research project for 10 credits which is a compulsory component under National Educational Policy 2020.**
- 5. There are five broad specialisations. Within each specialization, there are sub-specialisations. Students are expected to select one specialisation in the component of electives. They are expected to complete all four semesters with the same specialization. Within each specialization, students are offered the flexibility of selecting and switching among the sub-specialisation of their choice.**

M.A. / M.Sc. (Geography and Geospatial Technologies)

Semester I

Semester I

Title of the Course – Advanced Concepts in Physical Geography – I					
Year – 1			Semester – I		
Course Type	Course code	Credit Distribution	Credits	Allotted Hours	Allotted Marks

DSC – 1	GEOG 501	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To enhance the understanding of the students about geomorphic, atmospheric, oceanographic and hydrologic systems.
2. To make the students understand the interrelations between the various earth systems.
3. To reveal the evolutionary aspects of the lithosphere, atmosphere, oceanosphere and hydrosphere.

Course Outcomes:

CO 1. The students will be able interpret and interconnect the various geologic, atmospheric, oceanographic and hydrologic phenomena.

CO 2. The understanding of the origin of the earth, tectonics, Geological time scale and contemporary earth processes.

CO 3. Understand the history of the ocean, properties of seawater.

CO 4. Understand and acquire knowledge on waves and tides.

CO 5. Complete understanding of the calculation of the mean rainfall over basin

CO 6. Understanding the concepts of rainfall runoff and groundwater

Detailed Syllabus:

Unit 1: The Earth System Science (15 Hours)

- 1.1 The origin and the evolution of the earth – big bang theory, formation of the Earth
- 1.2 The Earth's interior: structure and composition, seismic waves and exploration for the earth's interior, deep drilling experiments
- 1.3 Tectonics of the earth and Endogenic movements and related landforms
- 1.4 Geological time scale, geologic periods and climate change, recently proposed geological epoch (Anthropocene)

Unit 2: Atmosphere and climate (15 Hours)

- 2.1 Origin and evolution of structure and composition of the earth's atmosphere,
- 2.2 Relationship of Climatology with Meteorology, Weather elements and climatic controls
- 2.3 Insolation and heat Budget of the Earth, Temperature - Vertical, horizontal and seasonal variations,
- 2.4 Processes heat energy transfer; Inversion of temperature

Unit 3: Oceanography (15 Hours)

- 3.1 History of Oceanography- Understanding the ocean with voyaging for trade and exploration, water, and ocean structure.
- 3.2 Ocean water- Thermal properties of ocean water - major dissolved nutrients and gases, Light and Sound propagation, Density and salinity of seawater
- 3.3 Wave generation – growth and decay, Classification – factors influencing oceanic waves
- 3.4 Generation of tides – types of tides, tidal constituents.

Unit 4: Hydrology (15 Hours)

- 4.1 Hydrology as a Science- Physical and Chemical Properties of Water
- 4.2 Concept of Catchment or river basin - Hydrological cycle – The global hydrological cycle
- 4.3 Mean rainfall over drainage basin – calculation methods - radar and satellite methods
- 4.4 Characteristics of Rain-storm

Suggested reading materials:

For UNIT 1 and UNIT 2:

1. Barry, R.S. & Chorley, R.J. (1971). *Atmosphere, Weather and Climate*, ELBS, Methuen & Co. Ltd., U.S.A.
2. Gardner, M. B. (1914). A journey to the earth's interior, or, have the poles really been discovered? *Bulletin of the American Geographical Society*, 46(7), 543.org (Crossref). <https://doi.org/10.2307/200943>
3. Gradstein, F. M. et al. (2014). *The geologic time scale 2012 2-volume set*. Elsevier Science.
4. Griffiths, J. F. (1966). *Applied climatology-an introduction*. Oxford University Press.
5. Karlekar, S. N. (2016). *Terms and concepts in geomorphology, oceanography and climatology: With essential diagrams and illustrations Dimond publication*.
6. Knoll, A. H. A brief history of Earth: Four billion years in eight chapters. *First Mariner Books paperback edition*. Mariner Books. (2023).
7. Lal, D. S. (1997). *Climatology, Sharda pustak Bhawan, Allahabad*.
8. Lefkowitz, R. J., & Yake, J. C. (1976). *Forces in the earth: A book about gravity and magnetism*. Parents' Magazine Press.

For UNIT 3 and UNIT 4:

9. Dingman, S. L. (2015). *Physical Hydrology. 2nd edition*, Prentice Hall.
10. Hawkins, S. J., Allcock, A. L., Bates, A. E., Firth, L. B., Smith, I. P., Swearer, S. E., & Todd, P. A. (2019). *Oceanography and Marine Biology: An annual review. Volume 57*. CRC Press.
11. Hornberger, G. M., Wiberg, P. L., Raffensperger, J. P., & D'Odorico, P. (2014). *Elements of Physical Hydrology*. JHU Press.
12. Singh, V. P. (1992). *Elementary Hydrology*. Pearson College Division.
13. Subramanya, K. (2013). *Engineering Hydrology*. Tata Mc-Graw Hill
14. Todd, D. K., & Mays, L. W. (2007). *Groundwater Hydrology*. John Wiley & Sons.
15. Thurman, H. V. (2011). *Essentials of oceanography*. 10th edition, Prentice Hall. <http://ci.nii.ac.jp/ncid/BB00668465>
16. Vallis, G. K. (2019). *Essentials of Atmospheric and Oceanic Dynamics*. Cambridge University Press.
17. Viessman, W., & Lewis, G. L. (2003). *Introduction to Hydrology*. Pearson.

Title of the Course – Modern Perspectives in Human Geography - I

Year – 1

Semester - I

Course Type	Course code	Credit Distribution	Credits	Allotted Hours	Allotted Marks
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DSC – 1	GEOG	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To study the evolution and growth of different spaces like urban, rural and tribal
2. To understand the evolution of human geography and geographical thoughts and its nature and scope
3. To understand the basic concepts like development, underdevelopment and associated patterns of disparity
4. To understand the demographic processes

Course Outcomes:

CO 1. The students are expected to be very well versed with the complex nature of human societies and develop a holistic understanding.

CO 2. Issue based analysis and problem solving approaches would be learned by the students.

CO 3. Student are expected to develop scientific approach through logical and rational thinking

Unit 1 : Nature of Changes in Human Geography

(15 Hours)

1.1 Definitions and key concepts; periods of development – ancient classical, medieval, modern; major Schools of Geographical Thought – German, French, British, Russian, American; Contribution of Indian geographers

1.2 Man-environment relationship – Determinism, Possibilism, Neo-Determinism, Darwinism, cultural and social determinism;

1.3 Geographic approaches and methods in 1950s & 1960s - Quantitative revolution, Positivism, Areal differentiation and spatial organization- Hartshorne Schaefer debate, Locational analysis, nomothetic approaches; Models in Geography - Gravity and Spatial interaction Models

1.4 Paradigm Shift - Kuhn's concept, evolution of principal ideas/ perspectives in Geography

Unit 2 : Geography of Settlement

(15 Hours)

2.1 Rural Settlements (types, patterns, and distribution) - Contemporary Problems of Rural Settlements - Rural society: caste hierarchy, segregation in rural settlement – rural social morphology – critical understanding of Agricultural Land use theory

2.2 Tribal societies - Origin and Distribution - India and the World - Socio-economic status of tribal societies in India - efforts of empowerment and welfare in Indian society

2.3 Theories of Origin of Towns - Gordon Childe, Henri Pirenne, Lewis Mumford - Urban Systems - the law of the primate city and rank size rule - Central Place Theories - Christaller and Losch - Internal Structure of the City - Models of Urban Land – Classical economic theories on urban land use

2.4 Spatial dimensions of urbanisation - patterns, process and characteristics of urbanisation in changing geographical settings - Changing urban forms - Concepts of Megacities, Global Cities and Edge Cities

Unit 3 : Demographic Processes : Patterns and spatial distribution

(15 Hours)

3.1 Demographic Processes – fertility, mortality and associated patterns - Demographic characteristics - developing and developed countries - Indian Examples

3.2 Population Growth – Attitudes and Interpretations – Malthusian, Neo-Malthusianism and Marxist viewpoint - Demographic transition theory – concept of Demographic dividend and Demographic Window - Indian Examples

- 3.3 Population, Resources and Development - Optimum population, overpopulation and underpopulation – Recent World Views
- 3.4 Migration- early and subsequent migration – scales of migration - Types of migration – Impacts of Migration - Contemporary Trends in migration

Unit 4 : Concepts of Development and Underdevelopment (15 Hours)

- 4.1 Economic growth and development - Ingredients and factors- Spatial and aspatial aspects
- 4.2 Theories of Growth and Development – Rostow’s stages of economic growth – Growth pole theory – - Core-periphery model - Circular and Cumulative causation theory
- 4.3 Concept of underdevelopment - Unequal Exchange and theories of underdevelopment - political economy of growth - theories of dependency
- 4.4 Recent theories on poverty and inequality - Capability approach by Amartya Sen and other contemporary theories

Suggested reading materials:

1. Aitken, S and Valentine, G. (2006), Approaches to Human geography, Sage.
2. Johnston, R.J., Gregory D. Pratt G. and Watts M., (2005, 5th ed.), the Dictionary of Human Geography, Blackwell.
3. Kitchin R., Thrift, N, (eds.) (2009), The International Encyclopedia of Human Geography, Elsevier.
4. Benko, G. and Strohmayer, U. (2004), Human Geography, a History for the 21st Century, Arnold, London.
5. Cloke, P., Crang, P., Goodwin, M., (2004), Envisioning Human Geographies, Arnold.
6. Cloke, P. and Johnston, R., (eds.), (2005), Spaces of Geographical Thought, Deconstructing Human Geography’s Binaries, Sage.
7. Atkinson, D., Jackson, P., Sibley, D. and Washbourne, N. (eds.) (2005), Cultural Geography, A Critical Geography of Key Concepts, Tauris, I.B.
8. Norton William, (2002), Human Geography, Oxford, 4th edition
9. Barnes, T. and Gregory, D., 1997, Reading Human geography, Arnold.
10. Smith, D. M. (1977): Human Geography, A Welfare Approach, Arnold
11. Peet, R. (ed) (1987): Radical Geography, Maroufa Press, Rawat, New Delhi, 2003
12. Ambrose, P. G. (1969): Analytical Human Geography, Longman, London
13. De Blij, H. J. (1986): Human Geography, John Wiley & Sons, New York.
14. Vivel, F. R. (1978): Cultural Anthropology, McGraw Hill, USA.
15. Peet R. and Thrift, N. (eds) (1989): New Models in Geography, Vol. I & II, Unwin Hyman.
16. Ahmed, A. (1999). Social Geography, Rawat Publication, New Delhi.
17. Massey, D, Alien, J, P, Jarre, P (eds) (1999): Human Geography Today, Cambridge Polity Press.
18. Harvey, D. (1969). *Explanation in Geography*. Edward Arnold.
19. Johnston, R.J. et.al. (ed.) (1986). *The Dictionary of Human Geography*. Blackwell.
20. <https://idrc-crdd.ca/en/books/analysis-multidimensional-poverty-theory-and-case-studies>
21. <https://www.ajol.info/index.php/jsd/article/view/216336>
22. Frank, A. (1975). ‘On capitalist Underdevelopment’. Oxford University Press.
23. Caroline, T. and Peter W. (ed.) (1997). Globalization and South. Macmillan Press Ltd.
24. Desai, V. and Potter B. (eds.) (2011). The Companion to Development Studies. A Hodder – Viva Edition, London.

Title of the Course – Principles of Remote Sensing and GIS

Year – 1			Semester - I					
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC – 1	GEOG 503	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To make students understand the basics of Remote Sensing and GIS
2. To expose the students to the technologies of GPS and Databases

Course Outcomes:

CO 1. The students will be able to practically use the knowledge of remote sensing, GIS and GPS for handling satellite images and spatial data

CO 2. The students will be able to understand the applications of DBMS in GIS

Unit I - Fundamentals of Remote Sensing

(15 hours)

- 1.1 Remote Sensing: Definition and Concept, Process of Remote Sensing
- 1.2 Electromagnetic Spectrum: Definition and Concept, interactions with atmosphere and earth's surface, Atmospheric window, Black body
- 1.3 Spectral Reflectance Curve: Concept, curves for land, water bodies/oceans, vegetation In Optical, IR, Thermal and Microwave bands
- 1.4 Fundamentals of aerial photography: Concept of stereoscopy and photogrammetry, geometric types of aerial photographs, photographic scale, measurements of distance, area and height, relief displacement, stereoscopic parallax, flight planning.

Unit II – Satellite Orbits and Platforms

(15 hours)

- 2.1 Platforms and Orbits: types of platforms, types of orbits
- 2.2 Resolutions and Sensors: Types of resolutions, Remote Sensors and types based on resolutions and sources of illumination, overview of space borne sensors.
- 2.3 Images - analog and digital formats - aerial photographs, satellite images and visual Image Interpretation: Image display and color composites, elements of visual image interpretation
- 2.4 Development of remote sensing – Global and Indian

Unit III – Fundamentals of Databases

(15 hours)

- 3.1 Databases: Data storage, basic file structures, types of database, advantages of database, spatial and non-spatial databases, scales of measurement, Entity – Relationship Model, SQL,
- 3.2 Geographic Information System: Definition, concept, components, functions and applications.
- 3.3 Spatial Data Models: Vector and Raster, Vector representation (point, line, area and TIN), Concepts of arc, node, vertices and topology.
- 3.4 Coordinate Reference Systems: Geographic and Projected, Map Projections and Datum for GIS data.

Unit IV – Spatial Analysis and GPS

(15 hours)

- 4.1 Vector-based spatial analysis: single layer operations (extraction and proximity) and multilayer operations (overlay operations)
- 4.2 Raster-based spatial analysis: Georeferencing, Spatial Interpolation and raster generation, raster reclassification, arithmetic, relational and logical operations
- 4.3 Global Positioning System: Segments of satellite-based positioning systems, main systems –

NAVSTAR, GLONASS, Galileo and Indian GPS

4.4 Principles of positioning and Datum: Positional Accuracies, Relative Positioning, errors and sources, concept of datum and widely used datums for GPS.

Suggested Reading Materials:

1. Agrawal, N. K. (2006). *Essentials of GPS* (2nd ed.). Book Selection Centre, Hyderabad.
2. American Society of Photogrammetry. (1983). *Manual of remote sensing*. ASP.
3. Barrett, E. G., & Curtis, L. F. (1992). *Fundamentals of remote sensing and air photo interpretation* (7th ed.). McMillan.
4. Bernhardsen, T. (2002). *Geographical information systems: An introduction* (3rd ed.). John Wiley & Sons, Inc.
5. Burrough, P. A., & McDonnell, R. A. (1998). *Principles of geographical information systems*. Oxford University Press.
6. Campbell, J. (1989). *Introduction to remote sensing*. Guilford Press.
7. Clarke, K. C. (1998). *Getting started with geographic information systems*. Prentice Hall.
8. Curran, P. J. (1988). *Principles of remote sensing*. Longman.
9. Heywood, I., Cornelius, S., & Carver, S. (2002). *An introduction to geographical information systems*. Pearson Education Limited.
10. Jonson, R. J. (2003). *Remote sensing of the environment: An earth resources perspective*. Pearson Education.
11. Joseph, G. (2009). *Fundamentals of remote sensing*. Universities Press (India) Pvt. Ltd.
12. Lillesand, T., & Kiefer, R. W. (1994). *Remote sensing and image interpretation*. John Wiley & Sons.
13. Parker, R. N. (2008). *GIS and spatial analysis for the social sciences*. Routledge.
14. Longley, P. A. (2005). *Geographic information systems and science*. John Wiley & Sons.
15. Pickles, J. (2006). *The social implications of geographic information systems*. Rawat Publications.
16. Star, J., & Estes, J. (1996). *Geographical information systems: An introduction*. Prentice Hall.
17. Shekhar, S., & Chawla, S. (2009). *Spatial databases: A tour*. Pearson Education.
18. Tempfli, T. K., Kerle, N., Huurneman, G. C., & Janssen, L. L. F. (2009). *Principles of remote sensing*. ITC.

Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC – 1	GEOG 504	Theory	Practical	04	120	CIE	ESE	Total
		00	04			00	100	100

Course Objective:

1. To enable students to comprehend the underlying principles of research in Geography.
2. To familiarize them with different types of data collection and data analysis techniques ,
3. To write the discussion and conclusions, and following of research and publication ethics.

Course Outcome:

CO 1. After attending this course students will be well-versed in the conduction of research in geography using relevant data and appropriate research techniques.

CO 2. They will gain expertise in report writing and presenting their research outcomes effectively.

Unit 1 : Introduction to Research Methodology

(24 Hours)

1.1. Defining research- Methods of research - types - qualitative, quantitative, mixed- Scientific method in geographical studies, inductive and deductive, positive, interpretive and critical

1.2. Research Design – Research Problem identification and formulation - selection of research plan – the steps - Conducting Literature review- searching literature, writing the review and identifying research gap

1.3 Identifying sources and methods of geographical data collection: collection of primary data - preparing questionnaires and schedules, conducting interviews , FGD

1.4 Collection of secondary data- reports, records, literature, newspaper, maps, etc. - Scales of measurements: Nominal, Ordinal, Ratio, and Interval

Unit 2 : Research Hypothesis Testing and Sampling

(24 Hours)

2.1. Meaning and types of hypothesis; Framing of Hypotheses: Problem identification, statement of hypothesis

2.2. Hypothesis testing (parametric/non-parametric) – testing for – i) Mean, ii) proportion iii) variance iv) difference of two mean v) difference of two proportion vi) difference of two variances , *p*-value approach.

2.3 Sampling: Meaning & types of sampling - determination of sample size

2.4 Sampling Intervals – Level of Significance and level of Confidence

Unit 3 : Use of Quantitative and Qualitative Techniques

(24 Hours)

3.1 Choice of statistical techniques for data analysis - types of variables - Quantitative, Categorical, experimental and other types

3.2 Central tendency - arithmetic mean and weighted mean - Concept of deviation - standard deviation - skewness and Kurtosis

3.3 Interpretation of visuals and nonvisual techniques of spatial analysis

a. From various sources: NATMO, Phillips Atlas, Oxford Economic Atlas and Census Atlas of India, Women and Children Atlas, Atlas of Religion, Historical Atlas of South Asia, Planning Atlas, etc.

- b. From documentaries, films, photographs, and cartoons as sources of spatio-social data.
- 3.4 Explanation of qualitative analysis: Ethnographic transcripts, experiential data and narrative data, newspaper and literary data

Unit 4 : Scientific Report Writing and Publishing

(24 Hours)

- 4.1. Introduction- aim and objectives, data and methodology
- 4.2. Data analysis, result discussion, conclusion
- 4.3. Referencing system, weblography and bibliography, plagiarism testing, research & publication ethics,
- 4.4. Comprehending impact factor, citation, DOI, identifying journals according to journal metrics

Unit 5 : Skill Enhancement

(24 Hours)

- 5.1 Soft Skill: Academic communication, Presentation skill, Body language
- 5.2 Computational Skill: MS Office, Adobe, Google Workspace,
- 5.3 Software used in Reference management such as Mendeley, Zotero.
- 5.4 Any two freeware softwares used for research methodology diagram preparation

Suggested Reading Material

- 1) . Karlekar Shrikant and Kale Mohan (2005). *Statistical analysis of Geographical data*. Dimond publication
- 2) Burt, J.E. and Barber, G.M.(1996). *Elementary statistics for Geographers*. The Guilford press.
- 3) Clark, W.A.V. and Hosking, P.C(1986). *Statistical Methods for Geographers*, John Wiley & Sons.
- 4) Dickinson, G.C.(1977). *Statistical Mapping and presentation of statistics*. Edward Arnold limited
- 5) Ebdon David (1989). *Statistical for Geographers*
- 6) Geoge Joseph (2003). *Fundamental of Remote Sensing*. Universities Press.
- 7) Gregory, S.(1963). *Statistical Methods and Geographer* Longman Group Ltd.
- 8) Kanetkar T. P. &Kulkarni S.V. (1986). *Surveying & leveling*, VidyarthiGrihaPrakshan.
- 9) Keates, J.S.(1973). *Cartographic design and production* 2nd Edition. Longman group
- 10) Kothari, C.R. & Garg, G. (2014). *Research Methodology*. New Age International Publishers.
- 11) Murthy, N. K.L. (2014). *Research Methodology in Geography*. Concept Publishing Company PVT. LTD.
- 12) Robinson, G.M. (1998). *Methods & Techniques in Human Geography*. John Wiley & Son.

Title of the Course – The Practical Components of Geoinformatics

Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC – 1	GEOG 505	Theory	Practical	02	60	CIE	ESE	Total
		00	02			00	50	50

Course Objectives:

1. Main objective is to learn how to analyze information about the Earth from RS and GIS data with raster and vector data models using specific tools in Geo-Informatics domain.

Course Outcomes:

At the end of the practical course students must be able to practically:

- CO 1. Understand raster and vector data models.
- CO 2. Learn basic algorithms to process raster and vector data models.
- CO 3. Learn to integrate raster and vector data models.
- CO 4. Learn Geo-spatial data processing with Open Source RS and GIS software.
- CO 5. Generate output from Geo-spatial data i.e. maps, tabular data and statistical information.
- CO 6. Design and carry out sequentially Geo-spatial data processing steps.
- CO 7. Understand capabilities of Geo-Informatics.

Unit 1 : Raster Data Analysis and Interpretation (30 Hours)

- 1.1 Georeferencing - GCP inputs, assigning projection and datum, resampling methods.
- 1.2 Applications of raster calculator: Arithmetic, relational and logical operations; Calculation of NDVI, land cover extraction from NDVI, raster classification and measurement.
- 1.3 Spatial Interpolation: meaning and methods- IDW, Ordinary Kriging.
- 1.4 Digital Elevation Model Analysis: Prerequisite on datum, projection, spatial resolution; Preparation average rainfall map- Arithmetic mean method, Thiessens polygon method, Isohyetal method-Delineation of River Basin; computation of flow direction, flow accumulation, extraction of streams; computation of land surface parameters; computation of morphometric parameters- elongation and circularity ratio, bifurcation ratio, stream frequency, drainage density.

Unit 2 : Vector Data Analysis and Interpretation (30 Hours)

- 1.1 Digitization: preparation of vector layer, shape file, linking attribute data.
- 1.2 Single layer operations: Feature identification, measurement, vector classification, extraction.
- 1.3 Multilayer operation: Data retrieval- Attribute and Spatial query; Point in polygon, Line in polygon, polygon in polygon; Union, intersection, symmetrical difference, update, merge, append and dissolve.
- 1.4 Presenting data: Map Layout and design, map composition.

Suggested Reading Material:

- 1. American Society of Photogrammetry (1983): Manual of Remote Sensing, ASP Palis Church, V.A.

2. Agrawal, N.K.(2006), Essentials of GPS (Second Edition), Book Selection Centre, Hyderabad
3. Barrett, E.G. and Curtis, L.F. (1992): Fundamentals of Remote Sensing in Air Photo-interpretation, McMillan, New York. 7.
4. Bernhardsen, Tor (2002): Geographical Information Systems: An Introduction, Third Edition, John Wiley & Sons, Inc., New York.
5. Burrough, Peter A and McDonnell, R.A. (1998): Principles of Geographical Information Systems, Oxford University Press, Mumbai.
6. Clarke, Keith C. (1998): Getting Started with Geographic Information Systems, Prentice-Hall Series in Geogl. Info. Science, Prentice-Hall, Inc. N.J.
7. Dykes, MacEachren & Kraak (eds.) (2005), Exploring Geovisualization
8. Gibson, P. J. (2000): 'Introduction to Remote Sensing - Principles and Concepts', Routledge - Taylor & Francis.
9. Heywood, I. et al (2002): An Introduction to Geological Systems, Pearson Education Limited, New Delhi.
10. Huisman O. and R.A. de By (ed.), 2009: Principles of Geographic Information Systems - An introductory textbook, 4th ed., ITC, ISBN 90-6164-269-5
11. Iliffe, J.C (2006), Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, New York.
12. Jonson. R. J. (2003): Remote Sensing of the Environment-An Earth Resources Perspective, Pearson Education Series in Geographical Information Science, Keith C. Clarke (Series editor) Pearson Educators Private Limited. (Singapore), New Delhi.
13. Joseph, G. (2009): Fundamentals of Remote Sensing, Universities Press (India) Pvt. Ltd., Hyderabad.
14. Kang-tsung Chang (2017) Introduction to Geographic Information Systems, McGraw Hill Education; 4th edition
15. Klaus Tempfli, Norman Kerle, Gerrit C. Huurneman, Lucas L. F. Janssen (2009) Principles of Remote Sensing, An introductory textbook, ITC, University of Twente, Enschede, The Netherlands.
16. Krygier & Wood (2005) Making maps: a visual guide to map design for GIS
17. Russ, J. C. (1992): The Image Processing Handbook, CRC Press SIUE Library call #: TA1632.R88 (reference).
18. MacEachren (1995), How map work
19. Menno-Jan Kraak and Ferjan Ormeling (2020) CARTOGRAPHY: Visualization of Geospatial Data, CRC press.
20. Michael N. DeMers (2009) Fundamentals of Geographic Information Systems, John Wiley & Sons.
21. Paul A. Longley, Michael F. Goodchild, David J. Maguire (2005) Geographic Information Systems and Science, 2nd Edition, John Wiley & Sons.
22. Star, Jeffrey and John Estes (1996), Geographical Information Systems: An Introduction, Prentice-Hall, inc., N.J.
23. Slocum et. Al. (2009), Thematic Cartography and Geovisualization
24. Sabins (Jr.) F. F. (1986), 'Remote Sensing - Principles and Interpretation', W. H. Freeman & Co., New York.
25. Sahu, K. C. (2008): Text Book of Remote Sensing and Geographical Information System, Atlantic Publishers and Distributors (P) Ltd., New Delhi.
26. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman (1015) Remote Sensing and Image Interpretation, 7th Edition
27. W. G. Rees (2012) Physical principles of remote sensing, Cambridge University Press.

Specialisation I : Earth Systems Science

Title of the Course: Hydrology - I : Integrated Watershed Planning and Sustainable Management

Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50601	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. Understand watershed concepts, delineation, and integrated approaches.
2. Learn soil erosion types, impacts, and conservation techniques.
3. Explore water harvesting methods and conservation strategies.
4. Gain skills in planning and evaluating watershed development projects.
5. Apply GIS, remote sensing, and participatory tools in watershed management.

Course Outcomes:

After completion of this course students will:

- CO 1. Delineate and classify watersheds using toposheets and GIS.
- CO 2. Assess soil erosion and recommend control measures using USLE/RUSLE.
- CO 3. Design water harvesting systems for rural and urban settings.
- CO 4. Prepare watershed development plans with economic and participatory inputs.
- CO 5. Integrate climate resilience and sustainability in watershed practices.

Unit 1: Watershed Concepts and Delineation

(15 Hours)

- 1.1 Watershed – Need for an integrated and multidisciplinary approach
- 1.2 Influencing factors – geology, soil, land use, and morphological characteristics
- 1.3 Toposheets – watershed delineation, codification, and catchment hierarchy
- 1.4 Watershed development – problems, prospects, and regional case studies
- 1.5 Introduction to GIS and Remote Sensing applications in watershed delineation and analysis

Unit 2: Soil Conservation and Erosion Control Measures

(15 Hours)

- 2.1 Soil conservation – importance and objectives; types of soil erosion – water and wind
- 2.2 Causes, factors, and impacts of soil erosion on watershed health
- 2.3 Soil conservation measures – agronomical (e.g., contour farming, mulching) and mechanical (e.g., bunding, terracing)
- 2.4 Estimation of soil loss – Universal Soil Loss Equation (USLE), Revised Universal Soil Loss equation (RUSLE) and its applications
- 2.5 Role of land use and vegetative cover in erosion control

Unit 3: Water Harvesting and Conservation Techniques

(15 Hours)

- 3.1 Water harvesting – need, objectives, and classification
- 3.2 Runoff harvesting – short-term and long-term techniques
- 3.3 Water harvesting structures – design principles, traditional systems in India, and modern adaptations
- 3.4 Non-structural water conservation measures – awareness, policies, water budgeting
- 3.5 Urban water harvesting systems and groundwater recharge

Unit 4: Watershed Management Practices and Planning

(15 Hours)

- 4.1 Watershed development in India – evolution, key programs, and national guidelines
- 4.2 Project proposal formulation – baseline data, watershed development plan, entry point activities, budget estimation
- 4.3 Watershed economics – cost-benefit analysis, grassland, wasteland, and forestry management
- 4.4 Evaluation and monitoring of watershed development projects – indicators and tools
- 4.5 Watershed management and climate resilience – role in Sustainable Development Goals (SDGs), disaster risk reduction, and community well-being
- 4.6 Participatory watershed management – community involvement, stakeholder roles, PRA tools

Suggested reading materials:

1. Bagdi, G. L., & Sharma, R. K. (2023). *Integrated watershed management: Principles and practices*. Satish Serial Publishing House.
2. Bhattacharyya, A. K. (2022). *Soil and water conservation engineering*. Oxford & IBH Publishing.
3. Chow, V.T., Maidment, D.R., & Mays, L.W. (1988). *Applied Hydrology*. McGraw- Hill.
4. Das, D. K. (2021). *Soil conservation and watershed management*. Kalyani Publishers.
5. Goyal, R. K., & Kaur, J. (2021). *Watershed management*. New India Publishing Agency.
6. Hudson, N. (2017). *Soil and water conservation in semi-arid areas*. Routledge. (Original work published by FAO)
7. Michael, A.M. (2010). *Irrigation: Theory and Practice* (2nd ed.). Vikas Publishing House Pvt. Ltd.
8. Murthy, J.V.S. (1994). *Watershed Management in India*. Wiley Eastern Limited.
9. Prasad, R. N. (2020). *Rainwater harvesting and watershed management*. Pointer Publishers.
10. Reddy, M. A. (2020). *Remote sensing and GIS for environmental sciences*. BS Publications.
11. Singh, G., & Mishra, D. P. (2018). *Watershed management: Issues and policies for 21st century*. Concept Publishing Company.
12. Suresh, R. (2008). *Soil and Water Conservation Engineering* (5th ed.). Standard Publishers Distributors.
13. Tiwari, A. K., & Mishra, A. (2019). *Watershed management and planning*. Scientific Publishers.
14. Wani, S. P., & Garg, K. K. (Eds.). (2021). *Harnessing dividends from drylands: Innovative scaling up with soil-water-nutrient management*. Springer.

Title of the Course – Coastal Systems and Geospatial Technology								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50602	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To develop the understanding of the coastal processes and coastal environments
2. To create the awareness about coastal systems and their dynamics
3. To enhance the knowledge about climate change with special reference to coastal hazards and importance of coastal zone management.
4. To make students aware about how Geospatial Technology can be applied for studying coastal systems

Course Outcomes:

The students will be able to:

CO 1. Identify the coastal components and understand the interactions between the coastal zone, foreshore and backshore zones.

CO 2. Inculcate a balanced view about the coastal development

CO 3. Know the impact of climate change on coastal areas and design coastal zone management plans.

Unit I - Coastal Systems (15 hours)

- 1.1 Evolution of coasts – Tectonic, Subaerial, Climatic and Anthropogenic factors
- 1.2 Components of coastal systems – Terrestrial and marine
- 1.3 Coastal Processes – Weathering, Erosion, Transport and Deposition
- 1.4 Classification of coasts based on GCC database and CMECS

Unit II - Coastal Energy Inputs and Dynamics (15 hours)

- 2.1 Waves – formation, types, wave parameters
- 2.2 Coastal currents – generation, types and significance
- 2.3 Tides – Generation Mechanisms, tidal regimes, tidal currents, tidal cycles
- 2.4 Sea level – as datum, changes – eustatic and isostatic, climate change and sea-level change

Unit III Geomorphologic Characteristics of Coastal Systems (15 hours)

- 3.1 Beach systems – types, formation, morphology and dynamics
- 3.2 Coastal Dunes systems - types, formation, morphology and dynamics
- 3.3 Sea cliffs and shore platforms – formation, morphology and dynamics
- 3.4 Mudflats, Wetlands and Mangroves – formation, morphology and dynamics

Unit IV – Recent Developments and Applications of Geospatial Technology (15 hours)

- 4.1 Shoreline change detection - coastal retreat, erosion-accretion patterns and climate change, Digital Shoreline Analysis System (DSAS)

4.2 Habitat Mapping and Change Detection using geospatial techniques– Mangroves, Wetlands and Coral Reefs

4.3 Sea-level change monitoring – use of Satellite Altimetry, Gravimetry, TOPEX/Poseidon,

4.4 Coastal Resources – monitoring, mapping, harvesting and conserving

Suggested Reading Materials:

1. Ahmed, E. (1972). *Coastal geomorphology of India, orient*. Longmans.
2. Bird, E. C. F. (1984). *Coasts – An introduction to coastal geomorphology*. Australian National University Press.
3. Bird, E. C. (2000). *Coastal geomorphology: An introduction*. John Wiley & Sons.
4. Bird, E. C. (2002). *Geomorphology: A systematic analysis of Late Cenozoic landforms, Prentice-Hall of India, New Delhi*.
5. Bloom, A. L. (2002). *Geomorphology* (3rd ed) Prentice-Hall of India. New Delhi.
6. Davis, J. L. (1980). *Geographical variation in coastal development*. Longman.
7. Embelton, & Thornes. (1979). *Process in geomorphology*. Arnold.
8. Fairbridge, R. (1968). *Encyclopaedia of geomorphology*.
9. Goudie, A. S. (2004) (Eds.). *Encyclopaedia of geomorphology*. Routledge.
10. Hails, J., & Carr, A. (1975). *Nearshore sediment dynamics and sedimentation*. Wiley.
11. Johnson, D. W. (1965). *Shore processes and shoreline development, Hanfer, New York*.
12. Kale, V. S., & Gupta, A. (2001). *Introduction to geomorphology*. Orient Longman.
13. Karlekar, S. N. (2016). *Coastal geomorphology of India*. Aparna Publication.
14. Karlekar, S. N. (2009). *Coastal processes and landforms*. Aparna Publication.
15. Karlekar, S. N. (1993). *Coastal geomorphology of Konkan*. Aparna Publication.
16. King, C. A. M. (1972). *Beaches and coasts*. Edward Arnold.
17. Masselink, G., & Hughes, M. G. (2003). *Introduction to coastal processes and geomorphology*, Arnold, London.
18. John, P. (1984). *An introduction to coastal geomorphology*. Arnold Heinemann.
- Tooley, M. J., & Shennan, I. (1987). *Sea level changes*. Basil Blackwell.

Title of the Course – Unstable Terrains, Changing Climate and Disaster Management								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50603	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To enhance the fundamental understanding of students about the scientific basis of climate change and natural disasters and disaster management.
2. To impart the knowledge about physical science of climate system and drivers of change as well as the hazard and vulnerability assessment techniques for various natural disasters.
3. To make the learners understand the climate change as per the IPCC reports and intricacies of disaster management

Course Outcomes: After completion of this course students will:

- CO 1. be able to explain how the climate system works and how the natural disasters occur.
CO 2. understand the physical basis of climate change and natural disasters.
CO 3. get familiarize with and understand the IPCC reports.
CO 4. know the various aspects of vulnerability disaster management

Unit I – Unstable Terrains Changing Climate and Hazards (15 hours)

- 1.1 Unstable terrain – Tectonic forces and geologic conditions, subaerial processes, climatic and anthropogenic factors and impacts
- 1.2 Unstable terrain and Hazards – Earthquakes, Volcanos, Landslides
- 1.3 Hazards – definition, classifications, hazard assessment
- 1.4 Vulnerability and risk assessment

Unit II – Disaster Management – strategies and policies (15 hours)

- 2.1 Disaster management cycle: mitigation, preparedness, response, recovery
- 2.2 Disaster Warning Systems
- 2.3 Disaster Management policies in India
- 2.4 National and State Bodies for Disaster Management

Unit III – Climate Change – Concept and Implications (15 hours)

- 3.1 Introduction to climate system – mechanisms of feedback and self-regulations - climate variability – major elements structuring the global climates – heat exchange – role of cryosphere, oceans – Global Conveyor Belt – ocean currents
- 3.2 Evidences and Indicators of Climate Change – records of climatic changes in geological past

3.3 Impact of climate change and natural imbalance – Global thermal distribution, Ocean and ocean currents, seasons and transitions

3.4 Climate Change and biosphere

Unit IV – Climate Change Adaptation – strategies and policies (15 hours)

4.1 Millennium Development Goals (MDG) – Sustainable development Goals (SDG)

4.2 Climate Change Adaptation policies

4.3 Initiatives at global level- IPCC-Structure – UNFCCC

4.4 International agreements- Kyoto Protocol

Suggested Reading Materials:

1. Berman, J. W., Wartman, J., Olsen, M., Irish, J. L., Miles, S. B., Tanner, T., Gurley, K., Lowes, L., Bostrom, A., Dafni, J., Grilliot, M., Lyda, A., & Peltier, J. (2020). Natural hazards reconnaissance with the NHERI RAPID facility. *Frontiers in Built Environment*, 6(v), 573067.org (Crossref). <https://doi.org/10.3389/fbuil.2020.573067>
2. David Archer & Stefan Rahmstorf (2010): The Climate Crisis, An Introductory Guide to Climate Change, Cambridge University Press
3. David, J., (2011) “Climate change and Climate modelling”, Cambridge University Press.
4. Davies, T. (2015). Landslide hazards, risks, and disasters T. R. H. Davies (Ed.). Elsevier.
5. Dhameja, A., & Dhameja, P. (2001). Disaster mitigation: Experiences and reflections. Prentice Hall.
6. Elliott, J. R. (2020). Earth observation for the assessment of earthquake hazard, risk and disaster management. *Surveys in Geophysics*, 41(6, November), 1323–1354.org (Crossref). <https://doi.org/10.1007/s10712-020-09606-4>.
7. GCRP, U S. (2009) "Climate literacy: the essential principles of climate science."
8. Hyndman, D. W., & Hyndman, D. W. (2017). Natural hazards and disasters (5th ed). Cengage Learning.
9. Khanna B K Nina Khanna. (2011). Disasters: Strengthening community mitigation and preparedness New India Publishing Agency.
10. Maque M, A (2021) Understanding Climate change, National Book Trust India.
11. Ramesh M (2019) The climate Solution, Hachette India.
12. Schumann, G., Hostache, R., Puech, C., Hoffmann, L., Matgen, P., Pappenberger, F., & Pfister, L. (2007). High-resolution 3-D flood information from radar imagery for flood hazard management. *IEEE Transactions on Geoscience and Remote Sensing*, 45(6, June), 1715–1725.org (Crossref). <https://doi.org/10.1109/TGRS.2006.888103>.
13. Singh, R. B. (2006). Natural hazards and disaster management: Vulnerability and mitigation. Rawat Publications

Specialisation II :Urban and Regional Planning

Title of the Course – Fundamentals of Urban and Regional Planning - I								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50604	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To make students understand various stakeholders and makers of the cities and urban spaces.
2. To make the students learn about various forces and processes that are shaping the urban spaces.

Course Outcome:

- CO 1. Students would learn how the cities are shaped by various processes and forces.
- CO 2. How the balance between all the elements is necessary to promote an inclusive city would be learnt by the students.

Unit 1 : The origin and growth of cities (15 Hours)

- 1.1 Preconditions for Urban Growth – pre-industrial city -industrial revolution and its effects on European urbanism- theories of urban origins
- 1.2 Early Urban hearths-the spread of urbanism and emergence of town planning- urban revival in western Europe- emergence of medieval towns and early modern urbanism- new urbanisation
- 1.3 Industrial cities and their forms -zoning and building regulations-residential segregation- residential sorting by class-socio-spatial segregation- development of slums-housing for the urban poor
- 1.4 Post-industrial urbanism- quartering of urban space- post-industrial /postmodern cities and their changing form.

Unit 2 : Urban Design (15 Hours)

- 2.1 Urban Structure – interrelationship between various landuses – urban grain - Density mix - the intensity of development and the diversity of users of urban space - Height and massing – its association with surrounding landforms – façade and interfaces
- 2.2 Public spaces – streets, open spaces, parks, pavements, etc. - Public space –types and uses
- 2.3 Topography – landscape and environment and its impact on urban design
- 2.4 Physical entity– built forms, architectural forms – the concept of built environment – production and reproduction of built environment

Unit 3 : Political Economy of Urban development (15 Hours)

- 3.1 Various actors in the city building - various stakeholders and their impact on the process of city building and built environment
- 3.2 Globalisation and city building - recent trends and urban designs
- 3.3 Urban Governance - recent theories in urban governance
- 3.4 Case studies of cities from Global North and Global South – Analysis of the recent urban changes on cityscapes and city spaces

Unit 4 : Basic Concepts in Urban and Regional Planning

(15 Hours)

- 4.1 Evolution and types of planning - Urban Planning stages and system
- 4.2 Regional Planning - types of regions, methods of regionalisation - concept of city-region / metropolitan region
- 4.3 Types and scales of planning - micro, meso, and macro - elements of spatial planning
- 4.4 Planning framework and process of development plans - concept of base map, master plan, perspective plan, regional development plans, zoning, etc.

Suggested Reading Materials:

1. Carter, H (1972): The Study of Urban Geography, Edward Arnold.
2. A. Latham, D. McCormack, K. McNamara, D. McNeill (2009): Key Concepts in Geography, Sage.
3. Campbell, H. 2006. "Just Planning: The Art of Situated Ethical Judgment." *Journal of Planning Education and Research* 26(1): 92–106.
4. Campbell, H. 2012a. "'Planning Ethics' and Rediscovering the Idea of Planning." *Planning Theory* 11 (4): 379–99.
5. Campbell, H. 2012b. "Planning to Change the World: Between Knowledge and Action Lies Synthesis." *Journal of Planning Education and Research* 32 (2): 135–46.
6. Pacione, M. 2005, Urban Geography, Routledge, New York
7. Communities and Local Government. 2006. *Barker Review of LandUse Planning: Final Report—Recommendations*. London: Stationery Office.
8. Innes, J. 1995. "Planning Theory's Emerging Paradigm: Communicative Action and Interactive Practice." *Journal of Planning Education and Research* 14 (3): 183–91.
9. <https://www.sciencedirect.com/science/article/pii/S2096232021000238#:~:text=The%20real%2Dworld%203D%20reconstruction,specific%2C%20and%20impactful%20visual%20experience>.
10. https://onlinecourses.nptel.ac.in/noc22_ar18/preview

Specialisation III Climate Change and Sustainability Studies

Title of the Course – Science and Theory of Climate Change								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50605	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The part of this course is designed for students to give fundamental understanding of the scientific basis of climate change.
2. The part of the course introduce to the physical science of our climate system, and drivers of change.
3. For in-depth understanding of the climate change the IPCC reports has been introduced.

Course Outcomes (Cos): After completion of this course students will:

- CO 1. Student will able to explain how the climate system works.
 CO 2. Understand the physical basis of climate change
 CO 3. Students will familiarize and understand the IPCC reports.

Unit 1: The context of Climate Change (15 Hours)

- 1.1 Introduction to climate system – mechanisms of feedback and self-regulations - climate variability – major elements structuring the global climates – heat exchange – role of cryosphere, oceans – Global Conveyor Belt – ocean currents
 1.2 Evidences and Indicators of Climate Change – records of past climatic changes and geological time scale
 1.3 Anthropogenic Greenhouse gas emissions and their measurement - Warming properties of GHGs, Carbon dioxide, Methane, Nitrous Oxide. Measurement of GHG concentration in the atmosphere
 1.4 Global Warming Potential (GWP), carbon footprint and its calculation, emissions factors (EF) from different industrial processes (IP) - GHG inventory and sinks - Emissions modelling and scenario building.

Unit 2: Theoretical Perspectives on Climate Change (15 Hours)

- 2.1 Milankovitch Theory - Greenhouse theory of Climate Change
 2.2 Political theory and Climate change – Conceptual analysis, critical theory, critical legal studies, Neo-Marxism
 2.3 Socialism, Marxism, Capitalism - perceptions on climate Change
 2.4 Perspectives of Alvin Toffler, John Belamy Foster, Yuval Noah Harari

Unit 3 : Political Economy of Climate Change (15 hours)

- 3.1 Historical development pathways (global north vs global south) and GHG emissions.
 3.2 The Paris Agreement (2015), UNFCCC's Global Climate Negotiations and the Conference of

Parties (COP).

3.3 Equity in Carbon Budget Allocations: Perspectives of the Global North vs Global South.

3.4 A critique of the neoclassical assumptions of SSPs and discussion on inequitable global mitigation pathways in climate change scenarios - IPCC's RCP (Representative Concentration Pathways) and SSP (Shared Sustainability Pathways) Scenarios for different nations.

Unit 4 : Climate Change and India

(15 Hours)

4.1 Impact of Climate change in India on various sectors like agriculture and other primary activities

4.2 Climate change – spaces, people and communities – issues of climate change induced displacement – climate refugees

4.3 India at the global climate negotiations - India's Climate Policy, INDCs (Intended Nationally Determined Contributions), stress on the principle of equity in carbon budget allocations, and commitment to Net Zero emissions.

4.4 Critical Assessment of Indian's stand at international climate negotiations

Suggested Reading Materials:

1. David, J., (2011) "Climate change and Climate modelling", Cambridge University Press.
2. David Archer & Stefan Rahmstorf (2010): The Climate Crisis, An Introductory Guide to Climate Change, Cambridge University Press
3. GCRP, U S. (2009) "Climate literacy: the essential principles of climate science.".
4. Maque M, A (2021) Understanding Climate change, National Book Trust India.
5. Ramesh M (2019) The climate Solution, Hachette India.
6. Toffler, Alvin. (1970). Future shock. New York :Random House,
7. Harari, Y. N. (2015). *Sapiens*. Harper.
8. Foster, J. (1999) : The Vulnerable Planet : A Short Economic History of the Environment. Monthly Review Press, NYU
9. IPCC (1990). First Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar1/syr/>
10. IPCC (1995). Second Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar1/syr/>
11. IPCC (2001). Third Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar3/syr/>
12. IPCC (1990). Fourth Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar4/syr/>
13. IPCC (1990). Fifth Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar5/syr/>
14. IPCC (1990). Sixth Assessment Report. <https://www.ipcc.ch/>
<https://www.ipcc.ch/report/ar6/syr/>
15. 1. Handbook of Climate Change Mitigation and Adaptation, 2nd edition, 4 volumes, Edition: 3rd Publisher: Springer ISBN: 978-3-319-14408-5; 978-3-319-14409-2. Wei-Yin Chen, Maximilian, Lackner, Toshio Suzuki.

Specialisation IV : Human Geography and the Human Systems

Title of the Course – Global Perspectives in Geopolitics								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50606	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The course intends to make students aware about the concept and implication of world political structure.
2. The course offers a detailed account of fundamentals of geopolitics and its implications on various nation states.

Course Outcome:

- CO 1. Students are expected to emerge with a holistic understanding on how the world political structure has been shaped by various forces and processes leading to a vary complex structure of international relations.
- CO 2. The understanding would formulate a base for understanding the geostrategies and international relation policies.

Unit 1 : Space, Place and Politics

(15 Hours)

- 1.1 Relevance of Space in political Geography - Concept of Territoriality claims over land, water and air as territories - contestations
- 1.2 Sovereignty - State as geographical and political unit - Concept of state, nation and nation-states - Territorial state and international Relations - State as a container - World Systems approaches
- 1.3 Theories of state formation - Geographical and political theorisations
- 1.4 The evolving state in changing global scenario - nationalisation , regionalisation, globalisation and the form of state – fronts - coalitions and international relations

Unit 2 : Geopolitics Theories

(15 Hours)

- 2.1 Concept of Geopolitics – Fundamentals of Geopolitics
- 2.2 Modern – postmodern and critical Geopolitics
- 2.3 Heartland Theory (Halford J. Mackinder), Sea Power (Alfred Thayer Mahan), Rimland Theory (Nicholas J. Spykman), Theory of Air Power Supremacy (Alexander Seversky),
- 2.4 German Geopolitik , Functional Approach to Political Geography (Richard Hartshorne), Stephen B. Jones (Unified Field Theory)

Unit 3 : Geopolitical tensions

(15 Hours)

- 3.1 Geopolitics of war - World tension zones
- 3.2 Geography of international terrorism - Contemporary examples.
- 3.3 Politics of the environment global environmental issues Claims and counterclaims Global North and Global South - water as a disputed territory
- 3.4 Politics of Climate Change

Unit 4 : Political Aspirations and Identities

(15 Hours)

4.1 Nationalism , deglobalisation - The Global Village or the world of nations

4.2 Borders, refugees and citizenships

4.3 Ethnicity – A major context to geopolitics - Identity politics in West Asia, Africa and South-east Asia - Clash of Civilisation - Samuel Huntington

4.4 Cultural hybridisation - religion, ethnicity and identity politics the future

Suggested Reading Materials:

1. Taylor, P.J., (1985): Political Geography; World Economy, Nation-State and Locality, Longman.

2. Kasperson. R E. and Minghi, J.V. (1969):The Structure of Political Geography, University of London Press.

3. De Blij. H.J. (1967): Systematic Political Geography, John Wiley and Sons.

4. Jackson, W. A. D. (1964): Politics and Geographic Relationships, Prentice Hall.

5. Nijman Airman, J. (1993): The Geopolitics of Power and Conflict, Belhaven Press.

6. Dikshit, S.K. (1994); Geography of Elections, Rawat Publishers.

7. Amin, S. (1980): Class and Nation, Monthly Review Press. 32

8. Agnew, J. and Corbridge, S. (1995): Mastering Space, Routledge.

9. Thorns, D. C. (1992): Fragmenting Societies, Routledge.

10. Bhambhri, C. P. (1991): Elections 1991; An Analysis, B. R. Publishers.

11. Prescott, J R V. (1967): Geography of Frontiers and Boundaries, Hutchinson & Co.

12. Johnston, R J. (1982): Geography and the State, MacMillan

13. Norris, R. E. and Haring, L.L. (1980); Political Geography, Bell and Howell.

14. Painter Joe and Alex Jeffrey (2009) Political Geography an Introduction to Space and Power, Sage, London.

15. Agnew John, (2002) Making Political Geography, Arnold, London.

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extension://efaidnbmnnnibpajpcgclclefindmkaj/https://scholar.harvard.edu/files/renos/files/syllabus_gov2525_spring2017.pdf

17. chrome-extension://efaidnbmnnnibpajpcgclclefindmkaj/<https://kirschgeographies.web.unc.edu/wp-content/uploads/sites/5454/2020/09/Geog453.Fall2020.syllabus.pdf>

Title of the Course – Geography of Tourism and Recreation								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50607	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives: To gain knowledge about -Tourism Concepts, Approaches, Methodologies of Study, planning & management.

Course Outcomes:

CO 1. Students will be able to develop an understanding about tourism as a phenomenon, the elements of tourism and their interrelationships.

CO 2. They will learn about the various approaches applied to study tourism from different perspectives.

CO 3. They will gain knowledge about the application of the latest tools and technologies used for tourism planning and management.

Unit 1: Introduction

(15 Hours)

- 1.1 Conceptualizing tourism and recreation – tourism system and components
- 1.2 Factors influencing tourism; Tourism & recreation types and forms;
- 1.3 Tourists – definition, typologies, purpose of visit & motivation, pattern of flow & seasonality;
- 1.4 Cohen & Plog's model of Tourist Typology

Unit 2: Stakeholders in Tourism & Recreation

(15 Hours)

- 2.1 Definition and meaning; stakeholder theory;
- 2.2 Types of stakeholders; their role, participation, involvement & interest;
- 2.3 Tourism organizations - National and International - their role and functions

Unit 3: Interdisciplinary approach to tourism studies

(15 Hours)

- 3.1 Geographical approach ; Historical approach
- 3.2 Economic approach, Sociological approach,
- 3.3 Cost-Benefit and Environmental approach,
- 3.4 Institutional approach; Product approach; Managerial approach; Systems approach

Unit 4: Tools & technologies for tourism planning & development

(15 Hours)

- 4.1 Tools and techniques used for - resource identification, planning of destinations, tourism destination performance evaluation and impact assessment
- 4.2 Tourism mapping – use and importance of tourist maps – traditional mapping and digital mapping
- 4.3 Tourism digitalization - role of Geospatial Technology in tourism development, planning and management – benefits and challenges
- 4.4 Tourism applications – types – purpose of use – virtual tourism

Suggested Reading Materials:

1. Abreu, A. Liberato, D. Gonzalez, E.A.& Ojeda, J.C.G. (eds) (2020). *Advances in Tourism, Technology and Systems: Selected Papers from ICOTTS20*, Volume 2. Springer.
2. Amoako, G.K., Darko, T.O. and Marfo, S.O. (2022). Stakeholders role in tourism sustainability: the case of Kwame Nkrumah Mausoleum and centre for art and culture in Ghana. *International Hospitality Review*. 36 (1): 25-44. <https://www.emerald.com/insight/content/doi/10.1108/IHR-09-2020-0057/full/pdf?title=stakeholder-role-in-tourism-sustainability-the-case-of-kwame-nkrumah-mausoleum-and-centre-for-art-and-culture-in-ghana>
3. Boniface, B.G. and Cooper, C.P. (1987) *The Geography of Travel and Tourism*. Butterworth-Heinemann
4. Bulchand-Gidumal, J. (2022). Impact of Artificial Intelligence in Travel, Tourism, and Hospitality. In: Xiang, Z., Fuchs, M., Gretzel, U., Höpken, W. (eds) *Handbook of e-Tourism*. Springer, Cham. https://doi.org/10.1007/978-3-030-48652-5_110
5. Butler, R.W. (1999). Sustainable tourism: a state-of-the-art review. *Tourism Geographies*, 1(1):. 7-25.
6. Freeman, R.E., Harrison, J.S. Wicks, A.C., Parmer, B.L. and De Colle, S. (2010). *Stakeholder Theory: The State of the Art*. Cambridge University Press.
7. Goeldner, R. and Ritchie, B. (2005). *Tourism: Principles, Practices Philosophies* (9th Edition). John Wiley & Sons.
8. Government of India (2022). *Report on National Digital Tourism Mission*. Ministry of Tourism. https://tourism.gov.in/sites/default/files/2022-09/National%20Digital%20Tourism%20Mission_2022.pdf
9. Hall, C.M. and Page, S.J.(2005) *Geography of Tourism and Recreation: Environment, Place and Space*, London: Routledge.
10. Holden, A. & Fennell. (2013). *The Routledge Handbook of Tourism and the Environment*. Routledge.
11. Kaurav, R.P. S, Gursay,D & Chowdhary, N. (2020) *An SPSS Guide for Tourism, Hospitality and Events Researchers*. Routledge.
12. Lok, J. (2022) *How Robots Can Bring Positive Emotion to Travellers*, Notion Press.
13. Pearce, D.G. (1987) *Tourism Today: A Geographical Analysis*, Harlow: Longman.
14. Pearce, D.G. (1989) *Tourism Development*, Harlow: Longman.
15. Pearce, D.G. and Butler, R.W (eds) (1993). *Tourism Research: Critiques and Challenges*. Routledge.
16. Shaw, G. and Williams, A.M. (1994). *Critical Issues in Tourism: A Geographical Perspective*. Blackwell (second Edition).
17. Shaw, G. and Williams, A.M. (2004). *Tourism and Tourism Spaces*. Sage.
18. Urry, J. (1990) *The Tourist Gaze: Leisure and Travel on Contemporary Societies*. Sage.
19. United Nations World Tourism Organization (2008). *Glossary of Tourism Terms*. In UN standards for measuring tourism. available at <https://www.unwto.org/glossary-tourism-terms>
20. Williams, S. (1998) *Tourism Geography*. Routledge.

Title of the Course – Population Geography - I								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50608	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To understand intricacies and theoretical frameworks related to Population Geography and Demography
2. To study the demographic processes related to fertility, mortality and migration.
3. To examine concepts and measures related to fertility, mortality and migration.

Course Outcomes:

- CO 1. Students are expected to develop an overview on different elements of Population Geography
CO 2. Students need to apply understanding of concepts for population problems.

Unit 1 : Concepts, Tools, and Techniques in Population Geography (15 hours)

- 1.1 Difference between Population Geography and Demography, Concept of Demographic Perspectives
- 1.2 Demographic methods - Demographic Analysis, Estimation and projection, Standardization, Cohort Analysis, Spatial Analysis and Epidemiologic Analysis
- 1.3 Demographic Data- Source, Types and Collection Methods

Unit 2 : Population Size, Distribution, Concentration and Composition (15 hours)

- 2.1 Defining Size, Distribution and Concentration
- 2.2 Population Composition Variables- Biosocial and Sociocultural Characteristics
- 2.3 Displaying and Analyzing Compositional Variables- Descriptive Statistics, Population Pyramids, Dependency Ratio and Cohort Analysis

Unit 3 : Fertility and Mortality as Demographic Processes (15 hours)

- 3.1 Concepts and measures of Fertility and Mortality
- 3.2 Trends in Fertility and Mortality with special reference to India
- 3.3 Factors affecting Fertility and Mortality with special reference to India
- 3.4 Data Source for Fertility and Mortality

Unit 4 : Migration as Demographic Process (15 hours)

- 4.1. Concepts and Measures of Migration
- 4.2 Types and Patterns of Migration - International and Internal Migration
- 4.3 Impact of Migration- Social, Political, Cultural and Economic
- 4.4 Laws and Theories of Migration- Ravenstein Laws of Migration, Inverse Distance Laws, Theory of Intervening Opportunities and Gravity Model

References:

1. Thomas, R. K. (2018) Concepts, Methods and Practical Applications in Applied Demography. Springer.
2. Newbold, B. (2017) Population Geography: Tools and Issues. Rowman & Littlefield Publishers.
3. Bhende, A and Kanitkar, T. (1985): Principles of Population Studies, Himalayan Publishing House, Mumbai.
4. Clarke, J. L. (1992): Population Geography, Pergamon Press, Oxford.
5. Demko, G. J., Rose, H. M. and Schnell, G. A. (1979): Population Geography: A Reader, McGraw Hill, New York.
6. Zelinsky, W., Kosinski, L.A, Prothero, R.M. (eds.) (1970) Geography and a Crowding World, Oxford University Press, London.
7. Ackermann, E.A. (1959): Population and Natural Resources in Hauser, P.M. and Duncan, O.D, (eds.) The Study of Population, Chicago.
8. Clarke, J.I. (1971): Population Geography and the Developing Countries .
9. Harper, C.L. (2001): Environment and Society, Human Perspectives on Environmental Issues, Prentice Hall, New Jersey.
10. Ehrlich. P.R., and Ehrlich, A.M. (1992): Population Explosion, Doomsday, New York.
11. Saare, P. and Blunder, J. (eds.) (1995): An Overcrowded World? Population, Resources and Environment, The Open University, Oxford.
12. Johnston, R.J. and Taylor, P. (eds.): The World in Crisis, Oxford: Blackwell.
13. Potter, R.B., Binns, T., Elliott, J.A. and Smith, D. (1999): Geography of Development, Longman.
14. Srinivas, K. and Vlanol, M, (2001): Population, Development Nexus in India: Challenges for the New Millennium, Tata McGraw Hill, New Delhi.

Title of the Course – Geography of Society and Culture - I								
Year – 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE – 1	GEOG 50609	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objective:

1. To provide a broad overview of the key concepts and approaches in social geography
2. To understand the relation between social processes, social identity and geographical space.

Course Outcome:

- CO 1. The students will get an understanding of the major concepts and approaches in the field of social geography.
- CO 2. The course will enable them to develop understanding of the social structure, process and spatial formations/production of social space.

Unit 1: Introduction and Evolution of Social Geography (15 Hours)

- 1.1 Introduction – definition, concept
- 1.2 Nature of social geography and its evolution - from 1800s to 1970s and beyond
- 1.3 Approaches – ecological approach, group approach, welfare or humanistic school, radical school, phenomenological school, Marxist approach, Structural approach, Postmodern approach
- 1.4 Development of Social geography in India

Unit 2 : Key Ideas in Social Geography (15 Hours)

- 1.1 Social Phenomena, Gemeinschaft-Gesellschaft,
- 1.2 Social Darwinism, Historical-materialism,
- 1.3 Anomie, Conflict theory, Feminism & Patriarchy,
- 1.4 Urbanism, Globalization, Post-Fordism, Post-modernisation

Unit 3: Society and Space (15 Hours)

- 3.1 Social relations and social structures
- 3.2 Social processes and spatial form
- 3.3 Socio-spatial diversity and differentiation
- 3.4 Social area analysis

Unit 4: Production of Social Space (15 Hours)

- 4.1 Social groups, social space
- 4.2 Production of space – spatial triad
- 4.3 Socio-spatial dialectics
- 4.4 Spatial semiotics

Suggested Reading Materials:

1. Ahmad, A. (1999): Social Geography, Rawat Publications, New Delhi.
2. Ahmad, A. (2012): Social Geography of India, Concept Publishing Company Pvt. Ltd, New Delhi.
3. Banerjee-Guha, S. (2004): Space, Society and Geography, Rawat Publications, New Delhi.
4. Benko, G. and Strohmayr, U. (2004): Human Geography: A History for the 21st Century, Arnold, London.
5. Casino, V.J.D., Jr., (2009): Social Geography: A Critical Introduction, Wiley-Blackwell, Chichester
6. Cloke, P., Philo, C., and Sadler, D. (1991): Approaching Human Geography: An Introduction to Contemporary Theoretical Debates, Paul Chapman Publishing Ltd., London.
7. Coates, B.E., Johnston, R.J. and Knox, P.L. (1977): Geography and Inequality, Oxford University Press, Oxford and London
8. Eyles, J. (ed.) (1986): Social Geography in International Perspective, Rowman and Littlefield, New Jersey and Los Angeles
9. Gregory, D. and Larry, J. (eds.) (1985): Social Relations and Spatial Structures, MacMillan, London
10. Hammett, C. (eds.) (1996): Social Geography: A Reader, Arnold, London
11. Jackson, P. and Susan, J.S. (1984): Exploring Social Geography, George Allen and Unwin, Boston and Sydney.
12. Jones, E. (ed.) (1975): Readings in Social Geography, Oxford University Press, London
13. Lefebvre, H., Nicholson-Smith, D. (1991): The Production of Space, Blackwell.
14. Knox, P. and Pinch, S. (2006). Urban Social Geography: An Introduction, Pearson Prentice Hall.
15. Slattery, M. (2003): Key Ideas in Sociology, Nelson Thornes Ltd., Cheltham.
16. Smith, D. (1977): Geography: A Welfare Approach, Edward Arnold, London

Specialisation V : Geospatial Technologies

Title of the Course – Fundamentals of Earth Observation								
Year - 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 1	GEOG 50610	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. Main objective is to learn how to generate information about the Earth from remote sensing data.

Course Outcomes:

At the end of the course students must be able to:

- CO 1. Explain the principles and use the vocabulary of Remote Sensing;
- CO 2. Describe the physical background of remote sensing and compare the main platforms and sensor systems;
- CO 3. Explain the main digital image processing procedures and Describe the common methods of image analysis; Perform basic image processing techniques;
- CO 4. Carry out a visual interpretation of an aerial photograph or a satellite image;
- CO 5. Apply appropriate Remote Sensing methods for problem solving;
- CO 6. Understand the capabilities, uses and limitations of RS in their field of application;
- CO 7. Design and carry out sequential data processing steps for solving a typical application problem;

Unit 1 : Electromagnetic Spectrum, platforms and sensors

(15 Hours)

1.1 Electromagnet energy and remote sensing:

Electromagnetic energy, Waves and photons, Sources of EM energy and radiometric units, Electromagnetic spectrum, Energy interaction in the atmosphere, Absorption and transmission, Atmospheric scattering, Energy interactions with the Earth's surface, Spectral reflectance curves, Sensing of EM energy, Sensing properties, Classification of sensors

1.2 Platforms and passive electro-optical sensors

Platforms and missions, Moving platforms, Aerial survey missions, Satellite missions, Market figures, Cameras, Detector arrays, Optical system, Scanners, Components, Geometric aspects, Stereoscopy, Overview of popular spaceborne sensors, Data selection criteria, Information requirements and constraints, Availability and cost

Unit 2 : Radiometric and Geometric Operations

(15 Hours)

2.1 Visualization and radiometric operations

Visualization, Perception of colour, Image display, Radiometric corrections, Sun elevation correction, Haze correction, Elementary image processing, Histograms, Histogram operations, Filter operations, Image fusion

2.2 Geometric operations

Elementary image distortions, Relief displacement, Two-dimensional approaches, Georeferencing,

Geocoding, Three-dimensional approaches, Orientation, Monoplotting, Orthoimage production, Stereo restitution

Unit 3 : Image Interpretation and Analysis

(15 Hours)

3.1 Visual image interpretation

Interpretation fundamentals, Human vision, Interpretation elements, Mapping, Interpretation, Analysing field data and map preparation, Quality aspects

3.2 Digital image classification

Principle of image classification, Image space, Feature space, Image classification, Image classification process, Preparation for image classification, Supervised image classification, Unsupervised image classification, Classification algorithms, Validation of the result, Pixel-based and object oriented classification

Unit 4 : Radar Remote Sensing and Laser scanning

(15 Hours)

4.1 Radar remote sensing:

Microwave remote sensing, Principles of imaging radar, Geometric properties, Geometric distortions, Radiometric distortions, Interpretation of radar images, SAR applications, INSAR, SAR systems

4.2 Laser Scanning: Basic Principles, System Components, History & Variants, Applications

Suggested Reading Materials

1. American Society of Photogrammetry (1983): Manual of Remote Sensing, ASP Palis Church, V.A.
2. Barrett, E.G. and Curtis, L.F. (1992): Fundamentals of Remote Sensing in Air Photo-interpretation, McMillan, New York. 7.
3. Campbell, J. (1989): Introduction to Remote Sensing, Guilford, New York.
4. Curran, Paul, J. (1988): Principles of Remote Sensing, Longman, London.
5. Duda, R. O. and Hart, P. E. (1973): Pattern Classification and Scene Analysis Wiley, New York.
6. Gibson, P. J. (2000): 'Introduction to Remote Sensing - Digital Image Processing and Applications', Routledge - Taylor & Francis.
7. Gibson, P. J. (2000): 'Introduction to Remote Sensing - Principles and Concepts', Routledge - Taylor & Francis.
8. Iliffe, J.C (2006), Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, New York.
9. Jonson, R. J. (2003): Remote Sensing of the Environment-An Earth Resources Perspective, Pearson Education Series in Geographical Information Science, Keith C. Clarke (Series editor) Pearson Educators Private Limited. (Singapore), New Delhi.
10. Joseph, G. (2009): Fundamentals of Remote Sensing, Universities Press (India) Pvt. Ltd., Hyderabad.
11. Klaus Tempfli, Norman Kerle, Gerrit C. Huurneman, Lucas L. F. Janssen (2009) Principles of Remote Sensing, An introductory textbook, ITC, University of Twente, Enschede, The Netherlands.
12. Russ, J. C. (1992): The Image Processing Handbook, CRC Press SIUE Library call #: TA1632.R88 (reference).
13. Sabins (Jr.) F. F. (1986), 'Remote Sensing - Principles and Interpretation', W. H. Freeman & Co., New York.
14. Sahu, K. C. (2008): Text Book of Remote Sensing and Geographical Information System, Atlantic Publishers and Distributors (P) Ltd., New Delhi.

15. Schowengerdt, R. A. (2006): 'Remote Sensing - Models and Methods for Image Processing', Elsevier India Pvt. Ltd., New Delhi.
16. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman (1015) Remote Sensing and Image Interpretation, 7th Edition
17. W. G. Rees (2012) Physical principles of remote sensing, Cambridge University Press.

Title of the Course – Digital Cartography - Visualization and Dissemination of Geodata								
Year - 1				Semester - I				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 1	GEOG 50611	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To introduce cartography as discipline in Geospatial Technology.

Course Outcomes:

- CO 1. What the roles are of geodata visualization in a GIS environment;
- CO 2. How use and users tailor visualization design decisions;
- CO 3. Various dissemination methods and environments, and their role in geodata provision for different kinds of use and users.
- CO 4. The basic concepts related to 3D representation of geodata;
- CO 5. Cartographic design principles to map topography and thematic data;
- CO 6. The basic principles of animated maps.
- CO 7. Main concepts of Geovisual exploration and analytics
- CO 8. Cartographic visualization principles to different kinds of visualizations of geodata, and judge the appropriateness of their application, taking data characteristics and use issues into account.

Unit 1: Colour and introduction maps: (15 Hours)

- 1.1 Colour Vision: Perception, Physical stimulus, Physiological reaction of the eye,
- 1.2 Colour output: Stimulation of the Cones and Rods, Primary colour transmitted light, Image display hardware, the monitor, Composites, Primary colour, reflected light,
- 1.3 Colour space: Munsell, Ostwald, The solid cube, conversion rgb/cmy, conversion cmy/rgb, HSL, RGB to HSL, HSV, RGB to HSV, Colour management, Colour charts, Colour factors that influence the choice, Colour tools
- 1.4 Definition of map, Why maps, Topographic and thematic maps; Maps- Chorochromatic maps, Dot maps, Proportional symbol maps, Proportional diagram maps, Pie graphs, Flowline maps, Isoline maps, Equal distance or equal travel time, Cartogram, Prism map, Choropleth maps, Methods in QGIS.

Unit 2 : Dissemination and Use Issues, maps and framework data: (15 Hours)

- 2.1 Dissemination and Use Issues- digital format, by spoken or written language, by numbers, by RS imagery, video, 3D or virtual imagery, maps
- 2.2 Maps: Answers of map- elementary, intermediate, temporal, overall; Dissemination of maps- paper maps, map displays on monitor screens, roles and limitations of web maps

2.3 Framework data: Geodetic control data, Digital elevation model, Fundamental topography, Administrative boundaries, Geographical names

Unit 3 : Map Layout, Typography and Visualization of 3d geospatial data (15 Hours)

3.1 Map layout: goals, prerequisites, elements, marginal information, types of map layout, map layout balance, inset, legends, paper format

3.2 Typography- basics, historic overview, typographic terminology, graphic text variable, name placement

3.3 Visualization of 3d geospatial data: Definition and examples of three-dimensional map, relief, Terrain and other themes, Mapping non-terrain in 3d, 3D maps, Realistic, Abstract, Thematic, Prism maps, Virtual Reality as 3d mapping environment

Unit 4 : Exploration of geodata, graphic variables and map design (15 Hours)

4.1 Visual exploration of geodata - I:

History – information, insight, knowledge, reasoning; Geovisualization – location space, attribute space, time space; Visual analytics

4.2 Visual exploration of geodata - II:

Example of Minard's map content- location, branches, dates, survivors, temperature, location, battles

4.3 Graphic variables- Single static map, Multiple static maps; Dynamic visualization variables- Moment of display, Order, Duration, Frequency, Rate of change, Synchronization; Application of the variables

4.4 Map design:

Factors influencing map design; Data characteristics- Measurement levels- nominal, ordinal, interval, ratio; Bertin's visual (graphic) variables, cartographic grammar

Suggested Reading Materials:

1. Crone, G. R. (1968): Maps and their Makers: An Introduction to the History of Cartography, Hutchinson University Library, London.
2. Cuff, D. J. and M.T. Mattson (1982): Thematic Maps: Their design and Production, Methuen and Company, New York.
3. Dickinson, G.C. (1977): Statistical Mapping and Presentation of Statistics, Edward Arnold limited, London.
4. Dykes, MacEachren & Kraak (eds.) (2005), Exploring Geovisualization
5. Heywood, Ian et al (1998) An Introduction to Geographical Information Systems, Addison Wesley Longman, Limited, England.
6. Kraak, Menno-Jan and Ferjan Ormeling (1996), Cartography Visualization of Spatial Data, Addison Wesley Longman Limited, England.
7. Keates. J S (1973): Cartographic Design and Production, 2nd edn., Longman Group Limited, London.
8. Keates, J.S. (1996): Understanding Maps, 2nd edn., Longman Group Limited, London.
9. Krygier & Wood (2005) Making maps: a visual guide to map design for GIS
10. MacEachren (1995), How map work
11. Menno-Jan Kraak and Ferjan Ormeling (2020) CARTOGRAPHY: Visualization of Geospatial Data, CRC press.
12. McDonnell. P. W. Jr. (1979): Introduction to Map Projections, Marcel Dekker, Inc New York and Basel.
13. Monmonier, Mark S. (1982), Computer-Assisted Cartography Principles and Prospects, Prentice-Hall, Inc, London

14. Robinson, A.H. et al. (1995): Elements of Cartography, Vol.VI, John Wiley & Sons, New York.
15. Slocum et. Al. (2009), Thematic Cartography and Geovisualization
16. Sabins, Floyd F. (1978): Remote Sensing: Principles and Interpretation, W.H. Freeman & Co., San Francisco.
17. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman (1015) Remote Sensing and Image Interpretation, 7th Edition

M.A. / M.Sc. (Geography)

Semester II

Semester II

Title of the Course – Advanced Concepts in Physical Geography - II								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC - 2	GEOG 507	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To impart knowledge on the earth systems by adopting the system approach.
2. To enhance the understanding of functioning of lithospheric, atmospheric and hydrologic systems.
3. To reveal the importance of various scales of study in earth sciences.

Course Outcomes:

- CO 1. The scientific basis for further studies in the field of earth sciences will be developed which will be useful for higher studies/research in this field.
- CO 2. The students will be in a position to reflect on the changes in the earth systems and on the global changes in the earth systems.

Unit I - Approaches and Scales in Geomorphology (15 hours)

- 1.1 Modern approaches and concepts in Geomorphology - General Systems Theory and feedback mechanisms
- 1.2 Temporal scale of processes, concepts of equilibrium and cyclic states in geomorphology
- 1.3 Spatial scales in Geomorphology – Micro, Meso, Mega scales of geomorphic systems
- 1.4 Rock cycles, sediment formation, types and stratigraphic studies

Unit 2 : Atmospheric Processes (15 hours)

- 2.1 Atmospheric pressure – vertical and horizontal distribution, General Circulation of atmosphere, Types of winds – Geostrophic, Gradient and local winds
- 2.2 Modern views about Extra-terrestrial wind system, Tricellular meridional circulation, Jet stream; Origin of Monsoon, recent theories of monsoon, factors influencing monsoon
- 2.3 Air masses: Origin, classification, types; Fronts: frontogenesis and frontolysis – classification of fronts; Tropical and Extra-tropical cyclones: formation and impact
- 2.4 Climatic Classification: Koppen and Thornthwaite, concept of water balance Problems and prospect

Unit 3 : Oceanography**(15 hours)**

3.1 Major marine bio-geo-chemical cycles

3.2 Ocean sediments- Classification- particle size and source, Marine minerals

3.3 Indian Ocean Circulation- Wind driven circulation, thermohaline circulation, specific currents and Gyres

3.4 ENSO indices, predictions and teleconnections

Unit 4: Hydrology**(15 hours)**

4.1 Runoff generation – processes and influencing factors -Water budget equation

4.2 Hydrographs – flood and unit hydrograph concepts

4.3 Estimation of peak discharge – empirical, rational, and SCS-CN methods

4.4 Floods and droughts – causes, classification, and mitigation measures

Suggested reading materials:

1. Bierman, Paul R., and David R. Montgomery. Key Concepts in Geomorphology. W.H. Freeman and Company Publishers : A Macmillan Higher Education Company, 2014.
2. Harp, H.J. and Trinidad, O.D. (eds) (1990): Climate and Development, Springer Verlag, U.S.A.
3. Marsh, William M., and Martin M. Kaufman. Physical Geography: Great Systems and Global Environments. Cambridge University Press, 2013.
4. Mather, J. R.(1974): Climatology: Fundamentals and Applications, McGraw Hill Book Co. New York. McBoyle, G.(1973): Climate in Review, Houghton Mifflin Co., Boston.
5. Oliver, J.E. and Hidose, J.J. (1984): Climatology - An Introduction, Charles and Merrill, U.S.A. Robinson, P.J. and Hendersen-Sellers, A.(1999): Contemporary Climatology, Pearson Education, London
6. Subrahmanyam, V.P.(ed)(1983):Contribution to Indian Geography, Heritage Publishers, New Delhi , a) Vol. III - General Climatology b) Vol. IV- Applied Climatology
7. Von Elverfeldt, Kirsten, and Thomas Glade. "Systems Theory in Geomorphology A Challenge." Zeitschrift Für Geomorphologie, Supplementary Issues, vol. 55, no. 3, June 2011, pp. 87–108. DOI.org (Crossref), <https://doi.org/10.1127/0372-8854/2011/0055S3-0053>.
8. Ahrens, C. D., & Henson, R. (2018). *Meteorology Today: An Introduction to Weather, Climate and the Environment*. Cengage Learning.
9. Ahrens, C. D. (2023). *Essentials of Meteorology: An Invitation to the Atmosphere*. Cengage Learning.
10. Dingman, S. L. (2015). *Physical Hydrology*. 2nd edition, Prentice Hall.
11. Garrison, T. (1995). *Essentials of Oceanography*. 6th edition, Cengage Learning. <https://ci.nii.ac.jp/ncid/BA70819455>
12. Hawkins, S. J., Allcock, A. L., Bates, A. E., Firth, L. B., Smith, I. P., Swearer, S. E., & Todd, P. A. (2019). *Oceanography and Marine Biology: An annual review. Volume 57*. CRC Press.
13. Hornberger, G. M., Wiberg, P. L., Raffensperger, J. P., & D'Odorico, P. (2014). *Elements of Physical Hydrology*. The Jhon Hopkins University Press, Maryland, USA.
14. Singh, V. P. (1992). *Elementary Hydrology*. Pearson College Division.
15. Subramanya, K. (2013). *Engineering Hydrology*, Tata Mc-Graw Hill.
16. Todd, D. K., & Mays, L. W. (2004). *Groundwater Hydrology*. John Wiley & Sons.
17. Viessman, W., & Lewis, G. L. (2003). *Introduction to Hydrology*. Pearson.

Title of the Course – Modern Perspectives in Human Geography - II

Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC - 2	GEOG 508	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To explore the spatial organisation of economy at local, regional, national and international levels and its interconnectedness to grasp the spatial patterns of development and underdevelopment
2. To study the geography of social, cultural and political processes
3. To understand the evolution of human geography and geographical thoughts and its nature and scope
4. to understand the specific dimension of society in terms of race, language, religion, gender and pattern of their distribution
5. to analyse historical, modern processes that shape cultures, politics and society
6. understanding of implications of globalisation as a major force on economy, society and culture

Course Outcomes:

- CO 1. The students are expected to become well versed with the complex nature of human societies and develop a holistic understanding.
- CO 2. Issue based analysis and problem solving approaches would be learned by the students.
- CO 3. Student are expected to develop scientific approach through logical and rational thinking

Unit 1: Modern Geographical Thought

(15 Hours)

- 1.1 Dualisms in Geographic Studies (physical vs. human, regional vs. systematic, qualitative vs. quantitative, idiographic vs. nomothetic)
- 1.2 Behavioural approach, Humanistic approach, Social Relevance revolution and Radical Geography
- 1.3 Welfare Approach - who, what, where and how- territorial social indicators - social justice
- 1.4 Structuralism, Feminism and Postmodernism - Deconstruction

Unit 2: Social and Cultural Geography

(15 Hours)

- 2.1 Evolution and development of Social and cultural Geography – Major Trends and Approaches- Critical Perspective and Associated Theoretical Developments
- 2.2 Traditional cultural geography – New cultural geography -linguistic and literary studies, Semiotic analysis and ‘space’ theories - critical social theory
- 2.3 Emergence and development of early cultural hearth – cultural diffusion, isolation and segregation - Ethnicity - Race, Language, Religion
- 2.4 Implications of race, religion, language and ethnicity- Contestation, conflicts and negotiations

Unit 3: Gender Geography

(15 Hours)

- 3.1 Structuring of sexuality and construction of gender identity – Gender binaries - Transgender and LGBTQA+ - role of socio-cultural forces and processes- stigmas and taboos – resultant gendered spaces-Indian examples
- 3.2 Spatiality of sex ratios – intra-regional and inter-regional – specific examples of India and China
- 3.3 Gender and economic space - placements and positioning of various genders in ‘work’ hierarchy
- 3.3 Gender and development – Gender Inequality Index. Gender Development Index, National Gender Index by India - Human rights and legal gender space - Indian context
- 3.4 Concepts of Gender Audit, Gender Budget, and Gender Empowerment

Unit 4 : Spatial Perspectives on Political Processes

(15 Hours)

- 4.1 Concepts of- territoriality, state, nation and nation- state - evolution of state during colonialism and post-colonial time
- 4.2 Theoretical perspectives on global political structure- critical analysis of Heart Land and Rim Land theories - Relevance of World Systems approach- Core-periphery structure
- 4.3 Boundary and Frontier concepts- Terrestrial and maritime context- Processes of boundary formation- cultural and ethnic identities.
- 4.4 Dynamics of electoral politics- Electoral System in India – Key Elements – Gerrymandering and associated politics

Suggested Reading Materials:

- 1. Adhikari, S. (1992). *Fundamentals of Geographical Thought*. Chaitanya Publishing House
- 2. Smith, D.M. (1977). *Human geography: a welfare approach*. Edward Arnold.
- 3. Dikshit, R.D. (2012). *The Art and Science of Geography: Integrated Readings*. PHI learning Private Limited.
- 4. Harvey, D. (1969). *Explanation in Geography*. Edward Arnold.
- 5. Johnston, R.J. et.al. (ed.) (1986). *The Dictionary of Human Geography*. Blackwell.
- 6. Peet, R. (1998). *Modern Geographical Thought*. Blackwell
- 7. Peet, R. and Thrift, N. (eds.) (2002). *New Models in Geography*. Unwin Hyman.
- 8. Kitchin R., Thrift, N. (eds.) (2009), *The International Encyclopedia of Human Geography*, Elsevier.
- 9. Glassner, M L, De Blij, H, J, Yacher, L. (1980): *Systematic Political Geography*, John Wiley.
- 10. Dear J. Michael and Flusty Steven, (eds.) (2002): *The Spaces of Post Modernity*, Blackwell, Massachusetts.
- 11. Benko Georges and Strohmayr Ulf, (eds.) (2004): *Human Geography- A History for the 21st Century*, Arnold, London.
- 12. Atkinson, D., Jackson, P., Sibley, D. and Washbourne, N. (eds.) (2005), *Cultural Geography, A Critical Geography of Key Concepts*, Tauris, I.B.
- 13. Cloke, P., Crang, P., Goodwin, M., (2004), *Envisioning Human Geographies*, Arnold.
- 14. Cloke Paul, Crang Philip and Goodwin Mark, (eds.) (1999): *Introducing Human Geographies*, Arnold, London.
- 15. Banerjee-Guha, S. (2004), *Space, Society and Geography*, Rawat, New Delhi.
- 16. Banerjee- Guha Swapna: *Space, Spatiality, Human Geography and Social Science: Politics of the production of Space*, Published in Transaction Institute of Indian Geographers, Vol.33, No.1, Winter 2011, pp 3-22, Pune.

Title of the Course – Tools and Techniques of Geographical and Spatial Analysis

Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC - 2	GEOG 509	Theory	Practical	04	120	CIE	ESE	Total
		00	04			00	100	100

Course Objectives:

1. Main objective is to get acquainted with various geographical tools useful for analysis of various geographical and human landscapes and development

Course Outcomes:

At the end of the practical course students must be able to practically:

CO 1. The students are expected to learn how various geographical tools can be used for geographical analysis.

CO 2. Student will get acquainted with various types of geographical resources like maps, aerial photographs, satellite imageries and so on. The same will offer them to develop the skills that are required in spatial planning and development.

Unit 1 : S.O.I. Topographical Maps:

(30

Hours)

1.1 Introduction Index to sheet- Scales- Conventional signs and symbols

1.2 Study and interpretation of topographical maps with reference to:

- Glacial; Fluvial, Aeolian and Coastal landforms
- Drainage pattern
- Land-use
- Settlement
- Transport and Communication

1.3 Study and interpretation of O.S sheets and USGS maps and Land-use.

Unit 2 : Aerial photographs and Satellite Images

(30 Hours)

2.1 Aerial Photography: Construction of stereo vision, Photo Interpretation and preparation of photo map, Determination and application of scale for distance, area and Determination height.

2.2 Aerial Photographs Interpretation - Satellite Image Interpretation, Conjunctive Use of Map, Aerial Photographs and Satellite Imagery

Unit 3 : Techniques of Soil and Sediment Analysis:

(30 Hours)

3.1 Soil profile, Weathering profile and Sedimentary Facies.

3.2 Textural analysis: Sieve analysis laboratory procedure; PHI, Millimeter and Microns Scale-

Grade; Methods of graphic representation of data-Histogram, Frequency curve, cumulative arithmetic and probability curve; Measures; Formulae for statistical parameters of grain size and interpretation.

3.3 The soil textural triangle: Drawing sand, silt and clay on triangular graph paper, identification of soil type and interpretation.

3.4 Chemical Analysis –pH, EC, Organic carbon, Colour and percentage of soil moisture determination.

Unit 4 : Techniques in Human Geography

(30 Hours)

4.1 Network Analysis:

a) Topological graphs -Connectivity- Calculations of Alpha, Beta and Gamma Indices.

b) Mapping of relative accessibility and connectivity – Matrices- point of minimum Aggregate travel distance

4.2 Measuring development: Choice and relevance of indicators - Calibration of ratios and indices - HDI, GII, GDI; Construction of diagrams and maps - Mapping and interpretation of Levels of development, Regional imbalance, Gender gap

Suggested Reading Materials:

1. Robinson, A. H. and Others (1995): Elements of Cartography, VI Edition, John Wiley & Sons, New York.
2. Anson, R. W. and Ormeling, F. J., (Ed.) (1993): Basic Cartography for Students and Technicians, Vol.I, International Cartographic Association and Elsevier Applied Science Publishers, London.
3. Dickinson, G. C. (1977) Statistical Mapping and the Presentation of Statistics, Edward Arnold Ltd., London.
4. Monkhouse, F. J. and H. R. Wilkinson, (1971): Maps and Diagrams, Methuen & Co. Ltd., London.
5. Hodgkiss, A. G. (1970): Maps for Books and Theses, David and Charles Publishers Ltd., London.
6. Misra R. P. and A. Ramesh, (1969): Fundamentals of Cartography, Prasaranga, University of Mysore
7. Young, P. V. and Schmid, C. F. (1979) : Scientific Social Surveys and Research, ntice Hall, New Delhi.
- 8 . Mahmood Aslam (1977), Statistical Methods in Geographical Studies, Rajesh Publication, New Delhi.
9. Hammond,R. and McCullagh,P.S. (1974), Quantitative Techniques in Geography: An Introduction, Oxford University Press, London.
10. Yeates, M (1974), An Introduction to Quantitative Analysis in Human Geography, McGraw Hill Book Co., New York.
11. Cole, J. P. and King, C. A. M., (1968), Quantitative Geography, John Wiley and Sons, London.
12. Fotheringham,A.S., Brunsdon, C., Charlton,M ,(2000) Quantitative Geography: Perspectives on Spatial Data Analysis, Sage Publication Ltd, London,
- 13 . Baily,T.C., and Gatrell, A. C, (1995), Interactive Spatial Data Analysis, Prentice Hall, London
14. Griffith ,D. A. , Layne, L.J.,(2002) A Casebook for Spatial Statistical Data Analysis: A Compilation of Analyses of Different Thematic Data Sets , Amazon.com
15. Wicox, P.R. (2003), Applying Contemporary Statistical Techniques, Academic Press, Amsterdam
16. Crang M. and Cook, I. 2007, Doing Ethnographies, Sage.

Title of the Course – On the Job Training / Internship

Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC - 2	GEOG 510	Theory	Practical	04	120	CIE	ESE	Total
		00	04			50	50	100

Course Objectives:

1. The students should get relevant industry, research, technological, work environment related, management, and advanced academic exposure.
2. To understand the practical applications of theoretical understanding

Course Outcomes:

CO1 : Students will have a working experience, research and industry exposure, exposure to new knowledge, and technological knowhow with reputed institutions, industries and equivalent organisations.

CO2 : Personal development, Personality Development, coping with work environment in terms of etiquettes, punctuality, and other such dimensions.

On the Job Training / Internship is mandatory as per the National Education Policy 2020. All the students are expected to complete a minimum of four weeks and a maximum of six weeks of on the job training or internship in the registered and recognized governmental, nongovernmental organisations, institutions, industries, and such equivalent establishments.

Title of the Course – Modern Land Surveying and Mapping Methods

Year – 1

Semester - II

Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSC - 2	GEOG 511	Theory	Practical	02	60	CIE	ESE	Total
		00	02			00	50	50

Course Objectives:

1. To get an understanding about various surveying instruments, its applications and data collection methods.
2. Use various application for the collection of spatial and nonspatial data

Course outcome:

After completion of this practical paper students will be able to

CO 1. calibration and handling of surveying instruments

CO 2. applications of surveying instruments

CO 3. applications of online utility to create maps and profile from geographical data iv) sources of mobile data collection platforms.

Unit 1: Application of Theodolite /Plane Table Survey

(15 Hours)

1.1 Definition of Surveying, Duties & Responsibilities of a Surveyor as per Government Regulation; Introduction to dumpy level survey- Rise and fall method, collimation level method and profile drawing.

1.2 Theodolite- Tachometry, Height & distance, Curve setting problems (Compound, Reverse & Transition), Traversing & Triangulation survey: Principle, Planning & Methods. Geodesy; Component parts of theodolite, technical terms; Theodolite data calculation- DMS to DD, calculation of slant distance, true distance, true height and reduce level. Plotting of theodolite data and contouring.

1.3 Types of Scale, Linear and Angular Measurements, Area & Volume – Calculations, Levelling, Contouring - Trigonometry & Rectangular Coordinate calculations - True North determination, Triangulation.

1.4 Plane Table Survey-Radiation, Intersection, Traversing, Resection

Unit 2: Application of GPS (dGPS) /UAV

(15 Hours)

2.1 Introduction to Differential GPS (dGPS) /UAV-

2.2 Principle and Functions

2.3 Practical exercises based on GPS

Unit 3 : Introduction to Total Station**(15 Hours)**

- 3.1 Principle and Function.
- 3.2 Process of data collection and analysis
- 3.3 Application of Total Station in Various Fields
- 3.4 Practical Exercises based on Total Station

Unit 4 : Applications of Apps and Data collection forms**(15 Hours)**

- 4.1 Google Earth Explorer
- 4.2 Google Earth Engine
- 4.3 KOBO Toolkit and its application in data collection and mapping
- 4.4 Qfield for QGIS

Suggested Reading Materials:

1. Surveying – Vol –II – By B.C. Punmia, A K Jain and A K Jain, Laxmi Publishers
2. Higher Surveying – Vol –II By B.C. Punmia, A K Jain and A K Jain, Laxmi Publishers
3. Surveying – Vol – I – By S.K.Duggal, Tata McGraw Hill Book Co.
4. Surveying – Vol – II – By S.K. Duggal, Tata McGraw Hill Book Co.
5. Advanced Practical Geography by Pijushkanti Saha, Partha Basu, Books and allied (P) Ltd.
6. <https://qfield.org/>
7. <https://www.kobotoolbox.org/>

Specialisation I : Earth Systems Science

Title of the Course – Hydrology - II -Hydrology and Water Intelligence								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51201	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. Understand the impact of climate change on the hydrological cycle and extreme water events.
2. Gain knowledge of various hydrological, meteorological, and remote sensing data sources.
3. Learn the fundamentals of Artificial Intelligence and Machine Learning for hydrologic modeling.
4. Develop proficiency in using modern tools and platforms such as QGIS, Python, and Google Earth Engine.
5. Explore smart and emerging technologies for water monitoring, ecohydrology, and decision-making.

Course Outcomes:

After completion of this course students will:

- CO1:** Analyze the effects of climate change on precipitation, streamflow, and hydrologic extremes like floods and droughts.
- CO2:** Identify, access, and apply different types of hydrological and climate-related datasets.
- CO3:** Apply machine learning algorithms for rainfall-runoff modeling and hydrologic forecasting.
- CO4:** Use geospatial and open-source tools for hydrologic analysis and visualization.
- CO5:** Evaluate and propose smart hydrology solutions using IoT, DSS, and ecohydrological approaches for sustainable water management.

Unit 1: Climate Change and Hydrologic Extremes

(15 Hours)

- 1.1 Climate change and hydrological cycle disruption
- 1.2 Detection of trends in precipitation and streamflow
- 1.3 Floods and droughts: indices, frequency analysis
- 1.4 Downscaling climate models for hydrological use

Unit 2: Data Sources

(15 Hours)

- 2.1 Remote Sensing data and GIS data
- 2.2 Meteorological data
- 2.3 Hydro-observation data
- 2.4 Climate Change data

Unit 3: AI and Machine Learning in Hydrology

(15 Hours)

- 3.1 Basic concepts of AI and ML
- 3.2 Overview of ML algorithms in hydrological modeling
- 3.3 Open-source tools: QGIS, Google Earth Engine
- 3.4 Tools: Python, Tensor Flow/Keras, WEKA

Unit 4: Smart Hydrology and Emerging Applications

(15 Hours)

- 4.1 IoT and sensor-based water monitoring systems
- 4.2 Smart cities and urban hydrology innovations
- 4.3 Eco hydrology and environmental flow modeling
- 4.4 Decision Support Systems (DSS) for water policy

Suggested reading materials:

1. Brooks, K. N., Ffolliott, P. F., & Magner, J. A. (2021). *Hydrology and the management of watersheds* (4th ed.). Wiley-Blackwell.
2. Cervone, G., Goel, N. K. M., & others. (2022). *Machine learning and data science in the geosciences*. Cambridge University Press.
3. Haan, C. T. (2023). *Statistical methods in hydrology*. Krieger Publishing Company. (Reprint edition)
4. Kumar, A. (2021). *Artificial intelligence in earth sciences: Best practices and applications*. Elsevier.
5. Lakshmi, V. (Ed.). (2021). *Remote sensing of hydrological extremes*. Springer.
6. Melesse, A. M. (Ed.). (2020). *GIS and remote sensing applications in hydrology*. Springer.
7. Owen, D. A. L. (2018). *Smart water technologies and techniques: Data capture and analysis for sustainable water management*. Wiley.
8. Singh, V. P. (Ed.). (2022). *Hydrologic modeling: Progress and future directions*. Springer.
9. Singh, V. P., & Singh, P. (2019). *Cryosphere hydrology: Snow, ice and climate change*. Springer.
10. Zaharin Aris, A., et al. (2020). *Decision support systems in water resources management and planning*. Springer.

Title of the Course – Morphodynamics of Fluvial Systems

Year – 1

Semester - II

Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51202	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To develop the skill of assessing the drainage basins and stream networks for watershed management.
2. To give an idea about the nature and patterns of streams and flows.
3. To enlighten on watershed management, GIS-based estimation of erosion and the scope and prospects of multipurpose projects

Course Outcomes: The students will be able to:

- CO 1. Delineate watersheds, differentiate them on the basis of their morphological properties.
 CO 2. Know the techniques of estimation of soil erosion using GIS techniques.
 CO 3. Develop a model for watershed development.

Unit 1 – Morphology of Fluvial Systems (15 hours)

- 1.1 Fluvial systems – components (geologic, topographic, hydrographic, atmospheric) and interrelations, Horton’s ‘belt of no erosion’
- 1.2 Geomorphic process of drainage basin evolution – Glock’s Model, Horton’ Model
- 1.3 Patterns of drainage basins – identification of different patterns from satellite images/toposheets
- 1.4 Morphometric characteristics of rivers – stream order models, stream density, stream frequency

Unit 2 – River Channel morphology and Streams Flow dynamics (15 hours)

- 2.1 River channels – evolution, types and forms (straight, meandering, anastomosing)
- 2.2 Channel Profiles – Longitudinal - obtaining a profile using DEM and toposheets, types and interpretation
- 2.3 Channel Cross Section – at a station geometry – width, depth, discharge and velocity
- 2.4 Stream Flow Dynamics – type of flow (laminar, turbulent) Stream Velocity, Stream Energy, Stream Competence and Capacity

Unit 3 – Riverine landscapes (15 hours)

- 3.1 Floodplains and levees – formation, morphology, delineation. LULC in floodplains and manning’s values
- 3.2 Deltas – evolution, morphology and types
- 3.3 Erosional landscapes – valleys, gorges, potholes

3.4 River rejuvenation – reasons and features

Unit 4 – Concerns and Solutions

(15 hours)

4.1 Erosion and channel siltation, effect on storage capacity of reservoirs and geospatial analysis

4.2 Channel acidification, eutrophication - geospatial techniques of mapping eutrophied channels

4.3 River pollution – cause, effects and solutions

4.4 River restoration – case studies

Suggested Reading materials:

1. Bridge, J., & Demico, R. (2008). *Earth surface processes, landforms and sediment deposits*. Cambridge University Press.
2. Carbonneau, P. E., & Piegay, H. (2012). *Fluvial remote sensing for science and management*. Wiley-Blackwell.
3. Charlton, R. (2007). *Fundamentals of fluvial geomorphology*, 2007.
4. Chaudhury, M. H. (2008). *Open channel flow*. Springer.
5. Crickmay C. H. (1974). *The work of the river olin Hayter*. American Elsevier Publishing Company.
6. Downs, P. W., & Gregory, K. J. (2004): *River Channel Management*. Arnold.
7. Faniran, A., & Jeje, L. K. (1983). *Humid tropical geomorphology*. Longman.
8. Fryirs, K. A., & Brierley, G. J. (2012). *Geomorphic analysis of river systems: An approach to reading the landscape*. Wiley.
9. Hickin, E. J. (1995). *River geomorphology*. Wiley-Blackwell.
10. Jarvis () *Network analysis*.
11. Jarvis, R. S. (1977). Drainage network analysis. *Progress in Physical Geography: Earth and Environment*, 1(2), 271–295. <https://doi.org/10.1177/030913337700100203>
12. Kale, V. S., & Gupta, A. (2001). *Introduction to geomorphology*. Orient Longman.
13. Leopold, L. B., Wolman, M. G., & Miller, J. P. (1964). *Fluvial processes in geomorphology*, W. H. Freeman, San Francisco.
14. Maiti, R. (2016). *Modern approaches to fluvial geomorphology*.
15. Miall, A. (2014). *Fluvial depositional systems*. Springer.
16. Morisawa, M. (1968). *Streams: Their dynamics and morphology*. McGraw-Hill.
17. Richards, K. (1982). *Rivers: Form and processes in Alluvial Channels*. Methuen.
18. Richards, K. (2004). *Rivers: Form and process of alluvial Channels*.
19. Robert, A. (2003). *River processes- an introduction to fluvial dynamics*. Arnold.
20. Rosgen, D. (1996). *Applied river morphology, Wild land Hydrology, Fort Collins, Colorado*.
21. Schumm, S. A. (1972). *River morphology* (3rd ed). Dowden, Hutchinson & Ross, the University of California.
22. Schumm, S. A. (1977). *Fluvial systems*. Wiley.
23. Schumm, S. A., & Khan, H. R. (1972). Experimental study of channel patterns. *Geological Society of America Bulletin*, 83, 1755–1770.
24. Sear, D. A., Newson, M. D., & Thorne, C. R. (2003): *Guidebook of applied fluvial geomorphology*, (Tech)
25. Sepehri, M., Ghahramani, A., Kiani-Harchegani, M., Ildoromi, A. R., Talebi, A., & Rodrigo-Comino, J. (2021). Assessment of drainage network analysis methods to rank sediment yield hotspots. *Hydrological Sciences Journal*, 66(5, April), 904–918.org (Crossref). <https://doi.org/10.1080/02626667.2021.1899183>

Other web resources: <https://archive.nptel.ac.in/courses/105/101/105101010/>

Title of the Course – Seismic Hazard Management

Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51203	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To impart knowledge on the mechanism of earthquakes and earthquake processes and related concepts – seismic waves, magnitude, measurement of magnitude.
2. To give an idea about the processing of seismic data, seismic precursors and their applications
3. To enhance the understanding about the seismogenic regions of the world including India, by discussing the seismotectonic characteristics of these regions and major events.
4. To create awareness about the seismic disaster management and levels of preparedness all over the world.

Course Outcomes:

After completing this course, the students will be able to

- CO 1. delineate the seismotectonic regions and prepare the earthquake distribution maps
- CO 2. read and interpret the fault plane solutions and seismographs
- CO 3. apply some precursors on seismic data sets and interpret the result
- CO 4. prepare disaster management plans – personal and community level

Unit 1: Earthquake Science and seismic hazard management (15 hours)

- 1.1 Plate tectonics and seismicity, faults and fault mechanisms and earthquakes, type of earthquakes,
- 1.2 Seismic waves – types and propagation, attenuation of wave amplitude with distance
- 1.3 Measurement of Earthquakes: seismograph and accelerometer, scales of measuring earthquake magnitude
- 1.4 Seismotectonics of the Indian plate and seismogenic regions of India, major seismic events in India and its surroundings.

Unit 2: Seismic data processing and applications (15 hours)

- 2.1 Seismic data – sources of seismic data and the nature of seismic data
- 2.2 Magnitude- Frequency relationship – Richter-Gutenberg Equation (b-value computation)
- 2.3 Seismic precursors – concept and reality, types – based on time and nature
- 2.4 Application of precursors (seismic gap, ‘b’ value) to seismic data sets

Unit 3: Seismic Precursors, Hazard and Vulnerability Assessment (15 hours)

- 3.1 Seismic Hazard Assessment –: Seismic history, seismic patterns and identification of sources,
- 3.2 Ground Motion Characterization: Peak ground acceleration, geotectonic conditions - N value) and seismic microzonation
- 3.3 Probabilistic Seismic Hazard Analysis (PSHA)
- 3.4 Deterministic Seismic Hazard Analysis (DSHA)

Unit 4: Seismic Vulnerability Assessment and Seismic Disaster Management (15 hours)

- 4.1 Seismic vulnerability assessment methods – empirical, analytical and hybrid
- 4.2 Key Components of assessment – Structural characteristics, site conditions, occupancy and usage of built structures
- 4.3 Advances in assessment techniques – Machine learning frameworks, VULMA project, seismic vulnerability indices, Bayesian Networks
- 4.4 Seismic disaster management - preparedness, mitigation, response and rescue and rehabilitation, risk assessment techniques

Suggested Reading Materials:

1. Baker, J. W. et al. (2021). *Probabilistic seismic hazard and risk analysis*. Cambridge University Press.
2. Baker, J., Bradley, B., & Stafford, P. (2021). *Seismic Hazard and Risk Analysis* (pp. V-Viii). Cambridge: Cambridge University Press.
3. Booth, E. D., & Key, D. (2006). *Earthquake design practice for buildings* (2nd ed). Thomas Telford.
4. Elnashai, A. S., & Di Sarno, L. (2008). *Fundamentals of earthquake engineering*. Wiley.
5. Hudson, D. E. (1995). Dynamics of structures: Theory and applications to earthquake engineering, by Anil K. Chopra, Prentice-Hall, Englewood Cliffs, NJ, 1995. No. of pages: Xxviii + 761, ISBN 0-13-855214-2. *Earthquake Engineering and Structural Dynamics*. Prentice Hall, ISBN 0-13-855214-2, 24(8, August), 1173–1173.org (Crossref).
<https://doi.org/10.1002/eqe.4290240809>
6. Muir-Wood, R. (1993). From global seismotectonics to global seismic hazard. *Annals of Geophysics*, 36(3–4, December), 10.org (Crossref). <https://doi.org/10.4401/ag-4261>
7. Panza, G. F., & Giuliano, F. (Eds.). (2011). *Advanced seismic hazard assessment*. Birkhauser Verlag.
8. Pinter, N., & Keller, E. A. (1996). *Exercises in active tectonics: An introduction to earthquakes and tectonic geomorphology*. Prentice Hall.
9. Stein, S., & Wysession, M. (2003). *An introduction to seismology, earthquakes, and earth structure*. Blackwell Publishing.
10. Sucuoğlu, H., & Akkar, S. (2014). *Basic earthquake engineering: From seismology to analysis and design*. Springer.
11. Tsapanos, T. M., & Burton, P. W. (1991). Seismic hazard evaluation for specific seismic regions of the world. *Tectonophysics*, 194(1–2, July), 153–169.org (Crossref).
[https://doi.org/10.1016/0040-1951\(91\)90278-Z](https://doi.org/10.1016/0040-1951(91)90278-Z)

Specialisation II: Urban and Regional Planning and Development

Title of the Course – Fundamentals of Urban and Regional Planning II								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51204	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The course is designed to make the students understand the basic element of spatial planning
2. The course offers a detailed discussion on different approaches, methods, issues and problems in planning

Course Outcomes:

- CO 1. The students are expected to develop in depth understanding about urban planning as well as regional planning.
- CO 2. The course would also expose them to various geographical datasets that are required for urban planning

Unit 1 : Urban and Regional Governance and Finance in India (15 Hours)

- 1.1 Evolution of Planning legislation in India - An overview of legal tools connected with urban planning and development, Town and country planning act
- 1.2 Institutions and Urban planning - Typology of institutions - their role, powers and significance (legal, political, social, cultural and economic institutions), formal and informal institutions – their interface, conflicts, classified work, and their effectiveness in planning: Analysing the institutions: Methods, process and evaluation.
- 1.3 Economics of Town Planning decisions - effects of legislation on land development and urban land economics.
- 1.4 Financial Planning and techniques - Public finance and resource mobilization: Some basic principles - Review of centre, state and local financial relationships – fiscal and financial freedoms - limitations – role of finance commission - procedures and method of financing

Unit 2 : Basic Elements of Environmental Planning (15 Hours)

- 2.1 Environmental planning – planning processes and tools and methods
- 2.2 Condept of Environmental Impact Analysis - methods and EIA matrices and networks – techniques of assessment– appraisal
- 2.3 Environmental ethics, laws and management –principles of ecological approach to urban and regional planning –environmental design in the context of natural resource management –public awareness and accountability

2.4 Environmental management systems –cleaner production and cleaner technologies – energy accounting and auditing – use of alternative sources – energy policies – norms and standards of clean air and water- reuse and recycling

Unit 3 : Infrastructure Planning

(15 Hours)

- 3.1 Elements of Urban Infrastructure, Types and role of Infrastructure - components of landuse integrated infrastructure planning
- 3.2 Provision of basic civic infrastructure - water, sanitation, electricity, solid waste management and transportation - overview of Development Planning Regulations, standards, guidelines, and gaps
- 3.3 Recent policies for urban and regional infrastructural development in India and spatial patterns and newer forms of urban Infrastructure Development in India - disparity and diversity
- 3.4 Case Studies – Infrastructure Development Plans - Examples from Global North and South

Unit 4 : Application of Geospatial Technologies in Urban and Regional Planning (15 Hours)

- 4.1 Various sources of data and information for urban regional planning - maps, satellite images, aerial photographs, data portals - scale and level of information
- 4.2 Cadestral maps, base maps, development plans - Land Information system - property tax, land revenue records
- 4.3 Mapping inventories and databases of urban utilities, services and infrastructural facilities
- 4.4 Various types of analysis - Proximity analysis, network analysis, crime mapping and analysis, fire safety analysis

Suggested Reading Materials:

- 1. Bagchi, S (2000): Financial Implications of Decentralisation: Issues Concerning Resource Mobilisation by Urban Local Bodies; *ArthVijnana* Vol.XLII; No.4.
- 2. Bagchi, S (2001): Financing Capital Investments in Urban Infrastructure: Constraints in Accessing Capital Investments in Urban Basic Services; *Economic and Political Weekly*; Vol.XXXVI; No.4.
- 3. Bagchi, S (2001): Private Provision of Public Utilities: Some Issues and Evidences from Indian Water and Sanitation Sector; *Nagarlok*; Vol.XXXIII; No.3.
- 4. Bahl, Roy. W (1998): Implementation Rules for Fiscal Decentralisation; Paper presented at the International Seminar on Land Policy and Reform; Taiwan Institute of Land Policy.
- 5. Bahl, R.W and J.F.Linn (1992). Urban Public Finance in Developing Countries, A World Bank Book, OUP Publication, New York.
- 6. Carrithers, D. F., and D. Peterson. 2006. "Conflicting Views of Markets and Economic Justice." *Journal of Business Ethics* 69:373–87.
- 7. Christensen, K. 1985. "Coping with Uncertainty in Planning" *Journal of the American planning Association* 51 (1): 63–73.
- 8. Commission of the European Community. 1999. *European Spatial Development Framework (ESDP)—Towards Balanced and Sustainable Development of the Territory of the EU*. Luxembourg: Office for Official Publications of the European Communities.
- 9. Mäntysalo, R., and I. Saglie. 2010. "Private Influence Preceding Public Involvement: Strategies for Legitimizing Preliminary Partnership Arrangements in Urban Housing Planning in Norway and Finland." *Planning Theory and Practice* 11 (3):317–38.
- 10. Adams, W.M. (2001): Green Development: Environment and Sustainability in the Third World, Routledge, London.
- 11. Agarwal, S.K. and Dubey, P.S. (2002): Environmental Controversies, A.P.H. Publishing Corporations, New Delhi.
- 12. Basu, D.(ed.)(1995): Environment and Ecology – The Global Challenge, Printwell, Jaipur.

13. Calvert P.S. (1999): The South, the North and the Environment, Pinter, London and New York.
14. Ewusie, J.Y. (1980): 'Elements of Tropical Ecology', Heinemann Educational Books Inc. London.
15. Gupta, A. (1988): 'Ecology and Development in the Third World', Routledge, London.
16. [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iitram.ac.in/public/frontend/Curriculum/hss/HS%20225002.pdf](https://iitram.ac.in/public/frontend/Curriculum/hss/HS%20225002.pdf)

Specialisation III: Climate Change and Sustainability Studies

Title of the Course – Climate Change Mitigation to Sustainability								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51205	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The course is designed to make students learn various dimensions of sustainability
2. It also offers experiential learning by studying the case studies on sustainable practices

Course Outcomes

- CO 1. Students would learn how to assess the impact of climate change through the praxis of vulnerability, risk assessment, and various global frameworks
- CO 2. How the sustainability practices can be replicated by adopting local terms and conditions

Unit 1 : Climate Change Mitigation - Vulnerability, Risk and Resilience (15 Hours)

- 1.1 Origins of the ideas of vulnerability, risk and resilience.
- 1.2 Climate Resilient Development Pathways
- 1.3 Interlinkages between vulnerability, adaptive capacity and resilience.
- 1.4 IPCC's changing stance on the vulnerability framework from AR 1 to AR 6. - Risk as an endpoint of vulnerability
- 1.5 Vulnerability frameworks : Socioeconomic and infrastructural vulnerability - Approaches to compute vulnerability. A critique of indicator based approaches.

Unit 2 : Sustainability in Perspectives and Space (15 Hours)

- 2.1 Concept of climate resilience - Frameworks of risk and resilience.
- 2.2 Approaches to quantify resilience in natural hazards: Indicator vs network based approaches.
- 2.3 Climate Change adaptation in developing nations. Technology based vs Nature based solutions to climate adaptive practices - Approaches to climate impact assessment.
- 2.4 Climate change and sustainable development

Unit 3 : Politics of Sustainability (15 Hours)

- 3.1 Role of International agencies in promoting sustainability – UN, UNEP, UNFCCC, etc.
- 3.2 Critical analysis of Millennium Development Goals to Sustainable Development Goals
- 3.3 Role of supranational institutions in shaping the perspectives on sustainability - international capital, global economic circuits, and sustainability
- 3.4 critical analysis of global efforts on climate change and sustainability – Critical analysis of policies on sustainable development in India

Unit 4 : Approaches to Sustainable Development

(15 Hours)

4.1 Modifying Behaviour to Achieve Sustainability: Learning and Pro environmental behaviour theories: Fostering Mindfulness, Gratitude and Hope - Social Norms and Emotional Contagion

4.2 System Thinking approach, World Viewing, Future and Design Thinking

4.3 Approaches to Sustainable Development: Appraisal of the Environment. Estimation of the Environmental Impact, Natural Resource Accounting, Government policies and Economic Outlook

4.4 Approaches to Sustainable Development: Positivist Approach, human development / opulence oriented approach, Multi-Dimension Approach, Ecosystem Approach and Livelihood Approach

Suggested Reading Materials:

1. Jenkins, R., (1987): Transnational Corporations and Uneven Development, Methuen.
2. Blake, D.H. and Walter, R.S., (1987): The Politics of Global Economic Relations, Prentice Hall.
3. Bagchi, A.K., (1989): The Political Economy of Underdevelopment, Cambridge University Press, 1982, Orient Longman.
5. Archibugi, D. and Michie, J., (eds.), (1997): Technology, Globalisation and Economic Performance, Cambridge University Press.
6. Hoogvelt, A., (1982): Third World in Global Development, Macmillan.
7. Cole, J.P., (1981): Development Gap, John & Wiley and Sons.
8. Kenwood, A.G. and Loughheed, A.L., (1983): The Growth of the International Economy, Alien and Unwin.
9. George, S., (1988): A Fate Worse than Debt, Grove Weidenfeld.
10. Chapman, K., (1979): People, Pattern and Process, Arnold Heinemann.
11. Adams, W.M., (1990): Green Development, Environment and Sustainability in the Third World, Routledge, London.
12. Sachs Wolfgang, (ed.), (1997): The Development Dictionary, Orient Longman.
13. Firoze Manji, (2006): 'Development and Rights', Rawat Publication
14. Hidenori Okahashi, (2008): 'Emerging new industrial spaces and regional development in India', Manohar.
15. D. Jayraj and S. Subramanian, (2010): Poverty, Inequality and population- Essays in Development and Applied Measurement, Oxford
16. Ramchandra Guha and Inequalities, (eds.) (1999): Institutions and Inequalities- essays in Honour of Andre Beteille, Oxford.
17. Ajit Muricken, (1997): 'Globalization and SAP Trends and impact An Overview', Vikas Adhayan Kendra Mumbai
18. IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [Stocker, T.F., D. Qin, G.K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. .
19. IPCC (2022): Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926
20. The Beginner's Guide to Representative Concentration Pathways By G. P. Wayne
21. IPCC (2021): Climate Change: the Physical Science Basis, Chapter 4.
22. Navroz Dubash (2011). Handbook of Climate Change in India. Routledge Publications,
23. India in a Warming World : Integrating Climate Change and Development. 2019. Edited by Navroz Dubash.

24. Kanitkar, T., Mythri, A., & Jayaraman, T. (2024). Equity assessment of global mitigation pathways in the IPCC Sixth Assessment Report. *Climate Policy*, 24(8), 1129–1148. <https://doi.org/10.1080/14693062.2024.2319029>
25. Vashold, L., Crespo Cuaresma, J. A unified modelling framework for projecting sectoral greenhouse gas emissions. *Commun Earth Environ* 5, 139 (2024). <https://doi.org/10.1038/s43247-024-01288-9>

Specialisation IV: Human Geography and the Human Systems

Title of the Course – Indian Foreign Policy								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51206	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To introduce the students about the changing Indian foreign policy in the rapidly changing global geopolitics
2. To understand the basis of formation of international relations to different countries

Course Outcome:

It is expected that course will equip the students in

CO 1. Understanding the various factors affecting the India foreign policy making

CO 2. To make students aware about the evolution of international relations of India vis-à-vis other countries

Unit 1: Indian Foreign Policy

(15 hours)

- 1.1 Historical background and evolution of Indian foreign policy – Determinants, Institutions and actors in the making of Indian Foreign policy
- 1.2 Strategic and core philosophy and drivers of foreign policy like Panchsheel, Nonalignment Movement – neighbourhood first
- 1.3 Strategic issues impacting Indian Foreign Policy - Case Studies and Examples
- 1.4 – Recent shift in Indian foreign policy – comparison between post-independence period and post globalisation period – shifts and drifts – Impact on the relations with neighbouring countries and external powers

Unit 2 : Indian Diplomacy

(15 hours)

- 2.1 Indian Diplomacy – Various aspects of Indian Diplomacy – key features of Indian Diplomacy – various strategies of diplomacy
- 2.2 Types of Indian Diplomacy - Hard Power and Soft power - various approaches to India diplomacy
- 2.3 Strategic Partnership and balancing - Regional Engagement and neighborhood first policy
- 2.4 Case studies of successful diplomatic resolutions

Unit 3 : Various Indian Foreign Policies

(15 hours)

- 3.1 Maritime policy – India and Indian ocean – various efforts of protection, legalisation and authority and collective establishment of claims

3.2 Defence policy – Key features of Indian defence policy – actors, processes and determinants of the policy – recent shifts

3.3 Nuclear policy – major features of nuclear policy – disarmament, CTBT, NPT, Nuclear deal

3.4 Role of foreign policies in shaping the international relations of India – case studies

Unit 4 : Policies focusing the Indian states

(15 hours)

4.1 North-Eastern States and associated policies - Look East Policy - Act East Policy

4.2 Jammu and Kashmir - evolution of various policies since independence to tackle the issues in the valley

4.3 Various policies for the development of border states - BADP - CIBMS - ICPs -FMR and Border Road development - Vibrant Village Program

4.4 India- Bangladesh Land Boundary Agreement - history, evolution and exchange of enclaves – Similar case studies of successful negotiations

Suggested Reading Materials:

1. Jain, B. M., Global Power: India's Foreign Policy 1947-2006 (Lexington Books, 2008).

2. Rajan, Mannaraswamighala Sreeranga, Studies on India's Foreign Policy (ABC Pub. House, 1993)

3. Jayapalan, N., Foreign policy of India (Atlantic Publishers & Distributors, 2001)

4. Gupta, K.R. & Vatsala Shukla, Foreign Policy of India (Atlantic Publishers & Distributors, 2009)

5. Mansingh, Lalit et al, eds., Indian Foreign Policy: Agenda for the 21st Century, Vol.1 and 2, New Delhi: Foreign Services Institute with Konark, 1998)

6. Sinha, A. and M. Mohta (eds), Indian Foreign Policy: Challenges and Opportunities, (New Delhi: Academic Foundation. 2003)

7. P. M Kamat, Emerging International Order and Foreign Policy Options for India (Indian Academy of Social Sciences, 1999)

8. Khanna, V N. Foreign Policy of India. new delhi: Vikas Publishing House, 2018.

9. Bandyopadhyay, Jayantanuja, The Making of India's Foreign Policy (Calcutta: Allied Publishers, 2003)

10. Chandra, Bipan, India After Independence 1947-2000 (New Delhi: Penguin, 2000)

11. Harshe, Rajen and K.M.Seethi (eds.), Engaging With the World: Critical Reflections on India's Foreign Policy (Hyderabad: Orient Longman, 2005), pp.25-40

12. Kapur, Harish, India's Foreign Policy – Shadows and Substance (New Delhi: Sage, 1994)

13. Ramakrishnan, A.K., "Neoliberal Globalist Transformations in India's Foreign Policy: Implications for West Asia and North Africa", in Anwar Alam (ed.), India and West Asia in the Era of Globalisation (New Delhi: New Century Publications, 2008), pp.25-30

14. Shastri, Amita and Wilson, Jeyaratnam (Eds), The Post-Colonial States of South Asia Democracy, Development and Identity (Palgrave Macmillan 2001)

15. J. N Dixit Assignment Colombo (New Delhi: Konarak Publishers, 1998)

16. Stephen P. Cohen, India Emerging Power, New Delhi, Oxford University Press, 2002

17. Wilson, Jeyaratnam and Dalton, Dennis (Eds), The States of South Asia (New Delhi: Vikas)

18. https://www.mcrhrdi.gov.in/5th_mesfc2023/week9/INDO-CHINA%20RELATIONS-An%20Overview.pdf

19. <https://www.state.gov/united-states-india-relations/>

20. https://www.mea.gov.in/Portal/ForeignRelation/Bilateral_Brief_as_on_09.10.2023.pdf

Title of the Course – Fundamentals of Tourism Development and Planning

Year – 1

Semester - II

Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSE - 2	GEOG 51207	04	00	04	60	50	50	100

Course Objectives :

1. To get an understanding about tourism products and types, planning, development and management of different types of tourist destinations attracting different types of tourists.

Course outcome: After completion of this paper students will be able to

CO 1. Understand tourism as a system and its different components

CO 2. Identify the various types of tourist attractions and comprehend how the various types of tourist attractions can attract different types of tourists

CO 3. Assess the status and requirement of tourist infrastructure and amenities

CO 4. Identify the types of tourist destinations and the characteristics that brand the destinations

CO 5. Planning and management of sustainable tourism destinations

Unit 1 : Tourism as a system

(15 Hours)

1.1 Tourism system – definition – components

1.2 Leiper's Tourism System Model

1.3 Mill and Morrison's Consumer Behaviour Model

1.4 Travel-Buying Behaviour Model by Mathieson and Wall

Unit 2 : Tourist attractions, infrastructure & amenities

(15 Hours)

2.1 Tourist Attractions – elements of attraction - functions and importance of attractions

2.2 Attraction types- natural, historical, cultural, religious, adventure

2.3 Types of infrastructure: Accommodation – types, capacity & services; Restaurants & eateries – types of establishments, types of food and services offered; Transport and travel services- transport network, means & modes of transport to and within destination

2.4 Other services - Shopping & recreational facilities; safety & security; other basic amenities

Unit 3 : Tourist Destinations

(15 Hours)

3.1 Types & characteristics

3.2 Destination image and branding - tourist gaze - sight sacralization

3.3 Comprehensive destination assessment, GSTC destination criteria

3.4 Planning & management of tourism destinations -strategic planning

Unit 4 : Tourism Development & Planning

(15 Hours)

- 4.1 Tourism product – definition – product development and types -relationship between tourism production and consumption
- 4.2 Tourism development – concept and determining factors - key aspects - stages of development - Butler's Tourist Area Life Cycle Model)
- 4.3 Tourism development strategy
- 4.4 Smart tourism principles

Suggested Reading Materials:

- 1 Boniface, B.G. and Cooper, C.P. (1987). *The Geography of Travel and Tourism*. Butterworth-Heinemann
- 2 Costa, R.A., Brandao, F., Breda, Z. & Costa, C. (2021). *Planning and managing the Experience Economy in Tourism*. IGI Global.
- 3 Dwyer, L., Forsyth, P. & Dwyer, W. (2010). *Tourism Economics and Policy*, Bristol. Blue Ridge Summit: Channel View Publications <https://doi.org/10.21832/9781845411534>
- 4 Edgell, D.L. Sr. & Swanson, J.R. (2018). *Tourism Policy and Planning: Yesterday, Today and Tomorrow*. Routledge
- 5 Fennell, D. (1999). *Ecotourism: An Introduction*. Routledge.
- 6 MacCannell, D. (1976). *The Tourist: A New Theory of the Leisure Class*. University of California Press
- 7 Pearce, D.G. (1987). *Tourism Today: A Geographical Analysis*. Longman.
- 8 Pearce, D.G. (1989). *Tourism Development*. Longman.
- 9 Rodrigue, Jean- Paul (2020). *The Geography of Transport Systems* (5th Edition). Routledge
- 10 Singh, R. (2007). *Infrastructure of Tourism in India*. Kanishka Publishers.
- 11 Songshan (Sam), H. (2021). Tourist Motivation. In R. Sharpley (Ed.), *Routledge Handbook of the Tourist Experience*. (pp.200-211). Routledge. <https://www.routledgehandbooks.com/doi/10.4324/9781003219866-18>
- 12 Urry, J. (1990) *The Tourist Gaze: Leisure and Travel on Contemporary Societies*. Sage.
- 13 Yoshi S. (2022). *Sustainable Tourism Supply Chain Management: Influence, Drivers, Strategies, and Performance*. Springer.
- 14 Papers
- 15 Butler, R.W. (1980). The concept of a tourist area cycle of evolution: implications for management of tourist resources. *The Canadian Geographer*, 24 (1):5-12.
- 16 Jennie Germann Molz (2022). Tourism geopolitics: assemblages of infrastructure, affect, and imagination. *Journal of Sustainable Tourism*, DOI: 10.1080/09669582.2022.2134402
- 17 Leiper, N. (1990). Tourism Attraction Systems. *Annals of Tourism Research*, 17(3): 367-384
- 18 Pearce, P.L., Morrison, A.M. & Moscardo, G.M. (2003). Individuals as tourist icons: a developmental and marketing analysis. *Journal of Hospitality & Leisure Marketing* 10(1/2):63-85.
- 19 Plog, S.C. (2002). The power of psychographics and the concept of venturesomeness. *Journal of Travel Research*, Vol. 40
- 20 Richards, G. (2002). Tourism attraction systems: Exploring Cultural Behaviour. *Annals of Tourism Research*, 29 (4): 1048-1064. Accessed from https://www.researchgate.net/publication/238378114_Tourism_attraction_systems

Title of the Course – Population Geography II								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51208	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives :

1. To get acquainted with basics of population studies along with historical background and sources of Demographic Data.

Course outcome: After completion of this paper students will be able to

CO 1. Learn fundamental concepts in population studies.

CO 2. Able to understand the history of population in terms of growth and trends

CO 3. Examine different sources of demographic data and methods used in data collection.

Unit 1 : Theoretical Perspectives in Population Geography (15 Hours)

1.1 Population Growth – Attitudes and Interpretations – Malthusian, Neo-Malthusianism and Marxist viewpoint

1.2 Critical Understanding of Demographic transition theory

1.3 Demographic Dividend, Demographic Equation and Demographic Window

Unit 2 : Demographic Shifts: Trends, Size, and Growth (15 Hours)

2.1 World Population Growth- a brief history, Historical Population trends

2.2 Trends and growth of India's population- a brief history

2.3 Population Problems- pre and post independence

2.4 Demographic Profiles of India and States

Unit 3 : Analyzing Age-Sex Distributions in Population Studies (15 Hours)

3.1 Definition: Age and Sex, Sex-Ratio

3.2 Classification of age group and its significance

3.3 Measures of age structure

3.4 Factors affecting age and sex structure

Unit 4 : Demographic Data: Types and Sources (15 Hours)

4.1 Types of Demographic Data

4.2 Different sources of Data

4.3 Population Census in World and India, Vital Registration System, Sample Registration System

(SRS), Survey on Causes of Death

4.4 National Sample Survey Organisations Survey (NSSO), National Family Health Survey (NFHS), District Level Household and Facility Survey (DLHS)

Suggested Reading Materials:

1. Aitken, S and Valentine, G. (2006), Approaches to Human geography, Sage.
2. Johnston, R.J., Gregory D. Pratt G. and Watts M., (2005, 5th ed.), the Dictionary of Human Geography, Blackwell.
3. Henry S. Shryock, Jacob S. Siegel, Elizabeth A. Larmon (1973) The Methods and Materials of Demography, Chapters 1, 2, 3, 7, 9, 10, Elsevier Science, USA.
4. John Weeks (2005): Population: An Introduction to Concepts and Issues, Wordsworth Learning. Singapore 9th edition.
5. Bhende, A. and T. Kanitkar, (2006): Principles of Population Studies Himalaya Publishing House, Bombay. 5. United Nations, World Population Ageing, 1950-2050
6. Davis, Kingsley (1968) . The Population of India and Pakistan, Russell and Russell, New York 7. United Nations (1958). Multilingual Demographic Dictionary, John Wiley & Sons Ltd., New York
7. Demko, G, J., Rose, H.M., Schnell, G.A. (1970): Population Geography: A Reader, McGraw Hill, New York
8. Clarke, J.I. (1971): Population Geography and the Developing Countries .
9. Harper, C.L. (2001): Environment and Society, Human Perspectives on Environmental Issues, Prentice Hall, New Jersey.
10. Ehrlich. P.R., and Ehrlich, A.M.(1992): Population Explosion, Doomsday, New York.
11. Saare, P. and Blunder, J. (eds.) (1995): An Overcrowded World? Population, Resources and Environment, The Open University, Oxford.
12. Johnston, R.J. and Taylor, P. (eds.): The World in Crisis, Oxford: Blackwell.
13. Potter, R.B., Binns, T., Elliott, J.A. and Smith, D. (1999): Geography of Development, Longman.
14. Srinivas, K. and Vlanol, M, (2001): Population, Development Nexus in India: Challenges for the New Millenium, Tata McGraw Hill, New Delhi.
15. Ackermann, E.A. (1959): Population and Natural Resources in Hauser, P.M. and Duncan, O.D,(eds.) The Study of Population, Chicago

Title of the Course – Geography of Society and Culture - II

Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51209	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objective:

1. To acquaint students about the urban social and cultural spaces with special reference to India
2. To introduce to students the roles and importance of culture and social structures in the socio-spatiality of cities
3. To acquaint the students about social and cultural segregations and division of urban spaces and how to address the same

Course Outcome:

The students will develop

CO 1. An understanding of Importance and role of social structure in city's social formation or urban sociality

CO 2. Skills to measure social and spatial segregations through Dissimilarity Index and Entropy Index

CO 3. An understanding of policy measures and how to design the same to address the urban social and cultural problems

Unit 1: Urban Social Geography

(15 Hours)

- 1.1 Introduction – scope and content
- 1.2 Different Approaches used – positivist approach, behavioural approach, structuralist approach, humanism, poststructuralist approach
- 1.3 Urban spaces and places – Social construction of urban spaces and places
- 1.4 Micro-geographies of the cities

Unit 2: Cultural Characteristics of the Cities

(15 Hours)

- 2.1 Culture of cities – meaning – elements of culture – urban landscape
- 2.2 Diversity and difference -cultural diversities - religious places and secular spaces
- 2.3 Identities; hybridity

Unit 3: Spatial Segregation and Exclusion

(15 Hours)

- 3.1 Spatial Segregation and Social polarization – urban deprivation
- 3.2 Measuring social exclusion and spatial segregation - Dissimilarity Index, Entropy Index;
- 3.3 Spatial segregations – economic, social and cultural factors - citadel, gated community, enclave, ghettos

3.4 Measures to address the socio-spatial segregations and exclusions

Unit 4: Urban Mobilities

(15 Hours)

- 4.1 Residential mobilities and neighbourhood change – pattern of mobilities - determinants of mobilities
- 4.2 Impacts of residential mobilities - Social and demographic impacts, housing and transportation impacts
- 4.3 Urban renewal and gentrifications

Suggested Reading Materials

- 1 Banerjee-Guha, S. (2004): Space, Society and Geography, Rawat, New Delhi.
- 2 Clemente, A., Lindstrom, D. and Stobart, J. (2023): Micro-geographies of the Western City, c. 1750-1900, Routledge, New York.
- 3 Horton, J. and Kraftl, P. (2013): Cultural Geographies: An Introduction, Routledge, New York.
- 4 Judge, P.S. (2014): mapping Social Exclusion in India, Cambridge University Press, Cambridge.
- 5 Knox, P. and Pinch, S. (2006): Urban Social Geography: An Introduction (Fifth Edition), Pearson, Prentice Hall, London.
- 6 Lefebvre, H. (1991): The Production of Space, Wiley Blackwell, Oxford.
- 7 Lefebvre, H. (2003) : The Urban Revolution, University of Minnesota Press, Minneapolis.
- 8 Michael, P. (2009) : Urban Geography: A Global Perspective, Routledge, New York.
- 9 Sattar, S. (2018): Social Exclusion and Muslims of Kolkata. In Shaban, A. (ed.) Lives of Muslims in India. Routledge, New Delhi/ London.
- 10 Shaban, A., Aboli, Z. (2021). Socio-spatial Segregation and Exclusion in Mumbai. In: van Ham, M., Tamaru, T., Ubarevičienė, R., Janssen, H. (eds) Urban Socio-Economic Segregation and Income Inequality. The Urban Book Series. Springer, Cham.
- 11 Sibley, D. (1995): Geographies of exclusion: society and difference in the West, Burns & Oates, New York.
- 12 Sidhwani, P. (2015): Spatial Inequalities in Big Indian Cities, Economic & Political Weekly, Vol 1. No.22: pp 55- 62.
- 13 Singh, R.P.B. (2016). Urban Heritage and Planning in India: A Study of Banaras. In: Dutt, A., Noble, A., Costa, F., Thakur, R., Thakur, S. (eds) Spatial Diversity and Dynamics in Resources and Urban Development. Springer, Dordrecht.
- 14 Smith, N (1996): The new urban frontier: Gentrification and the Revanchist City, Routledge, London.
- 15 Soja, E. (1989): Postmodern Geographies: The Reassertion of Space in Critical Social Theory, Verso, London.
- 16 Vithayathil, T. and Singh, G. (2012): Spaces of Discrimination: Residential Segregation in Indian Cities, Economic & Political Weekly, Vol 47. No. 37.
- 17 Zukin, S. (1996): The Culture of Cities, Wiley-Blackwell, Chichester.

Specialisation V: Geospatial Technologies

Title of the Course – Geospatial Information Processing								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51210	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The main objective of the course is to learn how to generate information about the Earth from data stored and processed in Geographic Information Systems.

Course Outcomes:

At the end of this course, students must be able to:

CO 1. Explain the principles and use the vocabulary of GIS:

CO 2. Describe the nature of geographic phenomena and their representation in the context of geoinformatics;

CO 3. Outline the principal data models for spatial and non-spatial data used in GIS databases;

CO 4. Outline the main components of a GIS and their functions;

CO 5. Explain the relationship between spatial data and coordinate systems;

CO 6. Outline the main spatial data analysis functions;

CO 7. Outline the principal rules for cartographic visualization;

Unit 1 : Geographic Information System and spatial data models (15 Hours)

1.1 Introduction to GIS:

The nature of GIS; Capabilities of GIS; Geographic phenomena, geographic fields, geographic objects; The real world and representations of it

1.2 Geographic information and Spatial data types:

Models and representations of the real world, Computer representations of geographic information, Organizing and managing spatial data, The temporal dimension

1.3 Spatial Data Models: Vector and Raster, Vector representation (point, line, area and TIN)

Unit 2 : Database Management System and GPS (15 Hours)

2.1 Database Management Systems (DBMS): DBMS, The Relational Data Model, Querying a relational database

2.1 Spatial referencing and positioning: Spatial referencing- Reference surfaces for mapping, Coordinate systems, Map projections, Coordinate transformations

2.3 Satellite-based positioning- NAVSTAR GPS, GLONASS and Galileo; Segments of satellite based positioning system; Absolute positioning, Errors in absolute positioning, Relative positioning, Network positioning, Code versus phase measurements, Positioning technology, DGPS

Unit 3 : Spatial Data and Spatial data Visualization

(15 Hours)

- 3.1 Spatial data input and Data preparation: Direct spatial data capture, Indirect spatial data capture, Other sources of spatial data, Data checks and repairs, combining data from multiple sources
- 3.2 Data quality and Point data transformation: Accuracy and precision, Positional accuracy, Attribute accuracy, Temporal accuracy, Lineage, Completeness, Logical consistency; Interpolating discrete data, Interpolating continuous data
- 3.3 Data visualization: GIS and maps, The visualization process, Visualization strategies: present and explore, The cartographic toolbox, Mapping of qualitative data, quantitative data, the terrain elevation data and map time series; Map setup, Map dissemination

Unit 4 : Spatial data analysis:

(15 Hours)

- 4.1 Retrieval, classification and measurement; Spatial selection queries
- 4.2 Overlay functions- Vector overlay operators- intersection, union, difference, complement; Raster overlay operators- arithmetic operators, comparison and logical operators, conditional expressions, overlays using a decision table
- 4.3 Neighbourhood functions- Search, buffer, interpolation, topographic functions; Proximity computations, Computation of diffusion, Flow computation, Raster based surface analysis; Filtering
- 4.4 Network analysis; Characteristics of application models, GIS and application models

Suggested Reading Materials:

- 1. Agrawal, N.K.(2006), Essentials of GPS (Second Edition), Book Selection Centre, Hyderabad
- 2. Bernhardsen, Tor (2002): Geographical Information Systems: An Introduction, Third Edition, John Wiley & Sons, Inc., New York.
- 3. Burrough, Peter A and McDonnell, R.A. (1998): Principles of Geographical Information Systems, Oxford University Press, Mumbai.
- 4. Clarke, Keith C. (1998): Getting Started with Geographic Information Systems, Prentice-Hall Series in Geogl. Info. Science, Prentice-Hall, Inc. N.J.
- 5. Dykes, MacEachren & Kraak (eds.) (2005), Exploring Geovisualization
- 6. Heywood, I. et al (2002): An Introduction to Geological Systems, Pearson Education Limited, New Delhi.
- 7. Huisman O. and R.A. de By (ed.), 2009: Principles of Geographic Information Systems - An introductory textbook, 4th ed., ITC, ISBN 90-6164-269-5
- 8. Kang-tsung Chang (2017) Introduction to Geographic Information Systems, McGraw Hill Education; 4th edition
- 9. Krygier & Wood (2005) Making maps: a visual guide to map design for GIS
- 10. Lillesand, Thomas and Ralph Kifer (1994). Remote Sensing and Image Interpretations, John Wiley and Sons, Inc., New York.
- 11. MacEachren (1995), How map work
- 12. Menno-Jan Kraak and Ferjan Ormel (2020) CARTOGRAPHY: Visualization of Geospatial Data, CRC press.
- 13. M. Anji Reddy (2012) Remote sensing and geographical information systems, 4th edition, B. S. Publications.
- 14. Michael N. DeMers (2009) Fundamentals of Geographic Information Systems, John Wiley & Sons.

15. Paul A. Longley, Michael F. Goodchild, David J. Maguire (2005) Geographic Information Systems and Science, 2nd Edition, John Wiley & Sons.
16. Parker, R. N. (2008), GIS and Spatial Analysis for the Social Sciences, Routledge, New York.
17. Pickles, John (2006), The Social Implications of geographic Information Systems, Rawat Publications, Jaipur.
18. Star, Jeffrey and John Estes (1996), Geographical Information Systems: An Introduction, Prentice-Hall, inc., N.J.
19. Shekar, S and Chawla, S, (2009), Spatial Databases: A Tour, Pearson Education, Delhi.
20. Slocum et. Al. (2009), Thematic Cartography and Geovisualization

Title of the Course – Applied Remote Sensing and GIS in Earth System Studies								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51211	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. To teach Students Remote Sensing and GIS in context of Geography
2. At the end of course students will understand the importance of Remote Sensing and GIS in Geography
3. Students will understand applications of Remote sensing and GIS in the solving of geographical problems.

Course Outcomes:

After completion of this course students will:

CO 1. Theoretical explanation based on case studies related to geographical problems will enhance the understanding of the students.

CO 2. Students will understand how GIS and Remote sensing tools can be used for Geographical studies.

Unit 1: Water Resources Applications

(15 Hours)

- 1.1 Remote Sensing of Water
- 1.2 Flood Mapping and Management
- 1.3 Rain water Harvesting and Water Quality Mapping
- 1.4 Drought Monitoring

Unit 2: Soil Applications

(15 Hours)

- 2.1 Remote Sensing of Geomorphology and Soil
- 2.2 Soil Moisture mapping
- 2.3 Soil Status Monitoring
- 2.4 Waterlogging and Saline soil areas

Unit 3: Forestry Applications

(15 Hours)

- 3.1 Remote Sensing of Vegetation
- 3.2 LULC- Forestry change detection
- 3.3 Forest resource Inventory
- 3.4 Forest Fire damage assessment

Unit 4: Urban Applications

(15 Hours)

- 4.1 Remote Sensing of Urban
- 4.2 Mapping and Updatations of city/town maps
- 4.3 Urban Sprawl Monitoring – Town planning
- 4.4 Facility management – GIS database development

Suggested reading materials:

1. Avery, T.E., and G.L. Berlin, (1992) Fundamentals of Remote Sensing and Air photo Interpretation, New York: Macmillan.
2. Burrough P.A. and McDonnell R.A., (1998) Principles of Geographical Information Systems,.Oxford University Press. New York.
3. Campbell, J.B., (2002) Introduction to Remote Sensing, 3rd ed., New York: Guilford Press.
4. Chang, K, (2020) “Introduction to Geographical Systems”, 4th Edition, Tata McGraw-Hill.
5. DeMers, M.N., (2009)“Fundamentals of Geographical Information Systems”, 3rd Edition, John Wiley & Sons.
6. Elachi, C., (1987) Introduction to the Physics and Techniques of Remote Sensing, Hoboken, NJ: Wiley.
7. Ian Heywood Sarah, Cornelius and Steve Carver (2002) An Introduction to Geographical Information Systems. Pearson Education. New Delhi.
8. Irons, J.R., J.L. Dwyer, and J.A. Barsi, (2012) “The Next Landsat Satellite: The Landsat Data Continuity Mission,” Remote Sensing of Environment, vol. 122.
9. Jensen, J.R., and R.R. Jensen, (2013) Introductory Geographic Information Systems, Glenview, IL: Pearson Education, Inc.
10. Jensen, A R (2013) REMOTE SENSING OF THE ENVIRONMENT: AN EARTH RESOURCE PERSPECTIVE, 2nd Edition, Pearson Education, Inc.
11. Lillesand, T.M. and Kiefer, R.W., (2015) Remote Sensing and Image Interpretation 7th Edition. John Wiley and Sons, New York.

Title of the Course – Advanced Geospatial Analysis								
Year – 1				Semester - II				
Course Type	Course code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
DSE - 2	GEOG 51212	Theory	Practical	04	60	CIE	ESE	Total
		04	00			50	50	100

Course Objectives:

1. The main objective of the course is to learn advanced geospatial analysis using geospatial data within Remote Sensing and Geographic Information Science.

Course Outcomes:

At the end of this course, students must be able to:

- CO 1. Explain the advanced methods of geospatial analysis;
- CO 2. Describe various methods for advanced geospatial analysis;
- CO 3. Study and understand basic and advanced photogrammetric task, its input-output and applications in the context of Remote Sensing and GIS;
- CO 4. Study and understand Geo-statistics and spatial statistics;
- CO 5. Study and understand Object Based Image Analyses (OBIA) as one of the advanced image processing techniques;
- CO 6. Study and understand Multi Criteria Decision Making (MCDM) methods and AHP as one of the MCDM methods;
- CO 7. Integrate advanced geospatial analysis to solve real world problem;

Unit - 1. Digital Photogrammetry, Orthoimages and DEM

- 1.1 Very High-Resolution Sensors: sensor/image selection criteria, satellite vs airborne cameras, line vs frame cameras, digital camera vs film camera products
- 1.2 Topography from Images: Topo mapping activities and plans, data modelling, conventional data collection, systems, quality control; Sensor orientation- imaging process, interior and exterior orientation, orientation task with one or two images, aerial triangulation- independent model vs bundles, direct georeferencing; Image matching; Digital orthophoto/ orthoimage production- basic concepts and products, demands and applications, image distortion and correction, production and quality.
- 1.3 DEM extraction from stereo images: Cartosat-1 stereo images, Block file, Image Orientation,

Projection and Datum Selection, Collection of the GCPs, Tie Points, Aerial Triangulation, Accuracy of the DEM, Extraction of the DEM, Generation orthoimages; Concept of mosaics.

1.4 DEM/ DTM /DSM: Concept, Demand, DTM data processing, Spatial interpolation, DEM applications, available DEM data sets, DEM from Photogrammetry, DEM from topographical maps (from contours), DEM from GPS and surveying instruments, Surface analysis – slope, aspect, flow direction, flow accumulation, curvature; profile analysis from DEM; River basin delineation and drainage network analysis; DEM Statistics.

Unit- 2. Geo-statistics and Spatial Statistics

2.1 Geo-statistics and Spatial statistics, Descriptive statistics and regression, Introduction to spatial analyses, spatial correlation, Spatial sampling- Types of sampling; Theory of random functions and modelling the variogram, the variogram- variogram models, variogram parameters, variogram cloud.

2.2 Spatial interpolation- Types of kriging, Ordinary kriging- from variogram estimation to prediction (kriging), Kriging as the Best Linear Unbiased predictor, the spatial mean, the kriged predictor, the kriging variance, the nugget effect; Applications of variogram and ordinary kriging; Block kriging, Universal kriging, Kriging with External Drift, Simple kriging, Regression kriging; Inverse Distance Weighting Interpolation Method; Other methods of spatial interpolation.

2.3 Lattice data- the nature of georeferenced data, exploratory spatial data analyses.

2.4 Spatial autocorrelation concept; Global measures- Moran's I, Geary's C, Ripley's K function; Local measures- Hot Spot Analysis (Getis-Ord G_i^*); Point pattern analysis.

Unit - 3. Object Based Image Analyses

3.1 Multispectral images; Introduction to Object-oriented analysis/Object Based image analysis-Trial and error segmentation, Segmentation parameters; three approaches- Thresholding, Edge detection and region-based segmentation; Classification, implementation.

3.2 Rules and membership (classification types) – Nearest neighbor (NN), Membership factions, Rule-based (can also contain NN and memberships).

3.3 Software's for OBIA; writing rule sets for complex analyses- landslide properties using OBIA, shape-based classification, Applications of OBIA- Mapping and updating forest, environmental resource management and agriculture, land use land cover and urban applications.

3.4 Drone mapping using Geographical Information Science; Photogrammetry and drone mapping, GIS and drone mapping, Applications of drone mapping.

Unit -4. Multi Criteria Decision Making and AHP:

4.1 Multi Criteria Decision Making- spatial and non spatial decision making, assigning values to criteria, weightage; MCDM and GIS.

4.2 Decision Support System and GIS- Characteristics of DSS, GIS and DSS, SDSS building.

4.3 Multi-Criteria Decision Making Methods- decision environment, MCDM methods.

4.4 Analytical Hierarchical Processes (AHP)- hierarchical division, pairwise comparison, performance score derivation, inconsistency; Integration of advanced geospatial analysis to solve real world problems.

References:

1. Alfred Stein, Freek van der Meer, & ben Gorte. (2002). *Spatial Statistics for Remote Sensing* (First). Kluwer Academic Publishers.
2. American Society of Photogrammetry. (1980). *Manual of Photogrammetry* (Subsequent). Asprs Pubns.

3. Atkinson, P. (2002). Spatial Statistics. In A. Stein, F. Meer, & B. Gorte (Eds.), *Spatial Statistics for Remote Sensing* (Vol. 1, pp. 57–81). Springer Netherlands.
https://doi.org/10.1007/0-306-47647-9_5
4. Atkinson, P. M., & Lewis, P. (2000). Geostatistical classification for remote sensing: an introduction. *Computers & Geosciences*, 26(4), 361–371.
<http://www.sciencedirect.com/science/article/B6V7D-3YVDBCW-2/2/9d969024e86cf54083d6edc51edd3ba4>
5. Blaschke, T. (2010). Object based image analysis for remote sensing. *ISPRS Journal of Photogrammetry and Remote Sensing*, 65(1), 2–16.
<https://doi.org/https://doi.org/10.1016/j.isprsjprs.2009.06.004>
6. Blaschke, T., Lang, S., & Hay, G. (2008). Object-Based Image Analysis: Spatial Concepts for Knowledge-Driven Remote Sensing Applications. In *Geographic Object-Based Image Analysis (GEOBIA)*. <https://doi.org/10.1007/978-3-540-77058-9>
7. Burrough, P. A., & McDonnell, R. A. (1998). Creating continuous surfaces from point data. In *Principles of Geographical Information Systems*. Oxford University Press.
8. Edward H. Isaaks, & R. Mohan Srivastava. (1989). *Applied Geostatistics* (1st ed.). Oxford University Press.
9. Garrigues, S., Allard, D., Baret, F., & Morisette, J. (2008). Multivariate quantification of landscape spatial heterogeneity using variogram models. *Remote Sensing of Environment*, 112(1), 216–230. <http://www.sciencedirect.com/science/article/B6V6V-4P7FHRS-1/2/5f929031a2820b9b8d5a9130c4f0dd17>
10. Getis, A. (2010). Spatial Autocorrelation. In M. M. Fischer & A. Getis (Eds.), *Handbook of Applied Spatial Analysis* (pp. 255–278). Springer Berlin Heidelberg.
https://doi.org/10.1007/978-3-642-03647-7_14
11. Jupp, D. L. B., Strahler, A. H., & Woodcock, C. E. (1988). Autocorrelation and regularization in digital images. I. Basic theory. *Geoscience and Remote Sensing, IEEE Transactions On*, 26(4), 463–473.
12. Lilles T. M., & Kiefer, R. W. (2015). *Remote Sensing and Image Interpretation*. John Wiley & Sons.
13. Lu, G. Y., & Wong, D. W. (2008). An adaptive inverse-distance weighting spatial interpolation technique. *Computers & Geosciences*, 34(9), 1044–1055.
<http://www.sciencedirect.com/science/article/B6V7D-4S33N6V-2/2/c6f7438f858af6737b7c0b99e123269f>
14. Otto Huisman, & Rolf A. de By. (2009). *Principles of Geographic Information Systems- An introductory textbook*. The International Institute for Geo-Information Science and Earth Observation (ITC),.
15. Papritz, A., & Stein, A. (2002). Spatial prediction by linear kriging. In A. Stein, F. Meer, & B. Gorte (Eds.), *Spatial Statistics for Remote Sensing* (Vol. 1, pp. 83–113). Springer Netherlands. http://dx.doi.org/10.1007/0-306-47647-9_6
16. Paul A. Longley, Michael F. Goodchild, David J. Maguire, & David W. Rhind. (2005). *Geographic Information Systems and Science* (2nd ed.). John Wiley & Sons.
17. Paul Bolstad. (2016). *GIS Fundamentals: A First Text on Geographic Information Systems* (6th ed.). XanEdu.
18. Saaty, T. L. (1980). *The Analytic Hierarchy Process* (1st ed.). McGraw-Hill International.
19. Tempfli, K., Kerle, N., Huurneman, G., & Janssen, L. (2009). *Principles of Remote Sensing* (4th ed.). ITC, Enschede, The Netherlands.

Annexure I
University of Mumbai
Two Year Degree Course of M.A. / M.Sc. (Geography and Geospatial Technologies)
As per Choice Based Credit System (CBCS)
(With effect from the academic year 2025-2026)
Examination pattern for Semester I and II

Semester I:

a) Theory Paper: 100 marks for each paper (Total theory papers 4)

i) Internal examination: Total marks 50 (in each theory paper)

ii) External examination: Total marks 50 (in each theory paper) Duration: 2 1/2 Hours

1) Total number of questions to be framed for theory paper in external examination is 7 of 10 marks each.

2) Out of total 7 questions, students are required to attempt **any Five** questions.

b) Practical Paper: 100 marks for one paper with four credits

50 marks for one paper with two credits

1) Out of total 100 marks in four credits practical, 80 marks for practical examination, 10 marks for journal writing and 10 marks for viva.

2) Out of total 50 marks in two credits practical, 40 marks for practical examination, 10 marks for journal writing and viva.

3) No of questions would correspond with number of major modules in the respective practical Course syllabus.

c) Marking system:

i) Total marks for theory: 4 Credits *4 theory papers =16 credits

ii) Total marks for practical: 6 credits for two practical papers

iii) Grand Total for Semester I is 22 credits

Semester II

a) Theory Paper: 100 marks for each paper (Total theory papers 3)

i) Internal examination: Total marks 50 (in each theory paper)

ii) External examination: Total marks 50 (in each theory paper) Duration: 2 1/2 Hours

1) Total number of questions to be framed for theory paper in external examination is 7 of 10 marks each.

2) Out of total 7 questions, students are required to attempt **any Five** questions.

b) Practical Paper: 100 marks for one paper with four credits

50 marks for one paper with two credits

100 Marks for On Job Training with four credits

1) Out of total 100 marks in four credits practical, 80 marks for practical examination, 10 marks for journal writing and 10 marks for viva.

2) Out of total 50 marks in two credits practical, 40 marks for practical examination, 10 marks for journal writing and viva.

3) The students are expected to complete on job training GEOG 510 to secure 4 credits. It is a mandatory component of first year M.A. / M.Sc. The evaluation of on job training will be done as per the guidelines provided by the University of Mumbai.

4) No of questions would correspond with number of major modules in the respective practical Course syllabus.

c) Marking system:

i) Total marks for theory: 4 Credits *3 theory papers =12 credits

ii) Total marks for practical: 6 credits for two practical

iii) 4 credits for on job training

iv) Grand Total for Semester II = 22 credits

Total credits earned at the end M.A. / M.Sc.first yar (Semester I and Semester II) would be 44.

Annexure II
Letter Grades and Grade Points

Semester GPA / Program CGPA Semester / Program	% of Marks	Alpha – Sign / Letter Grade Result
9.00 – 10.00	90.0-100	O (Outstanding)
8.00 -< 9.00	80.0 -< 90.0	A+ (Excellent)
7.00 -< 8.00	70.0 -< 80.0	A (Very Good)
6.00 -< 7.00	60.0 -< 70.0	B+ (Good)
5.50 -< 6.00	55.0 -< 60.0	B (Above Average)
5.00 -< 5.50	50.0 -< 55.0	C (Average)
4.00 -< 5.00	40.0 -< 50.0	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

Appendix B

Justification for M.A. / M.Sc. (Geography and Geospatial Technologies)

1.	Necessity for starting the course:	In the National education policy 2020 there has been a major emphasis on multidisciplinary nature of various educational programs and learning experiences. Exposure to more vocational and practical oriented curriculum is another highlight of the policy. It is aimed at developing students into good professionals with contemporary skills required for the industry, academia, research and other walk of professional life. The M.A. and M.Sc. (Geography and Geospatial Technologies) has been designed by keeping the core philosophy of NEP. Five specialisations have been designed in the form of electives with the core specific mandatory courses. The students would earn 34 credits specifically in their specialisation out of total 88 credits for two years. The students will be pursuing their research project as well as their job training in their selected specialization. The five broader specialisations are 1. Earth Systems Science 2. Urban and Regional Planning 3. Climate Change Science and Sustainability Studies 4. Human Geography and the Human Systems 5. Geospatial
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		Technologies. Total 22 credits have been planned to expose them to various geographical tools and techniques that would equip them with knowledge about various statistical techniques and huge repository of maps and GIS and remote sensing technologies. At the end of the two years master programme, the students are expected to develop major professional skills that is required in industries like GIS, tourism, Geostrategies, water resource management and so on. The mandatory component of the curriculum is planned to offer the students with various streams of knowledge that are cross disciplinary and interdisciplinary through the geographical (spatial) lens. Finally the curriculum is also designed to inculcate in them human values related to ethical behaviour and inclusiveness with respect to gender, language, nationality, caste and colour.
2.	Whether the UGC has recommended the course:	UGC has given guidelines for introduction of vocational elements in the regular curricula that would enhance the general output of the regular course that were otherwise run traditionally through an instructional learning method. (https://www.ugc.ac.in/oldpdf/xiplanpdf/revisedcareerorientedcourses.pdf). Universities are encouraged under NEP to run the diploma / certificate courses and with due approval of its governing councils/ statutory council wherever required (Ref: https://www.ugc.ac.in/faq.aspx). However, u/s 5(16) under Maharashtra Public Universities Act, 2016 (Mah. Act No. VI of 2017), Universities are empowered to offer course at various levels in choice based credit system for the various examinations leading to specific degrees, diplomas or certificates in a stand-alone format or joint format with other State or national or global universities.
3.	Whether all the courses have commenced from the academic year 2023-24:	The above degree programmes are recommended by the academic curriculum committee and further approved by the statutory bodies is to be introduced from the Academic Year 2023-2024. The curriculum has been revised to accommodate recent developments in the field of Geography and Geospatial Sciences. The revised curriculum will be implemented from academic year 2025-26
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available:	These degree programmes for M.A. (Geography and Geospatial Technologies) and M.Sc. (Geography and Geospatial Technologies) is the regular programme for the University Department in aided sections. The revised program is a standalone programme, to be implemented by the University Department of Geography in regular mode.
5.	To give details regarding the duration of the Course and is it	The duration of the M.A. (Geography) and M.Sc. (Geography) degree programmes is minimum 2 years (4 semesters) in the University Department of Geography. In affiliated colleges, the UG and PG programmes together would make 5 years (10 semesters) duration. In University departments, the exit point is after completion of one year (two semesters) where a post-graduate diploma will be offered to a student. It is not possible to compress the course as it has many components of vocational and theoretical learning.

	possible to compress the course:	
6.	The intake capacity of each course and no. of admissions given in the current academic year:	The intake capacity will be as per the university guidelines. However, the existing intake capacity for M.Sc. (Geography) and M.A. (Geography) together was 75 for both the years making it 150 students per academic year.
7.	Opportunities of Employability / Employment available after undertaking these courses:	• GIS and remote sensing industry • Land surveying firms • Various strategic thinking tanks in geostrategies • Research assistant / Research Associate / Project head at the research institutes governmental and/or Non-governmental organizations at national and international level • Academic faculty at various educational institutions at various levels like secondary, higher-secondary, undergraduate, postgraduate and research • Free lancing geography consultant • Urban and regional planning firms, organisations and government departments • Environmental consultants with specialization in environmental impact assessment, hydrology/ water resource management and seismicity with relevant expertise in Geographical data sets, GIS and remote sensing techniques • Sustainability consultants

Sd/-

**Sign of the BOS
Chairman
Dr. Rajaram B. Patil
Board of Studies in
Geography**

Sd/-

**Sign of the
Offg. Associate
Dean
Dr. C.A.Chakradeo
Faculty of
Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. Kunal Ingle
Faculty of
Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Dean
Prof. A. K. Singh
Faculty of
Interdisciplinary
Studies**