

CENTRAL UNIVERSITY OF PUNJAB



Master of Science in Geography

Academic Session 2021-23

Department of Geography

Graduate Attributes

The graduate students of M.Sc. Geography programme are expected to demonstrate a systematic and comprehensive understanding of the subject knowledge and apply their knowledge and skill in finding solutions to the contemporary and emerging social and environmental problems. They are able to apply their critical, creative and evidence-based thinking to solve the future challenges. They have respect for the diverse culture and pluralistic society and can demonstrate the ethical competency at all stages of life. They have ability to work effectively in a team and demonstrate leadership quality in academic as well as professional environment.

Apart from having these core attributes, the master's graduates, after their completion of M.Sc. programme, will be able to analyse the human interaction with the environment and how human and environment shape each other. They can describe and analyse the geomorphic, climatic and environmental processes operating at local, regional and global spatial and temporal scales and generate inventories in geospatial environment and apply the geospatial and geostatistical techniques on geographical and environmental issues. They are also able to conduct physical and social survey projects in diverse environment. They will develop digital capabilities through the skill based programmes designed for them. They will also recognize the essential value systems including academic ethical practices, the moral dimensions of one's own decisions.

Course Structure for M.Sc. Geography, 2021-2023					
Course Code	Course Title	Course type	Credit Hours		
			L	P	C
Semester-I					
GEO.506	Geomorphology	<i>Core</i>	3	-	3
GEO.514	Environmental Geography	<i>CF</i>	3	-	3

GEO.515	Population and Health Geography	Core	3	-	3
GEO.571	Geography of India	Core	3	-	3
GEO.516	Geography of Human Settlement	Core	3	-	3
GEO.551	Fundamentals of Remote Sensing (Theory)	Core	3	-	3
GEO.552	Fundamentals of Remote Sensing (Practical)	Skill Based	-	4	2
IDC					
IDC.	Interdisciplinary course from other discipline	IDC	2	-	2
Total Credits					22
IDC offered by the Department					
GEO.512	Introduction to Climate Change	IDC	2	-	2
Semester-II					
GEO.507	Climatology	Core	3	-	3
GEO.521	Geographical Information System & GNSS (Theory)	Core	3	-	3
GEO.522	Geographical Information System & GNSS (Practical)	Skill Based	-	4	2
GEO.537	Principles of Cartography and Photogrammetry (Practical)	Skill Based	-	4	2
xxx	Elective I	D. El	3	-	3
xxx	Elective II	D. El	3	-	3
Value Added Course					
GEO.503	Map Reading	VAC	2	-	2
Discipline Electives: Select any two of the following for M.Sc. Geography					
GEO.535	Soil Geography	D. El	3	-	3
GEO.524	Biogeography	D. El	3	-	3
GEO.554	Natural hazards and Disasters	D. El	3	-	3
GEO.575	Urban System and Planning	D. El	3	-	3
EGS.532	Oceanography	D. El	3	-	3
EVS.528	Natural Resource Management	D. El	3	-	3
Skill Based Practical Papers: Select any one of the following courses					
GEO.510	Introduction to Earth's material (Practical)	Skill Based	-	4	2
Total Credit					20
Semester-III					
GEO.523	Geographical Thoughts	Core	3	-	3
GEO.562	Research Methodology	CF	3	-	3
GEO.563	Geostatistical Techniques and Analysis	Core	3	-	3
GEO.564	Instrumentation and Field Methods	Core	3	-	3

GEO.565	Entrepreneurship	<i>CF</i>	1	-	1
GEO.573	Practice in Geography	<i>DEC</i>	2	-	2
GEO.xxx		<i>D. El</i>	3	-	3
Discipline Elective II: Select one of the following courses					
GEO.566	Glaciology	<i>D. El</i>	3	-	3
GEO.568	Transport Geography and Regional Development	<i>D. El</i>	3	-	3
GEO.569	Meteorology	<i>D. El</i>	3	-	3
Skill Based Practical Papers					
GEO.570	Instrumentation and Field Techniques	<i>Skill Based</i>	-	4	2
GEO.599	Field visit/internship/Research Proposal	<i>Skill Based</i>	-	8	4
	Total Credit				24
Semester-IV					
GEO.600	Dissertation/Industrial Project/Training	<i>Skill Based</i>	-	40	20
	Grand total	CBCS	L	P	Cr
		Hours			86

CBSC: Choice Based Credit System, L: Lecture, P: Practical, Cr: Credit, CF: Compulsory Foundation, Co: Core, SB, Skill Based, IDC: Inter Disciplinary Course, VAC: Value Added Course, D.El.: Discipline Elective, DEC: Discipline Enrichment Course.

Evaluation Criteria for Theory Papers	
A. Continuous Assessment: [25 Marks]	
B. Mid Semester Test: Based on Subjective Type Test [25 Marks]	
C. End Semester Exam: [50 Marks] Subjective (70%), Objective (30%)	

Evaluation criteria for Practical Papers			
Final Examination	Practical copy	Viva	Total
60%	20%	20%	100

Course Title: Geomorphology
Course Code: GEO.506
Total Hour: 45 Hours

L	T	P	Cr
3	-	-	3

Learning outcome: The course would help the students to get insight about research in geomorphology.

- To know the physical processes that form the landscape.
- To have an understanding of how the material is transported both by geomorphic and gravitational processes.
- To assess how different scales of time and space affect geomorphological processes.
- To learn the relevance of applied aspects of Geomorphology in various fields.

Unit I: Fundamental Concepts in Geomorphology: (11 Lectures)

- Concept & fundamentals of geomorphology;
- Concept of relief – mountains, plateaus, hills, foothills, valleys, plains and Floodplains.
- Doctrine of Isostasy - Views of Airy and Pratt.
- Mountain Building Theories – concepts of Kober, Daly and Holmes.
- Map and model reading

Unit II: Earth Movements and Interior of the Earth (11 Lectures)

- Plate Tectonics and Continental drift theory.
- Earth Movements (seismicity/Earthquake, folding, faulting and vulcanicity)
- Evolution of the earth and Earth's internal structure; composition and characteristics.
- Rocks and soil: types, formation and characteristics
- Map and model reading

Unit III: Geomorphic Processes and landforms (12 Lectures)

- Gradational and Aggradational processes: concept of slope, erosion and mass wasting. Weathering: Physical and chemical Process
- Cycle of Erosion - Concepts of Davis and Penck.
- Geomorphic landform: fluvial, glacial, Aeolian, coastal and karst.
- Causes of Geomorphic Hazards (earthquakes, volcanoes, landslides and avalanches)
- Map and model reading, case study

Unit IV: (11 Lectures)

- River forms and process: stream flow and stage-discharge relationship, hydrograph and drainage analysis
- Geomorphology and topographic analysis using DEM.
- Extra-Terrestrial Geomorphology

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Group discussion. Tools used: PPT, video, animation movie, whatsapp.

Suggested readings:

1. Bloom, Arthur L., (1991), Geomorphology: A Systematic Analysis of Late Cainozoic Landforms, Pearson
2. Gregory, Kenneth J. (Ed.) (2014), The SAGE handbook of geomorphology, New Delhi, Sage publications India Private Limited.
3. Harvey, Adrian (2012), Introducing geomorphology: A guide landforms and processes, Edinburgh, Dunedin academic press.
4. Huggett, Richard John (2011), Fundamentals of geomorphology, 3rd edition, Routledge Taylor & Francis group.
5. Thornbury, W.D. (1969) Principles of Geomorphology, New York: John Wiley and Sons, 2nd edition, December 2004.

6. Singh, Savindra (1998). Geomorphology, Allahabad: Prayag Pustak Bhawan.
7. Strahler, A.N. (1992) Physical Geography, New York: John Wiley and Sons.
8. www.usgs.gov

Course Title: Environmental Geography	L	T	P	Cr
Course Code: GEO.514	3	-	-	3

Total Hour: 45 Hours

Learning Outcomes

At the completion of the course, the student will be able to:

- Demonstrate a basic understanding of environmental issues
- Identify the magnitude of problem, current scenario and their impacts on human health and environment.
- Enlist the various government initiatives/policies and their progress.
- Understand the concept of sustainability
- Distinguish between sustainable and unsustainable practices

Unit I: Basics of Environmental Geography (10 Lectures)

- Nature, scope, significances, approaches, and history of Environmental Geography
- Human-environment interactions and impacts
- Different approach towards sustainable environmental development and its different constituents

Unit II: Basics of ecology and ecosystem (10 Lectures)

- Concept and Scope of ecology and ecosystem
- Basic ecological principles and Ecosystem Structure and functions: trophic level, ecological/energy pyramid, food chain and web,
- Types and characteristics of ecosystem- terrestrial (forest, desert, grassland) and aquatic (pond, marine), wetlands, estuaries, forest types in India.
- Assignment writing, Quiz/test

Unit III: Human and landscape ecology (13 Lectures)

- Introduction to Human and landscape Ecology; Key Concepts and theories
- Anthropocentrism, Environment ethics, and Deep Ecology
- Detecting and characterizing landscape patterns
- Landscape and society
- Theory of Landscape Metrics
- Quiz/test; Students' presentation/Group discussion; Things to Think About' exercise

Unit IV: Environment issues and policy (12 Lectures)

Environment issues:

- Atmospheric pollution & Global warming and Climate change
- Water quality and pollution
- Land degradation
- Ground water depletion and pollution
- Urban Heat Island
- Deforestation

Environment policy, Conventions, treaties, and Goals: UN Framework Convention on Climate Change (UNFCCC), 1992, Kyoto Protocol 1997, Brundtland Commission,

Rio de Janeiro (Rio Declaration, Agenda 21, Paris Agreement; COP, Sustainable Development Goals

Quiz/test; Students' presentation/Group discussion; Things to Think About' exercise

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested readings:

1. Akitsu, T. (2019). *Environmental Science: Society, Nature, and Technology*. Jenny Stanford Publishing
2. Simon, S. J. (2018). *Protecting Clean Air: Preventing Pollution*. Momentum Press.
3. Brinkmann, Robert. (2016). *Introduction to Sustainability*. Wiley-Blackwell
4. John, H. (2015). *Global Warming: The Complete Briefing*. Cambridge University Press.
5. Abbi, Y., Jain Shashank. (2015). *Handbook on Energy and Environment management*. The Energy Resources Institute.

Website/Web references

1. <http://moef.gov.in/en/>
2. <http://www.envis.nic.in/>
3. <https://www.fsi.nic.in/>
4. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>
5. <https://nptel.ac.in/courses/127/105/127105018/>
6. <https://nptel.ac.in/courses/122/102/122102006/>
7. <https://sdgs.un.org/goals>

Course Title: Population and Health Geography	L	P	Cr
Course Code: GEO.515	3	-	3

Total Hour: 45 Hours

Learning Outcome: On completion of this course students will have better understanding of;

- Quantify population data and analyse relationship with development and environment.
- Understand concept related to spatial epidemiological studies and health determinants.
- Explain the health indicators/determinants and
- Application of geospatial technology in Geo-health Analysis.

Unit I: (12 Lectures)

- Basics of Population Geography; Nature and Scope
- Population theories, and Data sources.
- Demography dynamics: Growth, density and distribution, fertility, morbidity, and mortality, Population pyramid
- Map reading and data reading

Unit II: (11 Lectures)

- Population-development and environment;
- Population Growth, Migration, and resources conflict
- Case study

Unit III: (11 Lectures)

- Basics of Health and medical geography, spatial epidemiological studies,
- Health Determinants: Socio-environment and physical environment, Concept of disease ecology
- Measures of health indicators: Disease Frequency, Prevalence, and incidences of disease
- Data analysis and Case Study

Unit IV: (11 Lectures)

- Concept of availability and accessibility of health care
- Disease and healthcare Cartographies: Geo-health studies
- Healthcare policies
- Case Study and assignments

Mode of Transaction: Lecture, class discussion, presentation methods would be used for teaching. Tools such as WhatsApp, ppt., and video will be use.

Suggested readings:

1. Anthamatten, Peter and Hazen, Helen (2016). An Introduction to The Geography of Health, Routledge Taylor & Francis
2. Koch, Tom (2017). Cartographies of Disease Map, Mapping and Medicine, Esri Press.
3. Izhar, Nilofar (2015). Geography and health: A study in medical geography, Aph publishing corporation.
4. John Eyles, Kevin J. Woods (2016). The Social Geography of Medicine and Health, Routledge Taylor & Francis
5. Cromley, Ellen K., McLafferty, Sara L. (2011), GIS and Public Health, Guilford Press.
6. www.cdc.gov

Course Title: Geography of India	L	P	Cr
Course Code: GEO.571	3	-	3
Total Hour: 45 Hours			

Course Outcome:

At the completion of the course, the student will be able to:

1. Comprehend the geological history of India plate and Eurasian plate.
2. Origin of physiographic features in relation to hydrological units of India.
3. Discuss the dimensions of growth and distributions of mineral resources, agriculture, and industry.
4. Analyse the social and environmental issues in relation to regional disparities

Unit I: (11 Lectures)

- Geological history of India
- Origin of Relief feature and Physiographic divisions: Precambrian shield, the Gondwana rift basins
- Drainage systems; watershed and basin
- Map & Model readings

Unit II: (11 Lectures)

- Climate of India: Types, Distribution and Mechanism of monsoon, environmental issue
- Indian forest: Types and Distributions
- Mineral resources: Types and Distribution Belt

- Data reading and Map reading

Unit III:

(12 Lectures)

- Indian Population: Growth, Distribution and Policies.
- Regional disparities in the levels of economic development.
- Map reading and case study

Activity: Group discussion and map reading.

Unit IV:

(11 Lectures)

- Agriculture: Salient features of agriculture, agricultural regions, major crops,
- Agricultural revolution with reference to India.
- Industry: Industrial belt of India: and New industrial policies
- Case study, Map reading and data analysis

Mode of Transaction: Lecture, Assignment, Seminar, Group discussion. Tools used: PPT, video, animation movie, WhatsApp, google classroom.

Suggested readings:

1. Shah S.K. (2018). Historical Geology of India, Scientific Publishers.
2. Khullar D. R. (2018). India a Comprehensive Geography, Kalyani Publication.
3. Sanyal, Sanjeev, Rajendran, Sowmya (2015). The Incredible History of India's Geography, Penguin Books Limited.
4. Verma, Sangeeta, Bodh, P.C. (2018). Glimpses of Indian Agriculture, OUP India
5. Siddhartha K. & Mukherjee S. Ahsan, Qamar (2017). Indian Industry, Kitab Mahal Publishers.
6. Dyson Tim (2018). A Population History of India: From the First Modern People to the Present Day, Oxford University Press.
7. Srinivasan, Krishnamurthy (2017). Population Concerns in India: Shifting Trends, Policies and Programs, Sage Publications India Private Limited.
8. Kumar A.K Shiva Et Al (2013). Handbook of Population and Development in India, Oxford University Press.
9. ICAR Report (2017). Handbook of Agriculture: Facts and Figures for Farmers Students and All Interested in Farming.
10. Rao Mohan (2019). The Lineaments of Population Policy in India Women and Family Planning, Routledge India
11. www.gsi.gov.in
12. www.geosindia.org
13. www.censusindia.gov.in
14. www.slusi.dacnet.nic.in
15. www.mospi.nic.in

Course title: Geography of Human Settlement

L P C

Course code: GEO.516

3 0 3

Total hour: 45 Hours

Learning outcome:

- Student will be proficient to comprehend concept, theory, models of regional and human settlement planning.
- Competent to investigate the use of geoinformation science for regional and human settlement planning at national to global context.
- Student will be professional to carry out independent research on contemporary regional and human settlement planning challenges.

Unit-I: Introduction to Rural settlement (11 lectures)

- Definition, scope, and nature of rural settlement
- Characteristics of rural settlement
- Materials used in rural settlement
- Types, distribution, and pattern of rural settlement
- Form and function of rural settlement
- Population, social, economic, and environmental, profile of rural settlement
- Challenges of rural settlement

Unit-II: (11 lectures)

- Theory, policy, and models in rural settlement
- Settlement, infrastructure, and transportation
- Planning for natural resource, economics, health, and sanitation
- Community development

Unit-III: Introduction to Urban Settlement (11 lectures)

- Definition, scope, nature, and history of urban settlement
- Characteristics, types, and distribution of urban settlement
- Theories of origin and growth of town
- Process of urbanisation and urban system
- Spatial and morphological pattern of urban settlement`
- Functional classification and urban theories

Unit-IV: (11 lectures)

- Concepts of Megacities, Global Cities and Edge Cities
- Changing Urban Forms (peri-urban areas, rural-urban fringe, suburban, ring and satellite towns)
- Social Segregation in the City, Urban Social Area Analysis
- Urban Poverty and slum in the City

Mode of Transaction: methods of transaction are lecture, audio-video, discussion which will be followed in teaching using ppt, social media etc.

Suggested readings:

Bunce, M.(2017). Rural Settlement in an Urban World, Taylor & Francis Group. Oxfordshire.

Carter, H.(1995). The Study of Urban Geography (4th Ed.) Edward Arnold. London

Cloke, P. (2014). An Introduction to Rural Settlement Planning, Routledge Revivals. London.

Council for Scientific and Industrial Research, C. (2000). Guidelines for human settlement planning and design: The red book. CSIR Building and Construction Technology. <http://hdl.handle.net/10204/3750>

Jabareen, Y. R., (2006). Sustainable Urban Forms: Their Typologies, Models, and Concepts, Journal of Planning Education and Research, 26: 38-52.

Mondal, R.B.(1979). Introduction to Rural Settlements, Concept publications. New Delhi.

Pacione, M.(2009). Urban Geography A Global Perspective (3rd Ed.). Routledge. Oxfordshire.

R. Y. Singh, Ry Singh(1994). Geography of Settlements, Rawat Publications, New Delhi.

<https://www.sciencedirect.com/topics/social-sciences/rural-settlement>

<https://opentext.wsu.edu/introtohumangeography/chapter/12-2-rural-settlement-patterns/>

Course title: Fundamentals of Remote Sensing L P Cr

Course code: GEO.551 3 0 3

Total hour: 45 Hours

Learning outcome:

- It introduces the students to the basic concepts and the skills necessary to acquire remote sensing data and extract geo-information from them.
- The objective of this course is to give understanding of fundamentals of remote sensing.
- The students will learn the interaction of electromagnetic radiation with terrestrial features; will get to know about satellite imaging sensor systems; and apply the underlying principles of interpreting image data

Unit I: Fundamental concepts of Remote Sensing (11 Lectures)

- Introduction to remote sensing: history, process, and types.
- Introduction to electromagnetic radiation: EMR theory, spectral bands, blackbody radiation
- Introduction to EMR interaction with earth surface: EMR process, spectral signature, spectral reflectance curve, EMR with soil, water, vegetation, land, and atmosphere, atmospheric windows

Unit II Remote sensing platforms, sensors, and satellite series (12 Lectures)

- Remote Sensing platforms: ground-borne, air-borne and space borne, orbital characteristics.
- Type of remote sensing satellites: geostationary and sun-synchronous, active, passive.
- Remote sensing satellite sensors: whiskbroom and push broom, scanner, and camera.
- Remote sensing satellite data products: IRS, LANDSAT, Sentinel, SPOT, IKONOS, Quick bird, world view, microwave, and hyperspectral data.

Unit III: Introduction to Aerial Photography (11 Lectures)

- Characteristics, history, and types of aerial photography
- Flight planning and execution
- Aerial camera and film
- Geometry of Aerial Photographs
- Basic photogrammetry: determination of scale, parallax, orthophoto, relief displacement, 3-dimensional features etc.

Unit IV Image Processing and Interpretation

(11 Lectures)

- Introduction satellite image and aerial photograph
- Introduction to visual image interpretation
- Introduction to digital image processing
- Introduction to ground truthing and uncertainty analysis
- Introduction to change detection analysis
- Case studies

Mode of Transaction: methods of transaction are lecture, audio-video, discussion which will be followed in teaching using ppt, social media etc.

Suggested readings:

1. Rees, W.G., (2001). Physical Principles Of Remote Sensing, Cambridge University Press.
2. Sabins F., Remote Sensing (1997). Principles And Interpretation, New York.
3. Lillesand T.M., And Kiefer R.M., (1999).Remote Sensing And Image Interpretation, Fourth Edition, Wiley.
4. Jensen J.R., (2000).Remote Sensing Of Environment: An Earth Resource Perspective, Prentice Hall.

Course Title: Fundamentals of Remote Sensing
(Practical)

L T P Cr

Course Code: GEO.552

- - 4 2

Total Hour: 60 Hours

Learning Outcome:

1. The practical course gives operational skills necessary to acquire remote sensing data and extract geo-information from them.
2. The students will critically examine the trade-offs between spatial, spectral, radiometric and temporal resolution of remotely sensed data; Perform basic operations associated with digital image processing; and evaluate applications of remotely sensed data for monitoring and managing natural resources.
3. The students can use their knowledge in their project report.

Exercises

- Remote sensing data mining: downloading and familiarization of satellite imagery, aerial photograph, reading metadata and basic characteristics of images and aerial photograph.

- Pre-processing: geometric and radiometric correction, FCC generation, mosaicking, sub-setting, and atmospheric correction
- Basic aerial photo interpretation: scale determination, mosaicking and interpretation.
- Image classification and interpretation: visual interpretation, digital image processing (supervised, unsupervised and hybrid classification)
- Post processing and accuracy assessment: mixed pixel correction, confusion matrix, user accuracy, producer accuracy, overall accuracy, kappa indices.
- Change detection analysis: Image-based and map-based approach.
- Case studies : land use mapping land use change analysis, urban growth monitoring, forestry etc.

Mode of Transaction: Lab exercise through open source softwares.

Course Title: IDC- Introduction to Climate Change	L	T	P	Cr
Course Code: GEO.512	2	-	-	2

Total Hour: 30 Hours

Learning outcome: After completing the course, student will be able to:

- Explain what climate change is.
- Identify the main drivers of climate change.
- Describe how they plan to adapt to the negative (or positive) impacts of climate change.
- Identify ways to plan climate actions.
- Explain how climate negotiations work.
- Formulate a climate project or policy.

Unit I: Introduction to Climate Change Science (6 Lectures)

- Introduction to Climate Change Science
- Fundamental feedbacks in the Climate System
- Natural & Anthropogenic Drivers of Climate Change
- Group discussions, Presentations, Assignments

Unit II: Climate Change Impacts at Global Scale (8 Lectures)

- Observed (in past & present) evidence & projected trends of Climate Change
- Carbon cycle feedbacks & Changes in atmospheric greenhouse gases
- Extreme weather & Modern surface temperature trends
- Introduction to live case studies from global agency datasets (e.g. NASA/ EGU/UN/WHO/IPCC/ISRO/JAXA)
- Group discussions, Presentations, Assignments

Unit III: Climate Change Impacts at National to Local Level (8 Lectures)

- Ecosystems and biodiversity
- Glacier melting, impacts on regional water balance and food resources
- Sea level rise and coastal impacts
- Human health impacts
- Introduction to live case studies from national to local level agency datasets (ISRO/PRL/IITM/IMD/NCOSS etc.)
- Group discussions, Presentations, Assignments

Unit IV: What Is Our Path Forward?**(8 Lectures)**

- Millennium and Sustainable Development Goals
- Geoengineering: A scientist’s perspective
- Emissions reductions and scenarios, stabilizing CO2 concentrations
- Solution at local to global scale, its approaches & policies: A path of hope
- Group discussions, Presentations, Assignments

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, whatsapp and Expert’s Video Conferencing lectures from various national & international organizations

International to National to Local reachability: The course will have wider reachability from local to international level to understand the today’s most dreadful problem of the world and our contribution to curb this at our maxima potential.

Suggested Readings:

- 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, doi:10.1017/CBO9781107415324.
- Kininmonth, William. (2004). Climate Change: A Natural Hazard. Brentwood: Multi-Science Pub. Co.
- Letcher, T. M. (Trevor M.). Climate Change: Observed Impacts on Planet Earth.
- Lovejoy, Thomas E., and Lee Hannah (2019). Biodiversity and Climate Change: Transforming the Biosphere. Biodiversity and Climate Change: Transforming the Biosphere. Yale University Press.
- Maslin, Mark (2014). Climate Change: A Very Short Introduction. Climate Change: A Very Short Introduction. Oxford University Press. doi:10.1093/actrade/9780198719045.001.0001.

Course Title: Climatology**L T P Cr****Course Code:** GEO.507

3 - - 3

Total Hour: 45 Hours**Learning Outcomes:** At the completion of the course, the student will be able to:

- Explain the overview of the climate system
- Enlist the processes that drive the general global as well as regional circulation.
- Analyse method of interpretation of weather symbols, and the contemporary climatic issues.

Unit I: Introduction to climatology**(10 Lectures)**

- Fundamentals of climatology.
- Earth’s Atmosphere: Evolution, Structure and Composition.
- Solar radiation and Terrestrial radiation; Variation, distribution and effect on atmosphere.
- Greenhouse effect and global heat budget

- Temperature: Concept, measurement, scales, daily and annual cycles of temperature; vertical distribution; world distribution.

Activity: Assignment writing

Unit II: Atmospheric dynamics

(11 Lectures)

- Stability and instability in atmosphere.
- Cloud: Type and formation.
- Atmospheric moisture and precipitation: Concept and measurement of atmospheric moisture;
- Condensation - forms of condensation; adiabatic temperature changes,
- Formation and types of precipitation; global distribution of precipitation.

Activity: Quiz; Students' presentation/Group discussion

Unit III: Wind circulation and Monsoon

(12 Lectures)

- Wind circulation Models of general circulation of the atmosphere: Jet stream, Air masses and fronts, characteristics, movements, frontogenesis.
- Tropical cyclones; mechanism and characteristics
- Genesis of Indian Monsoon and the causes of its variability.
- Oscillations: ENSO

Activity: Paper reading, case study; Movie

Unit 4: Climatic Classification

(12 Lectures)

- Classification of climates: Empirical and generic,
- Climatic classification with special reference to Koppen or Thornthwaite (any one).
- Indian Meteorological Department and All India Weather Forecast.

Activity: Case study, IMD report reading/ familiarisation with weather apps, Test

Suggested readings:

1. Grotzinger, J. P., Jordan, T.H. (2019). *Understanding Earth*, New York: Freeman & Company.
2. Kusky, T. (2017). *The encyclopedia of earth science*, Viva book private limited.
3. Singh, S. (2017). *Physical Geography*, Allahabad: Prayag Pustak Bhavan.
4. Strahler, A.N. (2013). *An Introduction to Physical Geography*, UK: John Wiley & Sons.
5. Roy, R. (2013). *Introduction to general climatology*, New Delhi: Anmol publication private limited.
6. D. S. Lal. (2011). *Climatology*, Sharda Pustak
7. Veena (2009). *Understanding earth science*, Delhi: Discovery.
8. Critchfield, H. J. (2008). *General Climatology*, Pearson Education India.
9. Frank Press and Raymond Siever (2003). *Understanding Earth*. W.H.Freeman & Co Ltd.
10. Lal, D.S. (1998). 'Climatology', Chaitanya Publishing House, Allahabad.

Website/web references:

1. IMD: <http://www.imd.gov.in/pages/main.php>
2. NASA Earth Observatory:
<https://earthobservatory.nasa.gov/?eocn=topnav&eoci=logo>

3. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=17>
4. <https://www.youtube.com/watch?v=ooZfziqY1Hk>
5. <https://www.tropmet.res.in/>
6. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=14>

Course Title: Geographical Information System and GNSS **L** **T** **P** **Cr**

Course Code: GEO. 521 3 - - 3

Total Hour: 45 Hours

Learning Outcome:

1. The students would get immense knowledge in extraction, generation, and analysing of maps.
2. This would benefit students for various geographical research works.
3. This course would give students theoretical framework in geographical information system.

Unit I: **(12 Lectures)**

- Concept and definition of GIS, History and development of GIS technology, Applications of GIS in various sectors:
- Geographic information System database: data types (map, attributes, image data) and structure; Spatial and non-spatial data;

Unit II: **(11 Lectures)**

- Geo-referencing; Map projection
- Data entry and preparations (inputs, editing and attributing);
- Spatial analysis: overlay, buffer and proximity, network analysis;
- Contours and spot heights; Determination of slope and hill shading; Data interpolation: point and line data; Output generation and layouts.

Unit III: **(11 Lectures)**

- Introduction to Geodatabase
- Geodatabase models
- Introduction to Geodatabase in open source and commercial software

Unit IV: **(11 Lectures)**

- Introduction to GNSS; Concepts and types. Sources of Errors and resolving of errors.
- Introduction to GPS; Concepts and types. Segments of GPS; Collection of GCPs.
- Introduction to DGPS, wide area augmentation system (WAAS);
- Application of GIS and GPS

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., video will be used.

Suggested readings:

Course Title: Principles of Cartography and Photogrammetry (Practical)

Course Code: GEO.537

Total Hour: 60

L	T	P	Cr
	-	4	2
-	-		

Learning outcome: After completing the course, student will be able to:

- Gained understanding of the purposes of cartography, recognize the elements of cartographic representation, and how maps work.
- used digital cartographic methods for exploring, critiquing, confirming and presenting geographical relationships.
- increased their proficiency in graphical literacy, geo-visualisation and map modelling.
- Adapted the current knowledge to emerging applications of photogrammetry and UAV technology.
- Mastery of the knowledge, techniques, skills and modern tools of photogrammetry to solve technical photogrammetric problems in geosciences and other trans-disciplinary subjects.

Exercises

Exercise 1: Introduction to Digital cartography, basic to advance tools of Digital cartography, Map concepts & content, types, scales, design and implementation.

Exercise 2: Map Projections: Shape and size of the Earth: Geoid, spheroid ellipsoid for world and India, the Geographic and Projected Coordinate System, Projection Mechanics and Distortions.

Exercise 3: Map Generalization, Typography & Symbolization: Cartographic Problematic & Generalization Operators, Label Appearance and Label Placement, Map Elements and Visual Hierarchy, The Visual Variables & Thematic Map Types, Map Composition & Production.

Exercise 4: Digital Mapping and Cartographic Techniques: Qualitative mapping Techniques (Shading, colours and other symbols, choroschematic and chorochromatic), Quantitative(Digital) mapping Techniques (Choropleth, Dot Maps and Dasymetric Maps, Isopleths and Isoline Maps, Cartograms, Flow Maps)

Exercise 5: Introductory concepts in Digital Photogrammetry, Fundamentals concepts of aerial photography, Types of Aerial photographs- wide angle, narrow angle, Horizontal, Vertical, Oblique, Difference between map and aerial photograph.

Exercise 6: Introduction to UAV data acquisition and processing, current rules and regulations governing owning and operating a UAV in India, and its different geo-information purposes.

Exercise 7: Analytical Stereophotogrammetry - Collinearity and Coplanarity conditions, Satellite based Digital Photogrammetry (Orbital Parameters, Orbital modeling, Data Processing for stereo generation)

Exercise 8: Concept of Image based 3-D modelling (IBM): Extraction, generation and characteristics of digital elevation model (DEM), digital surface model (DSM), digital terrain model (DTM), normalized DSM (nDSM), Structure from Motion (SfM)

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, whatsapp and Expert's Vedio Conferencing lectures from various national & international organizations

International to National to Local reachability: The course will have wider reachability from local to international level to understand the complex geographical

phenomena occurred over space and time and to reconstructing the three-dimensional model for the real world.

Suggested Readings:

- Cromley G.R. 2000, Digital Cartography, Prentice Hall- Gale, Englewood, New Jersey.
- Misra, R.P. and Ramesh, A. (1989). Fundamental of Cartography, Concept Publishing Company, New Delhi.
- Robinson, A.H. et al. (2012). Elements of Cartography, John Willy & Sons, New York
- Terry A. Slocum, Robert B. McMaster, Fritz C. Kessler, and Hugh H. Howard (2009). Thematic Cartography and Geographic Visualization, Pearson, New Jersey, US
- Robert G Cromley (1992). Principles of Digital Cartography, Prentice hall,
- Paul R. Wolf and Bon DeWitt (2014) Elements of Photogrammetry with Applications in GIS, McGraw-Hill Education, New York, United States
- Toni Schenk (1999). Digital Photogrammetry, TerraScience, New York, United States.

Course title	Map Reading (VAC)	L	T	P	Cr
Course code	GEO.503	2	-	-	2

Total Hour: 15 Hours

Learning outcome: After completing the course, student will be able to:

1. The practice of theoretical knowledge will help the students in applying at ground observation in field and to learn essential observational and practical skills.
2. This paper will help the student to formulate their knowledge in field trip and will be able to identify different land features in toposheets for adaptation in field work environment in certain professional and scientific organizations.

Unit I:

Introduction to map: Concept, history and applications; Orienting the Map; Scale in map and its usage.

Unit II:

Introduction to Topographical maps: Compositions and conventional symbols: Reading of Toposheets at scale of 1:50,000

Unit III:

Preparation of Thematic Map/and Generation of Data from the topographical maps (land use map and area under different land-use categories)

Unit IV:

Interpretation of Toposheets: Representation of features in classroom exercises.

Mode of Transaction: Hand on exercise with toposheets and lab exercises.

Suggested Reading:

1. Misra, R.P. and Ramesh, A. (1989). Fundamental of Cartography, Concept Publishing Company, New Delhi.
2. Robinson, A.H. et al. (1992). Elements of Cartography, John Willy & Sons, New York, 6th edition.
3. Singh, R.L. Elements of Practical Geography.

4. <https://www.oakton.edu>

Course Title: Soil Geography	L	T	P	Cr
Course Code: GEO.535	3	-	-	3

Total Hour: 45 Hours

Objectives and Learning Outcome:

The student will be introduced to various issues related to soil and water problems, components and characteristics.

Unit I: (11 Lectures)

Soil formation: Definition, rocks, minerals, soil forming factors, soil weathering types and processes, soil formation, soil horizon, soil profiles, composition of soil, soil biota and their function in soil, humus, Soil microbes in nutrient cycling, Soil types in India. Physico-chemical and biological properties of soil, sampling and analysis of soil quality.

Unit II: (11 Lectures)

Soil pollution: Definition, sources- point and non- point, soil pollutants – types and characteristics, routes. Soil pollutants – Types, pesticides – classification, formulation; residual toxicity, synthetic fertilizers, heavy metals, Industrial waste effluents and interaction with soil components. Effects and impacts of soil pollution, bio-magnification. Thermal pollution – sources and impacts.

Unit III: (11 Lectures)

Soil erosion: Salt affected soil – Saline soils, Sodic soil, Usar, Kallar, Types of erosion – water and wind erosion, causes, soil loss equation. Land degradation – causes and impacts, types of waste lands in India, desertification and its Control.

Unit IV: (12 Lectures)

Soil management: Methodologies for soil conservation, conservation of arable land, techniques of reclamation and restoration of soil, wasteland reclamation, soil salinity management, remedial measures for soil pollution, bioremediation- in situ, ex situ, phytoremediation and biodegradation. Principles of weed management, Legal measures for land conservation at national and international level.

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested readings:

1. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA. 2007.
2. Cunningham, W. P. and Cunningham, M. A. Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi. 2004.
3. Cutler, S.L, Environment Risks and Hazard. Prentice Hall of India, Delhi. 1999.
4. De, A.K., Environmental Chemistry. New Age International (P) Ltd. Publishers, New Delhi. 2000.
5. Hillel, D., Introduction to Soil Physics, Academic Press, New York. 1982.

Course Title: Oceanography	L	T	P	Cr
Course Code: EGS.32	3	-	-	3

Total Hour: 45 Hours

Learning Outcome: Upon successful completion of this course, the student will be able to

- Explain and discuss oceanographic phenomena for both laymen and experts
- Determine the history and development of oceanography including marine biogeochemistry

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Unit I:

(11 Lectures)

- Origin, evolution of ocean basins and their environmental response; Topographic
- features of the ocean floor; continental margin provinces, ocean basin provinces; coral
- reefs. Classification of marine sediments, sediment budget, transport and its
- accumulation in the ocean; sedimentation processes on continental shelves - physical
- processes, sediment response; deep-sea sediments. Assignment, Take home exercise,
- peer learning on oceanic topography.

Unit II:

(12 Lectures)

- Wave dynamics, deep water waves, shallow water waves; Ocean circulation: forces
- driving currents; surface currents, effects of surface currents on climate; thermohaline
- circulation - thermohaline circulation patterns, global heat connection and
- atmospheric Circulation. Wind induced vertical circulation - equatorial upwelling,
- coastal upwelling, downwelling; Coastal upwelling - its physical, chemical, biological
- characteristics, Tides - equilibrium theory of tides, dynamical theory of tides, tidal
- currents in coastal areas, observation and prediction of tides. Exercise on mechanics
- of atmospheric and oceanic circulation.

Unit III:

(11 Lectures)

- Seawater chemistry: salinity - components, sources and processes controlling the
- composition of sea water; dissolved gases - Nitrogen, Oxygen, Carbon dioxide; Density
- structure of ocean; inputs of organic carbon, concept of food chain; primary
- production, measuring productivity, factors limiting productivity, Role of light,
- temperature, nutrients, physiological adaptations; Marine resources: Petroleum and
- Natural Gas, sand and gravel, magnesium and magnesium compounds, salts,
- manganese and phosphate nodules, metallic sulfides and muds. Group discussion on
- marine resources and exploration.

Unit IV:

(11 Lectures)

- Origin and evolution of the Indian Ocean, structure and physiography of the Indian

- Ocean, bathymetry and bottom characteristics, sediment distribution on the Indian
- Ocean floor. Introduction to Marine exploration methods, petroleum potential of seabed provinces beyond the continental slope; petroleum occurrences and exploration
- activity around the margins of the Indian Ocean. India's Exclusive Economic Zone
- (EEZ); marine minerals in the EEZ of India. Assignment on bathymetry, structure and
- EEZ of Indian ocean.

Transactional Modes: Lecture, Demonstration, Lecture cum demonstration, Project Method, Inquiry training, Seminar, Group discussion, Blended learning, Flipped learning, Focused group discussion, Team teaching, Field visit, Brain storming, Mobile teaching, Collaborative learning, Case based study, Through SOLE (Self Organized Learning Environment).

Suggested readings:

1. Garrison, T., 1996. Oceanography-An invitation to Marine Science, Wadsworth Publishing Company 43
2. Gross, M.G., 1972. Oceanography - A view of the Earth, Prentice-Hall.
3. Thurman, B.Y., 1978. Introductory Oceanography, Charles E. Merrill Publishing Company.
4. Kale, V. S. and Gupta, A., 2001. Introduction to geomorphology, Orient Longman, Bangalore.
5. Singh, S., 2011. Physical geography, Prayag Pustak Bhavan, Allahabad.
6. Strahler, A.N. and Strahler, 1996. An introduction to physical geography, John Wiley & Sons, UK.
7. S. Davis, R.A. Jr. 1972. Principles of Oceanography, Addison - Wesley Publishing Company.
8. Roonwal, G.S., 1986. The Indian Ocean: Exploitable mineral and petroleum Resources, Narosa Publishing House.
9. Francis P. Shepard, 1977. Geological Oceanography: Evolution of coasts, continental margins & the deep-sea floor, Pan Publication.
10. Bhatt J.J., 1978. Oceanography – Exploring the planet Ocean, D. van Nostrand Company.

Web Resources:

<https://www.nationalgeographic.org/>

<https://www.nio.org/>

<https://science.nasa.gov/earth-science/focus-areas/oceanography>

Course Title: Bio-Geography

Course Code: GEO.524

Total Hour: 45 Hours

L	T	P	Cr
3	-	-	3

Course objective: To familiarise the students with the geographical and historical background of the field of biogeography. It helps the students to understand the ecological factors that shape the distribution of plants and animals and their changes over time.

Learning outcome: By the end of this course students will be able to understand the historical development of biogeography during different time periods. They will be able to explain the spatio-temporal variations of plant and animal regions and the factors affecting these variations. Students will also understand the biogeographical consequences of global change like climate change.

Unit I: (11 Lectures)

- Nature, scope, significances, approaches and history of Biogeography
- Spatial dimension and elements of biogeography;
- Distribution of forest and major plant community
- Distribution of major animal distributions,
- Bio-geographical regions, realms and biomes.

Unit II: (12 Lectures)

- Basic concept of biogeography, allopatric speciation, evolution, extinction, endemic, geo-dispersal, range and distribution, vicariance.
- Geo-biochemical cycles (gaseous & sedimentary): carbon, nitrogen, oxygen and phosphorus cycles;
- Concept of biomass, carbon content and carbon sequestration
- Concept of forest carbon index; contribution and policies, carbon footprint and carbon credit.

Unit III: (11 Lectures)

- Biogeography of the seas; island biogeography.
- Habitat fragmentation; biogeography of linear landscape features.
- Biodiversity: types, hotspots, depletion and conservation.

Unit IV: (11 Lectures)

- Biogeographical information, collection, retrieval and application.
- Biogeographical consequences of global to regional change; changing communities and biomes,
- Forest disturbances in India
- National forest and wildlife policy of India

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, whatsapp and Expert's Vedio Conferencing lectures from various national & international organizations

Suggested Readings:

- Richard John Huggett (2010) Fundamentals of Biogeography, Routledge, New York, US
- Brown, J. H., & A. C. Gibson, Biogeography, St. Louis, Mosby, 1983.
- Brown, J.H. and Lomolino, M.V., Biogeography, Second Edition, Sinauer Associates, Inc. Sunderland, Massachusetts, 1998.
- Cox, C.B., Moore, P.D., Biogeography, An Ecological and Evolutionary Approach, 5th ed., Blackwell Science, Cambridge, 2016.
- MacDonald, Glen, Biogeography: Introduction to Space, Time and Life, John Wiley, New York, 2002.
- Robinson, H., Biogeography, The English Language Book Society and Macdonald and Evans, London, 1982. (1999). Digital Photogrammetry, TerraScience, New York, United States.

Course Title: Natural Hazards and Disasters	L	P	Cr
Course Code: GEO.554	3	-	3

Hours: 45 hours

Learning Outcome:

1. Describe the influence of mitigation, preparation, response and recovery on natural hazards.
2. Discuss and propose solutions to complex problems in disaster risk reduction.
3. Compare and critically analyse recent disasters caused by natural events.

Unit I: (11 Lectures)

- Introduction to Disaster: Basic concept of Hazard and Catastrophe;
- Concept of vulnerability and risk
- Geographical analysis of Disaster study.
- Models reading

Unit II: (12 Lectures)

- Classification of Disasters: Natural and man-made disaster;
- Natural Disaster study (Causes, Assessment and Management): Flood, Cyclones, droughts, forest fires, earthquakes, volcanoes, landslides.
- Man-made disaster study: Accident, Oil spill, Terrorism, Food poisoning, stampedes.
- Map reading, Data Collection and analysis

Unit III: (11 Lectures)

- Concept of Disaster Risk Reduction and mitigation, prevention, preparedness, response and recovery
- Disaster response and management: Policies, Agencies and organisation.
- Model reading

Unit IV: (11 Lectures)

- Disaster management plan: formulation and framework
- Tools and techniques: Monitoring, tracking and decision support system (DSS), hazard risk vulnerability and capacity analysis (HRVC)
- Assignment and case study

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested readings:

1. Hayes, Flynn, (2020). Global flood hazard: Mappings forecasting and risk assessment, Syrawood publishing house.
2. Feidan, Nicola (2019). Natural hazards and disasters: A case study approach, Callisto reference.
3. Schwab, Anna K. (2017). Hazard mitigation and preparedness: An introductory text for emergency management and planning professionals, Crc press.
4. Vaidyanathan, S. (2011). An introduction to disaster management: Natural disasters and manmade hazards, Ikon books.
5. Lopez-Carresi, Alejandro (2014). Disaster management: International lessons in risk reduction, response and recovery, Routledge.
6. Reddy, Sunita (2013). Clash of Waves, Indos Books.
7. Kapur, Anu, (2010), Vulnerable India: A geographical Study of Disaster, Sage and IAS Publication.

8. www.usgs.gov
9. www.bhuvan.nrsc.gov.in
10. www.emdat.be

Course Title: Urban System and Planning	L	T	P	Cr
Course Code: GEO.575	3	-	-	3

Total Hour: 45 Hours

Learning Outcomes

At the completion of the course, the student will be able to:

- Explain multiple theoretical perspectives on the city and to define, in multiple ways, the processes that constitute the city
- Describe various contemporary issues of urban areas from planning perspective
- Explain the impact that urban policy of India has on cities.

Unit I: Urbanisation in India (11 Lectures)

- Introduction to Urbanisation
- Urban environment and ecology
- Urban problems: environmental, transportation, housing.
- Urban infrastructure and services; Urban transportation

Unit II: Urban governance (10 Lectures)

- Introduction to urban governance
- Urban poverty and housing
- Community building
- Urban reforms and management
- Urban development policies of India
- Group discussion, Case study, Quiz

Unit III: Basic of Urban Planning and Development (12 Lectures)

- Basic concepts of planning; urban land use planning.
- Urban and Metropolitan planning
- Master Plans approach: A case study of Chandigarh and Jaipur
- Concept of garden city; Neighbourhood unit
- Centrally sponsored plans and schemes (Smart City mission, HRIDAY mission, AMRUT Mission)
- Group discussion, Case study, Quiz

Unit 4: (12 Lectures)

- Urban sprawl
- Managing and planning urban environment (green and blue spaces)
- Urban public spaces
- Spatial analysis in urban planning
- Group discussion, Case study, Quiz

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested readings:

1. Bridge, B. and Watson, S. (eds.) (2000): A Companion to the City. Blackwell, Oxford.
2. Carter, H. (1995): The Study of Urban Geography. 4th ed. Reprinted in 2002

- by Rawat Publications, Jaipur and New Delhi.
3. Dubey, K.K. (1976): Use and Misuse of Land in KAVAL Towns. National Geographical Society of India, Varanasi.
 4. Dubey, K.K. and Singh, A.K. (1983): Urban Environment in India. Deep and Deep, New Delhi.
 5. Dutt, A. Allen, K, Noble, G., Venugopal G. and Subbiah S. (eds.) (2003): Challenges to Asian Urbanisation in the 21st Century. Kluwer Academic Publishers, Dordrecht and London.

Additional readings:

6. Hall, P. (1992): Urban and Regional Planning. Routledge, London.
7. Hall, T. (2001): Urban Geography. 2nd edition. Routledge, London.
8. Haughton, G and Hunter, C. (1994): Sustainable Cities. Jessica Kingsley, London.
9. Jacquemin, A. (1999): Urban Development and New Towns in the Third World – A Lesson from the New Bombay Experience. Ashgate, Aldershot, UK.
10. Johnson, J.H. (1981): Urban Geography, Pergaman Press, Oxford.
11. Mayer, H. and Cohn, C. F. (1959): Readings in Urban Geography, University of Chicago Press, Chicago.
12. Paddison, R. (ed.) (2001): Handbook of Urban Studies. Sage, London.
13. Pacione, M. (2005): Urban Geography: A Global Perspective, Routledge, London and New York.
14. Ramachandran, R., (1991): Urbanisation and Urban Systems in India. Oxford University Press, Delhi.

Websites/web references:

1. <http://mohua.gov.in/upload/uploadfiles/files/URDPFI%20Guidelines%20Vol%20I.pdf>
2. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=17>
3. <http://mohua.gov.in/>
4. [http://mohua.gov.in/upload/uploadfiles/files/G%20G%202014\(2\).pdf](http://mohua.gov.in/upload/uploadfiles/files/G%20G%202014(2).pdf)
5. <https://nptel.ac.in/courses/105/105/105105202/>
6. https://bhuvan.nrsc.gov.in/bhuvan_links.php
7. NASA Earth Observatory:
<https://earthobservatory.nasa.gov/?eocn=topnav&eoci=logo>

Course Title: Natural Resource Management	L	T	P	Cr
Course Code: EVS.527	3	-	-	3

Total Hour: 45 Hours

On completion of the course, the learner will be able to:

Relate the importance of natural resources in the environment

Discuss the causes of natural resource depletion

Apply the various management strategies to protect and restore the natural resources

Inspect various legal measures taken at the national and international level to conserve and restore natural resources

Unit I: Forest resources

(11

Lectures)

- Natural resources: Definition and Classification; natural resource degradation - Environmental impacts and conservation
- Forest Resources: Forest cover of India; forest types, functions of forest – production and protection; Conservation of forests; forestry programmes – social forestry, farm forestry, urban forestry, community forestry; deforestation; Afforestation; Desertification; Forest policy.

Unit II: Water and Marine resources

(12 Lectures)

- Water Resources: Surface, groundwater, marine and brackish water resources - assessment and utilization; Rivers and Lakes in India; Ground water resource depletion and salinity issues; Water Conservation and management techniques; Rain water harvesting; Watershed management; River cleaning, River action plans - Ganga and Yamuna action plan, Interlinking of rivers; conflicts over water; Jal Shakti Abhiyaan, Namami Gange, National Water Mission; Marine mineral resources - polymetallic manganese nodules, phosphorites, hydrocarbons, rare metals, corals, pearls and shells, Management of marine resources.

Unit III: Land and mineral resources

(11 Lectures)

- Land resources: Land degradation due to mining, exploration, industrialization, irrigation and natural disasters; Soil Erosion, Loss of soil fertility, Restoration of soil Fertility, Soil Conservation Methods; restoration of degraded land-CoP 14-Delhi Declaration; Wasteland reclamation, Organic farming, green manuring, Wetland – definition, classification, functions, ecological importance and conservation.
- Mineral resources: Distribution of mineral resources of India – Use, exploitation and environmental impacts; Restoration of mining lands.

Unit 4: Bio resources (11 Lectures)

- Evolution strategies, adaptation, Vegetation, flora and fauna of India; Aquatic bioresource; Definition, Types and significance of biodiversity, values and threats, biodiversity conservation strategies; Bioprospecting. Biopiracy. REDD+; Conventions and protocols. Wild life resources and conservation measures;
- Human resources – population explosion, urbanization, industrialization, slums, poverty

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested Readings:

1. Singh, C. K. (2018). *Geospatial Applications for natural Resources Management*, CRC Press.
2. Primak, R. B. (2014). *Essentials of Conservation biology*, Sinauer Publishers, 6th edition.
3. Raju, N. J., et al., (2014). *Management of Water, Energy and Bio-resources in the Era of Climate Change: Emerging Issues and Challenges*, Springer.
4. Anderson, D. A. (2013). *Environmental economics and natural resource management*, Taylor and Francis 4th Edition.
5. Beckman, D. W. (2013). *Marine environmental biology and conservation*, Jones and Barlett learning.
6. Balyani, R. (2012). *Indian Forest and Forestry*, Jaipur: Pointer Publishers.
7. Jetli, K. N. (2011). *Mineral Resources and policy in India*, New Century Publications, Delhi.

- Identification of hazardous earth material for human health

Suggested readings:

1. Minerals and Rocks-Exercises in Crystallography, Mineralogy and Hand Specimen Petrology by Cornelius Klein, 2007, Wiley publisher.
2. Earth Materials: Introduction to mineralogy and petrology by Cornelius Klein and Anthony Phillpotts, 2013, Cambridge University press, Cambridge.

Course Title: Geographical Thoughts	L	T	P	Cr
Course Code: GEO.523	3	-	-	3
Total Hour: 45 Hours				

Learning Outcomes

At the completion of the course, the student will be able to:

- Describe the theoretical traditions and contemporary lines of thought of the discipline.
- Describe the philosophical and methodological standpoints of leading geographers.
- Explain the continuities in geographic thought over time
- Explain the debates and issues that geographers have wrestled with for decades.

Unit I: Introduction (11 Lectures)

- The field of Geography: its place in the classification of Sciences
- Epistemology of geography
- Evolution of Geographic Thought: Changing paradigms – Determinism, Possibilism. Environmentalism

Activity: Assignment writing, Quiz/test

Unit II: Emergence of modern Geography and regions (11 Lectures)

- The Emergence of Modern Geography: Varenius, Kant, Humboldt and Ritter
- Concept of region, place and space
- Areal differentiation, spatial organisation

Activity: Paper reading, Quiz/test

Unit III: Spatial Science and Quantitative Revolution (11 Lectures)

- Exceptionalism and the Schaefer-Hartshorne debate
- Critical assessment and debates on Spatial science, quantitative, qualitative revolution
- Critical understanding of positivism
- Behaviourism

Activity: Quiz/test, Group discussion/ debate

Unit 4: Contemporary geographical thought (12 Lectures)

- Humanistic Geographies
- Feminist Geographies
- Postmodernism and beyond
- Changing methodologies of geography in the Globalising World
- Progress and Contributions in Indian Geography

Activity: Paper reading (As given in the suggested paper/article list), Group discussion/ debate

Suggested readings:

1. Cresswell, Tim. (2012). *Geographic Thought: A Critical Introduction*. Malden, MA: Wiley Blackwell
2. Dikshit, R. D. (2018): *Geographical Thought. A Critical History of Ideas*. 2nd Edition. Prentice-Hall of India, New Delhi.
3. Hartshorne R. (1939): *The Nature of Geography*, AAG, New York.
4. Harvey, D. (1969). *Explanation in Geography*. Arnold, London
5. Hussain, M. (2014). *Evolution of Geographical Thought*. 6th edition. Rawat Publisher.
6. Livingstone, David. (1992). *The Geographical Tradition: Episodes in the History of a Contested Enterprise*. Oxford: Blackwell.
7. Peet, R. (1998). *Modern Geographical Thought*. Wiley-Blackwell, New York.
8. Soja, Edward. (1989). *Post-modern Geographies*, Verso. London. Reprinted 1997: Rawat Publ., Jaipur, and New Delhi.
9. Tuan, Yi-Fu. (1977). *Space and Place: The Perspective of Experience*. Minneapolis: University of Minnesota Press, Introduction, Epilogue.
10. Anne Knowles, ed. (2008). *Placing History: How Maps, Spatial Data, and GIS Are Changing Historical Scholarship*. Esri Press.

Suggested papers/articles:

1. Schaefer, Fred. (1953). Exceptionalism in Geography: A Methodological Examination. *Annals of the American Association of Geographers* 43: 226–49.
2. Wilson, Robert. (2005). Retrospective Review: Man’s Role in Changing the Face of the Earth. *Environmental History* 10 (3), 564-66.
3. Meinig, D W. (1983). Geography as an Art. *Transactions of the Institute of British Geographers* 8: 314–28.
4. Hawkins, Harriet, et al. (2015). What might the geohumanities do? Possibilities, practices, publics, and politics. *GeoHumanities* 1 (2): 211–32.
5. Harvey, David. (1984). On the History and Present Condition of Geography: An Historical Materialist Manifesto. *The Professional Geographer* 3: 1–11.
6. Butler, Judith. (2011). Your Behavior Creates Your Gender. Big Think. <http://bigthink.com/videos/your-behavior-creates-your-gender>.
7. Domosh, Mona. (1991). Toward a feminist historiography of geography. *Transactions of the Institute of British Geographers*. 16 (1): pp. 95–104.
8. Commentary by David Stoddart and Domosh’s response: *Transactions of the Institute of British Geographers* 16(4): 484–490.

Websites/web references:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=17>

Course Title: Research Methodology

Course Code: GEO.562

L	T	P	Cr
3	-	-	3

Total Hour: 45 Hours

Learning Outcome:

1. After completion of this course students will have better understanding of various approaches, research methods and tools of data collection and analysis.
2. Students will be able to write the synopsis and project report.

Unit I:

(11 Lectures)

- Introduction to research in Geography: Critical thinking.
- types of research design, Formulation of research problem
- Research approaches; types of journals - open access, hybrid, merits and demerits of publishing in different types of journals, concept of citations, impact factor, *h*-Index, I-10 index etc.
- Assignments, Group discussion

Unit II:

(12 Lectures)

- Web-based literature search engines- Google Scholar, Scopus, Web of Science etc.
- Review of Literature, identifying gap areas for literature review, hypothesis testing
- Assignments, Group discussion

Unit III:

(11 Lectures)

- Scientific writing, Writing research/review paper and book chapter, Poster preparation and presentation, Dissertation. Writing, Reference writing and management.
- Assignments, Group discussion

Unit IV:

(11 Lectures)

- Writing thesis, project report and research paper; Synopsis writing: procedure, content, methods, literature review.
- Plagiarism and similarity search, Use of tools like Urkund, Turnitin/Ithenticate, Reference Manager – endnote, Mendeley, Statistical and graphical tools
- Assignments, Group discussion

Mode of Transaction: Lecture, class discussion, presentation methods will be used for teaching. Tools such as whatsapp, ppt., and video will also be used.

Suggested readings:

1. Blackburn, J. and Holland, J. (eds.) (1998): Who Changes? Institutionalising Participation in Development. IT Publications, London.
2. Blaxter, L.; Hughes, C. and Tight, M. (1996): How to Research. Open University Press, Buckingham.
3. Dikshit, R. D. (2003): The Art and Science of Geography: Integrated Readings. Prentice-Hall of India, New Delhi.
4. Dorling, D. and Simpson, L. (eds.) (1999): Statistics in Society. Edward Arnold, London.
5. Fisher, P. and Unwin, D., (eds.) (2002): Virtual Reality in Geography. Taylor and Francis, London.
6. Flowerdew, R. and Martin, D. (eds.) (1997): Methods in Human Geography. A Guide for Students Doing a Research Project. Longman, Harlow.

7. Hay, I. (ed.) (2000): Qualitative Research Methods in Human Geography. Oxford University Press, New York.
8. Kitchin, R. and Tate, N., (2001): Conducting Research into Human Geography. Theory, Methodology and Practice. Prentice-Hall, London.
9. Limb, M. (2001): Qualitative Methodologies for Geographers. Issue and Debates. Edward Arnold, London.

Course Title: Geostatistical Techniques and Analysis	L	T	P	Cr
Course Code: GEO.563	3	-	-	3

Total Hour: 45 Hours

Learning Outcome: The student would be able to analyse data and apply various skill in research works.

Unit I: Descriptive Geostatistics (Lectures 12)

- Introduction of Geostatistics: population, statistics, data and variables, scales measurement
- General Geostatistics : count, frequency, curve, ogives, graphs, histogram
- Measures of central tendency : mean, median, mode, skewness and kurtosis
- Measures of variability: range, standard deviation, variance, co-variance and z-score
- Assignments, Group discussion

Unit II: Inferential geostatistics (Lectures 11)

- Sampling: probabilistic and non-probabilistic
- Regression analysis: simple, multiple and logistic regression
- Correlation analysis: simple and multiple correlation
- Probability distribution: normal, binomial and Bayesian probability distribution
- Hypothesis testing: student's t-test, Chi-square test, F-test
- Assignments, Group discussion

Unit III: Graphing and mapping geostatistics (Lectures 11)

- Diagram and charts: bar, pie, boxplot, line graph, dots
- General maps : choropleth map, isopleth map, dot map, bar and pie map
- Inferential maps: Interpolated maps (IWD, Kriging, thin plate spline), pattern mapping (hotspot and cold spot map)
- Symbols and colours: sign, shades, pattern and legend
- Assignments, Group discussion,

Unit IV: Introduction to geostatistical software (Lectures 11)

- Introduction to open source programming language
- Introduction to SPSS, R and Python
- Assignments, Group discussion,

Mode of Transaction: Classroom lecture and solving problem exercise.

Suggested readings:

1. P. L. Meyer, Introductory Probability and Statistical Applications, Oxford & IBH Pub, 1975.

On the completion of this course, the student will be able to:

- Understand the basic concepts of entrepreneur, entrepreneurship and its importance.
- Aware of the issues, challenges and opportunities in entrepreneurship.
- Develop capabilities of preparing proposals for starting small businesses.
- Know the availability of various institutional supports for making a new start-up.
- Identify scope and opportunity of funding for higher education in geography in India and abroad.
- Apply the knowledge of scope and opportunity of geography in higher education to find out better job after having higher education in geography.
- Choose appropriate branches of geography, institute, and place of study for better education and job prospects.

Unit I

Introduction to entrepreneur and entrepreneurship; Characteristics of an entrepreneur; Characteristics of entrepreneurship; entrepreneurial traits and skills; innovation and entrepreneurship; Types of entrepreneurial ventures; enterprise and society in Indian context; Importance of women entrepreneurship

Group discussion, case study

Unit II

Promotion of a venture – Why to start a small business; How to start a small business; opportunity analysis, external environmental analysis, legal requirements for establishing a new unit, raising of funds, and establishing the venture - Project report preparation – format for a preliminary project report, format for a detailed/final project report.

Group discussion, case study

Unit III Opportunity and scope of geography at higher education

(12 Lectures)

- Scope of higher education in geography after bachelor and master
- Scope of higher education in geography in India and abroad
- Higher education in geoinformatics
- Higher education in urban and regional planning
- Higher education in physical geography
- Higher education in population and health geography
- Higher education in interdisciplinary subjects (e.g., climate change, disaster management etc.)
- Group discussion, case study

Unit IV Funding, resource, and job opportunity of geography

(Lectures 11)

- Funding opportunity and resource availability for higher education in India and abroad
- Types of job opportunity for geography student
- Job opportunity in India and abroad
- Opportunity to establish own business after higher education in geography
- Group discussion, case study

Mode of Transaction: Lecture, demonstration, Power point, E-tutoring, discussion, assignments, case study

Course Title: DEC – Practice in Geography	L	T	P	Cr
Course Code: GEO.573	2	-	-	2

Total Hour: 30 Hours

Learning outcome: After completion of this course student will be able to solve subject specific problems/competitive exam questions in a better way.

Unit I

- Geomorphology
- Climatology
- Geographical Techniques

Activity: Assignments, Group discussion, Quiz, problem solving, question solving

Unit II

- Geography of India
- Cultural, Social and Political Geography

Activity: Assignments, Group discussion, Quiz, problem solving

Unit III

- Geography of Environment
- Oceanography
- Geographic Thought

Activity: Assignments, Group discussion, Quiz, problem solving

Unit IV

- Population and Settlement Geography
- Geography of Economic Activities and Regional Development

Activity: Assignments, Group discussion, Quiz, problem solving

Transaction mode: Discussion method and MCQs practice test (UGC previous years papers/other subject specific competitive exam papers will be used for this course.

Suggested readings:

- Singh, Surender (2009), Geography - For UPSC Civil Services Preliminary Examination Paperback, Tata mcgraw hill education.
- Siddhartha, K. (2017), Geography through maps, Kitab Mahal.
- Hussain, Majid (2016), Models in Geography, Rawat Publishers, Jaipur.

Course Title: Glaciology	L	T	P	Cr
Course Code: GEO.566	3	-	-	3

Total Hour: 45 hours

Learning outcome: After completing the course, students are expected to:

- Explain the formation, movement, and effects of the different kinds of glaciers.
- describe the different time scale physical properties of glaciers (including glacial hydrology) on landform-building processes
- describe and explain the physical behaviour of ice sheets in relation to regional and global climate and to climate change
- explain principles for glacier movement, glacier dynamics and glacier mass balance modelling
- explain the continuous and growing threat of Glacier- and permafrost-related hazards to human lives and infrastructure in high mountain region

Unit I: Introduction to Glacial process and geomorphology 11 Lectures

- Introduction to physical and environmental glaciology.
- Glacier formation, classification, and characteristics and overview of global and national glacier monitoring initiatives.
- Glacial geomorphic processes: erosion, transport and deposition & glacial sedimentation
- Glacio-fluvial, periglacial and paraglacial landforms (special emphasis on rock glaciers and permafrost area).
- Glaciations and past glacial activity - classical models of Quaternary glaciation and the records in glacial sediments, ice-cores and other proxy datasets.
- Group discussions, Presentations and Assignments

Unit II: Glacial-climate interactions, dynamics and mass balance

14 Lectures

- Principles of glaciers mass balance, gradient, profile and equilibrium line altitude.
- Glacier mass balance measurement, analysis and modelling: Direct/Glaciological method, Geodetic, Hydrological and AAR based method, limitations and strengths.
- Glacier motion and dynamics, ice flows, surges, calving, glacier instabilities and modelling the flow of Glaciers.
- Glacier-climate interactions study using temperature index modelling, energy balance modelling and linear mass balance modelling.
- Glacier hydrology and water balance in glaciated catchment: water storage changes, water balance of a glacier, runoff and its variability, contribution of glacier and snow melt to stream flow and impacts of climate change on water resources in the glaciated valleys and downstream areas.
- Group discussions, Presentations and Assignments

Unit III: Glacier and Permafrost Hazards

10 Lectures

- Glacial lake, types, characteristics and outburst floods
- Ice break-offs and subsequent ice avalanches from steep glaciers;
- Stable and unstable glacier length variations and surging;
- Debris flows and Destabilisation of frozen or unfrozen debris slopes;
- Rock avalanches and Destabilisation of rock walls;
- Group discussions, Presentations and Assignments

Unit IV: Geo-physical and Geo-chronology methods for glacial studies

10 Lectures

- Inventorying and monitoring, glacier's surface elevation changes, glacier's velocity and motion, glacier's ice thickness and volume estimation, geodetic and AAR based glacier's mass balance measurements, limitation and strengthens.
- Geophysical field based measurements and sample collections of glacial parameters (e.g. glacial mass balance, thickness, velocity) using glaciological method, ground penetrating radar, DGPS measurements, total station or terrestrial LiDAR survey.
- Geo-chronology methods to reconstruct the past glaciations and geomorphic process and resultant landforms or features using OSL, CRN and Tree rings dating methods, samples collections and processing.
- Group discussions, Presentations and Assignments

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, whatsapp and Expert's Video Conferencing lectures from various national & international organizations

International to National to Local reachability: The course will have wider reachability from local to international level to provides a systematic survey of modern research into glacial processes, and the response of glaciers and ice sheets to climate change and resultant impacts on the regional water balance and associated hazards in the mountainous regions and its downstream areas.

Suggested Readings:

- Benn, D. I., and Evans, D. J. A. (2018). *Glaciers and glaciation*: New York, New York, Wiley, 734
- Andrews, J. T., (1990). *Glacial systems*: Belmont, California, Wadsworth, 191
- Kargel, J.S., G.J. Leonard, M.P. Bishop, A. Kaab, B. Raup (Eds), 2014, *Global Land Ice Measurements from Space* (Springer-Praxis). 33 chapters, 876 pages. ISBN: 978-3-540-79817-0.
- Brodzikowski, K. and van Loon, A. J. (1991). *Glacigenic sediments*: Amsterdam, Netherlands, Elsevier, 674.
- Pellikka P. and W.G. Rees, eds. (2010). *Remote sensing of glaciers: techniques for topographic, spatial, and thematic mapping of glaciers*. Boca Raton, FL, CRC Press/Taylor & Francis. 330pp
- Cuffey, K.M., and Patterson, W. S. B., 2010, *The physics of glaciers* (4th ed.): New York, NY, Academic Press, 704 p.
- Embleton, C., and King, C. A. M., 1975, *Glacial geomorphology*: New York, New York, Wiley, 573 p
- Evans, D. J. A., ed., 2003, *Glacial landsystems*: London, England, Arnold, 532 p.
- Hooke, R. LeB., 2005, *Principles of glacier mechanics* (2nd ed.): Cambridge, U.K., Cambridge University Press, 448 p.
- Knight, P. G., 1999, *Glaciers*: London, U.K., Stanley Thornes, 272 p.
- Nesje, A., and Dahl, S. O., 200, *Glaciers and environmental change*: London, U.K., Arnold, 203 p.
- van der Veen, C.J., 2013, *Fundamentals of glacier dynamics* (2nd ed.): Boca Raton, Florida, CRC Press, 403 p.
- Elias, S. A., ed., 2006, *Encyclopedia of Quaternary science* (four volumes):Netherlands, Elsevier.

Course title: Geography of Transport and Regional Development (Theory) L P C

Course code: GEO.568 3 - 3

Total hour: 45 hours

Learning outcome:

At the completion of the course, the student will be able to:

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Unit I: Geography of Transport (11 lectures)

- Introduction to Geography of Transport
- Theories and Models of spatial interaction (Edward Ullman and M. E. Hurst)
- Measures and Indices of connectivity and accessibility; Spatial Flow Models: Gravity Model and its variants,

Unit II: (11 lectures)

- World Trade Organisation, Globalisation and Liberalisation and World Trade Patterns.
- Problems and Prospects of Inter and Intra Regional Cooperation and Trade.

Unit III: Regional Development (11 lectures)

- Concept of Regional Development
- Typology of Regions, Formal and Fictional Regions,
- World Regional Disparities

Unit IV: (12 lectures)

- Theories of Regional Development(Albert O. Hirschman, Gunnar Myrdal, John Friedman,
- Dependency theory of Underdevelopment, Global Economic Blocks, Regional Development and Social Movements in India

Mode of Transaction: methods of transaction are lecture, audio-video, discussion which will be followed in teaching using ppt, social media etc.

Suggested readings:

Rodrigue, Jean Paul (2020). The Geography of Transport System, Routledge
 Knowles, Richard, Shaw, Jon, Docherty, Iain Transport Geographies, Wiley-Blackwell

Pike, Andy, Rodriguez-pose, Andres, Tomaney, John (2017), Local and Regional Development, Routledge

Chand, Mahesh, Puri, V.K. (2011). Regional Planning in India, Allied Publication Ltd

Website:

www.transportgeography.org

www.cbpbu.ac.in

Course Title: Meteorology **L T P Cr**

Course Code: GEO.569 3 - - 3

Total Hour: 45 Hours

Course objective: To familiarise the students with the General principles of meteorology. It helps the students to understand explain the physical laws governing the structure and evolution of meteorological phenomena spanning a broad range of spatial and temporal scales.

Learning outcome: By the end of this course students will be able

- To Explain the principles behind, and use of, meteorological instrumentation.
- To understand critical and analytical skills to interpret and predict weather systems using weather products.
- Equip the students with the skills of quantitative and statistical analysis with regards to meteorological data processing and management

Unit I: Physical Meteorology (11 Lectures)

- Importance of radiation in the study of meteorology: basic Laws - Rayleigh and Mie scattering, multiple scattering, radiation from the sun, solar constant, effect of clouds, surface and planetary albedo.
- Emission and absorption of terrestrial radiation, radiation windows, radiative transfer, Greenhouse effect, net radiation budget;
- Thermal structure of the atmosphere and its composition.
- Adiabatic and isentropic processes, Vertical structure of atmosphere, Concept of lapse rates (DALR, SALR, ALR)

Unit II: Dynamic Meteorology

(12 Lectures)

- Basic equations and fundamental forces: Pressure, gravity, centripetal and Coriolis forces, continuity equation in Cartesian and isobaric coordinates.
- Geostrophic approximation: Definition and properties of geostrophic wind. Vectorial expression for geostrophic wind.
- Divergence and vertical motion Rossby, Richardson, Reynolds and Froude numbers.
- Basic principles of general circulation modelling; grid-point and spectral GCMs; role of the ocean in climate modelling; interannual variability of ocean fields (SST, winds, circulation, etc.) and its relationship with monsoon, concepts of ocean – atmosphere coupled models.

Unit III: Synoptic Meteorology

(11 Lectures)

- Scales of weather systems; Network of Observatories; Surface, upper air; special observations (satellite, radar, aircraft etc.); analysis of fields of meteorological elements on synoptic charts; Vertical time / cross sections and their analysis.
- Wind and pressure analysis: Isobars on level surface and contours on constant pressure surface. Isotherms, thickness field; slope of pressure system, streamline and isotach analysis.
- Indian summer monsoon; S.W. Monsoon onset: semi-permanent systems, Active and break monsoon, Monsoon depressions: MTC; Offshore troughs/vortices. Influence of extra tropical troughs and typhoons in northwest Pacific; withdrawal of S.W. Monsoon, Northeast monsoon,
- Meso-scale meteorology, sea and land breezes, mountain/valley winds, mountain wave, Jet streams and weather

Unit IV: Weather Radar and Satellite Meteorology

(11 Lectures)

- Introduction to Weather radars. Different frequency bands used in the weather radars and their applications. Principles of pulsed radar, Polarimetric radars.
- Details features of Real Time Analysis of Product & Information Dissemination (RAPID) webbased tools for satellite Data/products visualization
- Meteorological satellites – Polar orbiting and geostationary satellites, visible and infrared radiometers, multiscanner radiometers;

- Identification of synoptic systems, fog and sandstorms, detection of cyclones, estimation of SST, cloud top temperatures, winds and rainfall: temperature and humidity soundings.

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, whatsapp and Expert's Vedio Conferencing lectures from various national & international organizations

Suggested Readings:

- James R. Holton (2010) An Introduction to Dynamic Meteorology, Academic Press, US
- C. Donald Ahrens (2004) Essentials of Meteorology: An Invitation to the Atmosphere, Brooks Cole, UK

Course Title: Instrumentation and Analysis
(Practical)

L T P Cr

Course Code: GEO.570

- 4 2

Total Hour: 60 Hours

Learning outcome:

Upon the completion the student will be able to understand and utilise the instrument for carrying out research and project work.

Exercise with instruments

- Prismatic compass
- Pocket and mirror stereoscope
- Thermometer, Barometer, Anemometer, Hygrometer, Rain gauge
- pH meter, Conductivity meter, TDS meter, DO meter, Salinity meter, Clinometer, Mohs Hardness Test
- Ground Penetrating Radar, Automatic Weather Station (AWS), Continuous Ambient Air Quality monitoring system, Laser distance meter, Range Finder, Brunton Compass

Mode of Transaction: Lecture, demonstration, Power point, E-tutoring, discussion, assignments, case study

Suggested readings:

- American Public Health Association (APHA) (2012). Standard method for examination of water and wastewater, 22nd edn. APHA, Washington.
- Yadav, M. S. (2008). Instrumental methods of chemical analysis, New Delhi: Campus Books International.
- Rajvaidya, N., Markandey, D. (2005). Environmental Analysis and Instrumentation, APH Publisher.
- Chatwal, G. R., Anand, S. K. (2013). Instrumental Methods of Chemical Analysis, New Delhi: Himalaya Publishing House.
- Skoag, D. A., Holler, F. J., Crouch, S. R. (2007). Principles of Instrumental Analysis, CENGAGE Learning.

Course Title: Field visits/Internship/Dissertation	L	T	P	Cr
Course Code: GEO.599	-	-	8	4

Learning Outcomes

On completion of the course, the learner will be able to:

- Relate the theoretical knowledge gained in lectures to practical studies in field
- Design experiments to implement theoretical and laboratory knowledge to field studies
- Choose appropriate demonstration skills for field/ action report preparation.

The Students are required to submit a dissertation proposal / synopsis of the research work to be carried for the fulfilment of M.A. dissertation. It will have following components:

- Origin of the research problem and literature review
- Objective of the research work
- Methodology of the work, field observations (if any) and data recorded by the candidate,
- Proposed laboratory investigation (if any) carried out by the candidate,
- Expected Outcome

Mode of Transaction: Demonstration, Experimentation, Tutorial,

Evaluation Criteria:

The evaluation of dissertation proposal in the third semester will carry 50% weightage by supervisor and 50% by HoD and senior-most faculty of the department which include Dissertation proposal and Presentation.

Course Title: Dissertation	L	T	P	Cr
Course Code: GEO.600	-	-	80	20

The student will be evaluated (Satisfactory/ Not Satisfactory) based on

- Project report
- Formatting and timely submission
- Plagiarism
- Quality of viva presentation
- Response to questions of the committee
- Continuous evaluation by the guide

The Students are required to submit a dissertation based on the research work carried out towards the fulfilment of M.A. dissertation. It will have following components:

- Origin of the research problem and literature review
- Objective of the research work
- Methodology of the work, field observations (if any) and data recorded by the candidate,
- Details of laboratory investigation (if any) carried out by the candidate,
- Synthesis of results and interpretation
- Concluding remarks and future direction

Evaluation Criteria:

The evaluation of dissertation in the fourth semester will be as follows:

- 50% weightage for continuous evaluation by the supervisor which includes regularity in work, mid-term evaluation, report presentation, and final viva-voce.
- 50% weightage based on average assessment scores by an external expert, HoD and senior-most faculty of the department; this includes report of dissertation (30%), presentation (10%), and final viva-voce (10%).
- The final viva-voce will be through offline or online mode. Similar evaluation pattern will be used for internship where supervisor will award 50% marks and external co-supervisor, HoD and senior-most faculty will award 50% marks.
- The workload of one contact hour per student will be calculated for dissertation in fourth semester.