Central University of Punjab, Bathinda

Ph.D. Geography

Academic Session:2020

Programme Learning Outcome

The Ph.D. Geography Programme will enable the students to:

1. Formulate research problems in the field of geographical enquiry
2. Explore real world issues through research tools of geography
3. Review the thematic issues with research competencies.
4. Analyze various tools and techniques of data collection
5. Apply geographical research techniques in solving problem with spatial dimension.
6. Evaluate the validity of findings in research
7. Demonstrate research competencies in completion of dissertation in relevant themes at various scales.

Department of Geography

Syllabus for Ph.D. Course work in Geography						
Course Code	**Course Title**	**Course type**	**Credit Hours**			
			L	**T**	**P**	**Cr**
Semester-I						
Core courses						
GEO.701	Research Methodology in Geography	Co	4	-	-	4
GEO.702	Computer Applications – P	CF	-	-	4	2
GEO.703	GIS & GPS – P	SE	-	-	4	2
GEO.599	Seminar	Co	-	-	-	1
	Research and Publication Ethics	Co	2	-	-	2
Elective courses: Select any one of the specialized courses listed below						
GEO.705	Population, development and environment	EL	4	-	-	4
GEO.706	Regional analysis with special reference to India	EL	4	-	-	4
GEO.707	Earth and the Environment	EL	4	-	-	4
GEO.708	Urban Geography and Environment	EL	4	-	-	4
GEO.709	Land Degradation and Desertification	EL	4	-	-	4
GEO.710	Paleoclimatology	EL	4	-	-	4
GEO.711	Sustainable and Resilient city	EL	4	-	-	4
	Total	**CBCS**	**10**	**-**	**8**	**15**

Note: Number of elective courses to be offered in a semester will depend on the availability of faculty.

Choice Based Credit System (CBCS):

CF: Compulsory Foundation, **Co**: Core, **SE**: Skill-based, **EL:** Elective

L: Lecture, **T**: Tutorial, **P**: Practical, Cr: Credit

Evaluation Criteria

- End Semester Examination- 100 marks

Evaluation criteria for Practical Examination			
End Semester performance	**Practical copy**	**Viva**	**Total**
50	30	20	100

Evaluation criteria for Seminar					
Continuous evaluation (out of 50)	**End semester presentation** (out of 50)				Total (out of 100)
	Literature Strength (out of 10)	Organization of content (out of 10)	Presentation (out of 20)	Discussion (out of 10)	

Course Title: Research Methodology in Geography

L	T	P	Cr
4	1	-	4

Course Code: GEO.701
Total Hour: 60 Hours
Learning Outcomes: student will competent to explore:

- Concept, theory, methods and tools in geographical research
- Types of data, data collection tools and methods
- Scientific thesis and research paper writing
- Research ethics, valuation and visualization

After completion of the course the students will learn:

- Types and methods of research
- How to review literature
- How to formulate research problem
- Methods of data collection
- Develop research problems
- Application of statistical techniques in research

Unit I: Research paradigm in geography **15 lectures**

- Concept, theory and types of geographical research
- Scientific research philosophy: Kuhn and David Harvey philosophy
- Scientific reasoning: inductive and deductive, empirical and general
- Geographical research: models and tools
- Discipline-wise geographical research: A survey

Unit II: Research procedure/Research design and methodology: 15 lectures

- Research approach: qualitative, quantitative and mixed
- Research design: methods and tools
- Research process: steps in scientific research
- Research valuation: SWOT analysis, Cost-benefit analysis

Unit III: Methods of data collection and analysis **15 lectures**

- Concept and types of data and information
- Data collection instruments and process
- Data sources and data collection ethics
- Cloud-based and off-cloud data mining
- Applied geostatistics: descriptive and inferential geostatistics

Unit IV: Scientific thesis and paper writing **15 lectures**

- Scientific thesis writing: methods and tools
- Scientific paper writing: methods and tools
- Bibliography, referencing and citation: methods and tools
- Research ethics: copyright issues and plagiarism
- Guideline for theme-based journal articles

Transaction Mode: Lecture delivery using White Board and PPT, Problem Solving through Assignments.

Suggested readings:

1. Amedeo, D. and Golledge, R.G. (1975). An introduction to scientific reasoning in geography, New York, Willey and Sons.
2. Berg, Bruce L. (2001). Qualitative Research Methods for Social Sciences. Boston: Allyn and Bacon.
3. Brent, E. E. (1990).Computer Applications in the Social Sciences. Philadelphia: Temple University Press.
4. Bryant, Christopher G. A. and David Jary (eds). (1991). Giddens' theory of structuration: a critical appreciation. London: Routledge.
5. Chakravarti, A.K. & Tiwari, R.C. (1990). A Basic Research Paradigm in Geography, Journal of Geography, 89:2, 53-57, DOI: 10.1080/0022134 90 08979595Sack, R. (1973).
6. Harvey, D. (1973). Explanation in Geography. Historical Methods Newsletter, 6(2), 68–72. doi:10.1080/00182494.1973.10593999
7. Robert, A. (2002). Epistemology: A Contemporary Introduction to the Theory of Knowledge. London: Routledge

Course Title: Computer Applications -Practical

L	T	P	Cr
-	-	4	2

Course Code: GEO.702
Total Hour: 30 Hours
Learning Outcomes:student will proficient in exploring :

- Computer fundamentals
- Software and programming languages
- Database management
- Social medial and Web application and
- Cloud computing in geographical research

Unit I: Fundamentals of Computer **15 lectures**

- Computer hardware and software
- Computer number system: binary, decimal, octal and hexadecimal
- Computer logic gate and boolean algebra
- Computer management: working principle in geography

Unit II: Computer software **15 lectures**

- System software: Windows and Linux
- Application software: documentation, graph building and visualization
- Remote sensing, GIS and Statistical software
- Software relevance in geographical research: discipline-wise exercise

Unit III: Programming language **15 lectures**

- Geostatistical: R, Python
- Web design and visualization: HTML, CSS, JavaScript
- Documentation: LaTeX

Unit IV: Web searching and database management system **15 lectures**

- Web-based information retrieval and management
- Social-media for geographical research
- Cloud computing
- Management of geographical data: cloud-based and off-cloud

Transactional Modes: PPT, Video, e-content, google drive, software hands on.

Suggested readings:

1. Bhatt, Pramod Chandra P. An Introduction to Operating Systems: Concepts and Practice. Second edition, New Delhi: PHI Learning Pvt. Ltd., 2008.
2. Date, C. J. (2000). An Introduction to Database Systems. Massachusetts: Addison-Wesley Longman, 7th Edition.
3. Douglas, G. and Mark C. (2007). Fundamentals of MS Office. Second edition, Dubuque: Kendall Hunt Publication Company.
4. Gookin, D. (2007). MS Word for Dummies. Wiley and Sons.
5. Harvey, G. (2007). MS Excel for Dummies. Wiley and Sons
6. Jamsa, K.A. (1993). DOS: The Pocket Reference. Berkeley: Osborne McGraw-Hill.
7. Narang, R. (2006). Database Management System. New Delhi: PHI Learning

Pvt. Ltd.
8. Rajaraman, V. (2015). Fundamentals of Computers. New Delhi: PHI Learning Pvt. Ltd.
9. Sanders, D.H. (1988). Computers Today. Singapore: McGraw Hill Publishing.
10. Sinha, P.K. (2017). Computer Fundamentals, BPB Publications.

Course TitleGIS & GPS – P

L	T	P	Cr
-	-	4	2

Course Code: GEO.703
Total Hour: 30 Hours
Learning Outcomes: After completion of the course the students will learn:

- theoretical framework in geographical information system
- Types of datasets
- Extraction, generation, and analysing of data.
- digital cartography
- Learning of GIS software

Unit I **15 Hours**

- Georeferencing Maps/Images,
- Digitization of Raster Map: Point, Line and Polygon Features,
- Preparation of Attribute Tables, Editing and Joining Tables,
- Analyzing Attribute Data: Calculating Area, Perimeter, and Length.
- Spatial Representation: Mapping Techniques,
- Spatial Representation: Symbolizing and Map Layouts, Basic

Unit II:15 Hours

- Analysis in GIS: Buffering, Overlay and Query Building
- GPS Applications
- User interface with global positioning receivers
- Collection of ground control points using hand held GPS receiver
- DGPS, wide area augmentation system (WAAS)
- Transferring data from GPS receiver to PC.

Transaction Mode:
Lecture, demonstration, tutorial, hands on exercise, problem solving.

1. Bhatta, B. (2011). Remote sensing and GIS, 2nd edition, New Delhi, Oxford University Press.
2. Harvey, F. (2016). A primer of GIS: Fundamental geographic and cartographic concepts, 2nd edition, New York, The Guilford press.
3. Holfmann-wellenhof, B., Lichtenegger, H., Collins, J., Hofmann-wellenhof, B. (2013). GPS global positioning system: Theory and practice 5th edition, New Delhi, Springer (India) private limited.
4. Kennedy, M. (2013). Introducing geographic information systems with arcgis: A workbook approach to learning GIS, 3rd edition, New Jersey, A John Wiley & Sons publications
5. Liu, JianGuo& Mason, Philippa J. (2016). Image processing and GIS for Remote Sensing, Techniques and applications, 2nd edition Publication, United Kingdom, Wiley Blackwell.
6. Van Sickle, J. (2008). GPS for land surveyors, 3rd edition, London, CRC press.

Thematic Papers (Select any one)

Course Title: Population, development and environment

L	T	P	Cr
4	1	-	4

Course Code: GEO.705

Total Hour: 60 Hours

Learning Outcomes: After completion of the course the students will learn:

- Population environment issues
- Critical appraisal of population theories
- Issues of inequality present at different scales
- Environmental issues with respect to human sustenance

Unit I **15 Hours**

- Concept: population, development and environment
- Theories: Malthus, marx, neo-malthusian and cornucopian

Unit II:15 Hours

- Demographic transition: stages, form and transformation
- Ageing: concept, measurement, global and Indian pattern, implications

Unit III:15 Hours

- Human development: component, measurement, distribution
- Poverty distribution
- Women and development: genders role, indicator of gender inequality, women and work participation, reproductive health

Unit IV:15 Hours

- Population and environment: climate change, global warming
- Food security
- Measurement: Vital rate, life table and population projection

Transaction Mode:

Lecture, demonstration, tutorial, problem solving.

Suggested readings:

1. Council for Social development. (2006). India social development report OUP New Delhi.
2. Domash M. et al. (2001). Putting women in place, Gulliford press, New York.
3. Jain, D. (2005) women development and UN – A sixty years of quest for equality and justice, Indiana university press, USA
4. Newbold, B.K. (2006).Six billion plus: world's population in the 21st century, Rowman and Little field Pub. USA.
5. Ramakumar, R. (2018). Technical Demography, New Age International, New Delhi.
6. Saraswati R. et al. (1999). Atlas of women and man in India, Kali for women, New Delhi
7. Sialkind, N.J. (2006). Encyclopaedia of human development vol I, II,III sage new York.
8. Zukerman, B. et al. (1996).Human population and environmental crisis, Jone&Berlett, Boston.

Course Title: Regional analysis with special reference to India

L	T	P	Cr
4	1	-	4

Course Code: GEO.706

Total Hour: 60 Hours

Learning Outcomes: After completion of the course the students will learn:

- Theories of regional development
- Issues of disparities across the regions
- Development and sustainability issues

Unit I 15 Hours

- Regions, regional system, regional disparities and regionalism
- Theories of regional development: Myrdal-hirschman, dependency-world system &export base

Unit II:15 Hours

- Urban-regional theories: economic base theory, threshold theory
- New urbanismMethods and techniques of regionalization
- Regional analysis with reference to India

Unit III:15 Hours

- Regional resource analysis: resource region (reference to India)
- Resource and livelihood; sustainability issue
- Conflicts in developmental goals, mega project and disadvantages communities

Unit IV:15 Hours

- Manufacturing belt and complexes of India
- Post-fordism, industrial regions- emerging patterns and regional disparities

Transaction Mode:

Lecture, use of green board, PPT, tutorial, assignments.

Suggested readings:

1. Alonso, W. and Friedman (ed). (1974). Regional Policy; A reader Mass: MIT press.
2. Berry, BJL and Marble, D. (ed). (1968). Spatial analysis Nj: Englewood cliff
3. Guha, R. and Madan, T.N. (1994). Social Ecology, New Delhi, OUP.
4. Kundu, A. (1977).urbanization and regional development in India concept New Delhi.

Course Title: Earth and the Environment

L	T	P	Cr
4	1	-	4

Course Code: GEO.707

Total Hour: 60 Hours

Learning Outcomes: After completion of the course the students will learn:

- Different environmental issues of various scales
- Political economy of resources
- Environmental development debates

Unit I **12 Hours**

Earth as a complex system

- Components and their interrelations; Environment as resource field and sink
- Environmental crisis: Causes and manifestations
- Environmentalism and green movements; Major global environmental issues.

Unit II:15 Hours

Environment and Development

- Conventional and ecological economics
- Production and consumption spiral; Impacts on ecosystems
- Sustainable development: Is sustainability an impossibility theorem?

Unit III:15 Hours

Environmental risk assessment

- Perception, assessment and evaluation of environmental risks;
- Environmental impact assessment (EIA) and uncertainty;
- EIA practices around the world; EIA procedure in India
- Adaptation to global environmental change

Unit IV:18 Hours

- Agenda 21; Globalisation and environment;
- Political economy of resource use and environmental management
- Environmental management strategies at sub-national level: Integrated watershed and eco-region management; Management at local level: Municipal water supply management; Conservation and restoration of forest cover and organic farming atpanchayat level.

Transaction Mode:

Lecture, use of green board, PPT, tutorial, assignments, group learning.

Suggested readings:

1. Bailey, R.G. (2002). Ecoregions: Design for Sustainability; New York: Springer Science & Business.
2. Bailey, R.G. and Ropes, L. (2007). Ecoregions : The Ecosystem in Geography of theOceans and Continents; New York : Springer
3. Chiras, D.D. (2010).Environmental Science;London: Jones and Bartlett PublishersInternational
4. Common, M.S. and A Stage, S. (2005). Ecological Economics:An

Introduction;Cambridge:Cambridge University Press.
5. Daly, H. E. ad Farley, J. (2004). Ecological Economics: Principles and Applications;Washington, D.C.: Island Press6.
6. Dupont R., Baxter, T.E. and Theodore, L. (1998).Environmental Management:Problems and Solutions;Florida: CRC Press.

Course Title: Urban Geography and Environment

L	T	P	Cr
4	1	-	4

Course Code: GEO.708

Total Hour: 60 Hours

Learning Outcomes: After completion of the course the students will learn:

- Theories and approaches of urbanisation
- Different urban environmental issues of various scales
- National schemes/policies of urban development
- Themes of research in urban geography

Course Learning Outcomes:

The objective of the course are to develop an understanding of multiple theoretical perspectives on the city and to define, in multiple ways, the processes that constitute the city, its production. The students will also study various contemporary issues of urban areas from planning perspective. They will also understand the impact that urban policy of India has on cities.

Unit I **12 Hours**

Basic Concepts of Urban/Urbanization

- Nature and Scope of Urban Geography; Concept and theories
- Approaches to the study of Urban Geography
- Origin and growth of the cities
- Urban Environment: Concept, Components and Levels of Analysis
- Approaches to the study of Urban Environment; Global context of Urbanization and urban change.

Unit II: **18 Hours**

Emerging Issues

- Trends and Patterns of Urbanization in India: Pre and Post-Independence Period
- Functional Classification of Towns
- Urban Problems and Environmental Degradation in India; Micro Climate of Cities; Urban Pollution (Air, Water and Noise) and Health Impacts
- Rural-urban migration, Housing the urban poor, Poverty, power and politics
- Urban development policies of India

Unit III: **14 Hours**

Urban Environment

- Urban environment problems: Global and national;
- Concept of Urban Sustainability and Urban Environmental Conservation Strategies
- Traffic and transport problems
- Urban governance. Towards the city of the future.

Unit IV: **16Hours**

Research Methods in Urban geography

- Models for Internal Structure, Hierarchy and Spacing of Cities;
- Urban Sprawl; Urban Poverty and Slums;
- Use of Remote Sensing Data for Urban Land uses and Change Detection; GPS and GIS for Urban Mapping
- Socio-economic and Environmental Surveys for Urban Themes.

Mode of Transaction: The course will be taught with a combination of lectures, discussion, and presentations**,** assignments, group learning exercise.

Suggested readings:

1. Burgess, R., Marisa C., and Thed K. (1977). The Challenge of Sustainable Cities, Zed Books, New Jersey.
2. Carter, H. (1972). The Study of Urban Geography, Edward Arnold, London.
3. Choley, R.J.O. and Haggett, P. (1966). Models in Geography, Methuen, London.
4. Gibbs, J.P. (1961). Urban Research Methods, Princeton, New Jersey.
5. Goudie, A. (1993). The Human Impact on Natural Environment, Blackwell, USA.
6. Hall, P. (1992). Urban and Regional Planning, Routledge, London.
7. Knox, P. (1994). Urban Social Geography- An Introduction, Longman, U.K.
8. Nangia, S. (1976). Delhi Metropolitan Region: A Study in Settlement Geography, Rajesh Publications.
9. Pacione, M. (2009). Urban Geography: A Global Perspective. Routledge; 3 edition.
10. Ramachandran, R. (1997). Urbanizatiion and Urban Systems in India. OUP India.
11. Yamagata, Y. and Yang, P. (2020). Urban Systems Design: Creating Sustainable Smart Cities in the Internet of Things Era. Elsevier Science Publishing Co Inc; 1 edition.
12. Yang, X. (2011). Urban Remote Sensing: Monitoring, Synthesis and Modelling in the Urban Environment. John Wiley and Sons Ltd.

Course Title: Land Degradation and Desertification

L	T	P	Cr
4	1	-	4

Course Code: GEO.709

Total Hour: 60 Hours

Learning Outcomes: After completion of the course the students will learn:

- Different processes of land degradation
- consequences of land degradation
- land degradation research method
- various methods to mitigate land degradation processes

Unit I **15 Hours**

Types and causes of land degradation and desertification

- Definition, and concept, Clear cutting, Deforestation, Agricultural depletion of soil nutrients through poor farming practices, Overstocking and overgrazing,
- Land pollution including industrial waste, Mining and quarrying
- Climate change as cause and result of degradation of dryland areas.

Unit II:15 Hours

Processes and consequences of degradation

- Impacts of soil degradation on the landscape and the built environment both temporally and spatially
- Consequences of loss of topsoil, acidification, water logging, salinization, compaction, reduced soil fertility, the consequences for productivity
- Famine, starvation, migration and economic loss.

Unit III:15 Hours

Land degradation distribution patterns in India

- Land, Population and environment in India, Status of degradation in India
- Economic consequences of land degradation
- Impact of land degradation on people.
- Methods of monitoring desertification/ degraded land and recognizing its spread including the use of remote sensing, Interpretation of Satellite imagery, LULC classification, change detection, Ground verification
- Soil erosion intensity mapping, NDVI, Land capability classification.

Unit IV:15 Hours

Managing land degradation and desertification

- Mitigation strategies at different scales include: short term including the use of appropriate/intermediate technology, Long term planning to include irrigation systems and land use change,
- Mitigation strategies for soil degradation at different scales: Improving monitoring, improving information and communication, improving technology, improving practices
- Political solutions; incentives and investment, Institutions and programmes to combat degradation.

Transaction Mode:

Lecture, use of green board, PPT, tutorial, assignments.

Suggested readings:

1. Barrow, C.J. (1991). Land Degradation: Development and Breakdown of Terrestrial Environments. Cambridge: Cambridge University Press.
2. Beinroth, F.H, H Eswaran, P.F. Reich and E Van Den Berg. (1994). Land Related Stresses in Agroecosystems." in S.M. Virmani, J.C. Katyal, H. Eswaran, and I.P. Abrol (eds), Stressed Ecosystems and Sustainable Agriculture. New Delhi: Oxford and Ibh.
3. Blaikie, P. and H. Brookfield. (1987). Land Degradation and Society. London: Methuen.
4. Crosson, P.R. (1997). The On-Farm Economic Costs of Erosion. in R. Lal, W.E.H. Blum, C. Valentin and B.A. Stewart (eds). Methods for Assessment of Land Degradation. Boca Raton: CRC Press.
5. Darkoh, M.K. (1995). The Deterioration of the Environment in Africa's Drylands and River Basins. Desertification Control Bulletin, 24: 35–41.
6. Stocking, M.A. and Murnaghan, N. (2001). A Handbook for the Field Assessment of Land Degradation, 1st Edition. CRC Press.

Course Title: Paleoclimatology
Course Code: GEO.710

L	T	P	Cr
4	1	-	4

Total Hour: 60 Hours

Course objective: The goal of this course is to present an overview of the methods used to reconstruct the earth's climate history and the techniques used to determine the timing of environmental changes. Paleoclimate data from proxy records, such as ice cores or tree rings, provides a longer perspective on climatic variability than is possible from instrumental or historical records. Particular emphasis will be given to the climatic changes during the late Cenozoic – the time of the ice ages.

Learning outcome: The students would be able to identify climate forcing and responses over longer time scale.

- To discuss the various components of Earth's climate system, such as the cryosphere, atmosphere, biosphere, and hydrosphere.
- To discuss tools and techniques used to interpret changes in Earth's climate through geologic time.
- To recognize and critique modern paleoclimate studies through the use of primary literature in climate science.
- To examine the variable time scales upon which different climate processes occur and understands as residence time, and periodicity.

Unit I: Fundamentals of Paleoclimate: 10 Hours

- Introduction and Why Study Paleoclimate
- Overview of Climate Sciences
- Earth's Climate System Today
- Climate Archives, Data and Models

Unit II: Tectonic & Orbital-Scale Climate Change 20 Hours

Tectonic Scale Climate Change

- CO_2 and Long-Term Climate
- Gaia Hypothesis and Snowball Earth
- Plate Tectonic Drivers
- Greenhouse Climates, Greenhouse to Icehouse
- Paleoclimate Evidence from Oxygen Isotope Measurements

Orbital-Scale Climate Change

- Long term changes in the Earth's Orbit
- Orbital Parameters
- Changes in Insolation
- Ice ages, Ice Cores and Insolation Control of Ice Sheets
- North Hemisphere Ice Sheet History
- Orbital-Scale interactions

Unit III: Glacial/Deglacial& Human Climate Change 15 Hours

Glacial/Deglacial& Human Climate Change:

- The Last Glacial Maximum
- Climate Change since the last Deglaciation
- Millennial Oscillations of Climate

Human Climate Change:

- Early Humans and Climate Change
- Climate Change over the last 1,000 years
- Climate Change since 1850
- Current and Future Climate Change

Unit IV: Techniques of PaleoclimateResearch: 15 Hours

- Introduction to geochronology techniques
- Theory and Applications of Luminescence Dating
- Theory and Applications of Dendrochronology Dating
- Essential field techniques used in Paleoclimate research, including remote sensing, surveying, mapping, and sediments/sample collections & coring.

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 JNU, New Delhi, PRL-Ahmedabad, IUAC-Delhi, BSIP-Lucknow

International to National to Local reachability: The course will be further enhanced with the advice of experts from following international to national organizations

- Queens University, Belfast, Northern Ireland (U.K.) (World Famous lab of Carbon Dating)
- Department of Marine, Earth and Atmospheric Sciences, North Carolina State University (US)
- Johannes Gutenberg University, Mainz (Germany)
- Physical Research Laboratory, Deptt. Of Space**,** Ahmedabad (India)
- BirbalSahni Institute of Palaeosciences, DST, Lucknow (India)
- Jawaharlal Nehru University, New Delhi (India)
- National Institute of Hydrology, Roorkee (India)
- Inter-University Accelerator Centre (IUAC), New Delhi (India)

Suggested Readings:

- Cronin, Thomas M. (1999). Principles of Paleoclimatology. Columbia University Press.
- Gornitz, Vivien. (2009). Encyclopaedia of Paleoclimatology and Ancient Environments. Springer Netherlands.
- Gilbert, Loren (2012). Paleoclimatology: Understanding Past Climate.
- Bradley, Raymond S. (2014). Paleoclimatology: Reconstructing Climates of the Quaternary: Third Edition.

Course title: Sustainable and Resilient city

Cr	T	P	Cr
4	-	-	4

Course code:GEO.711

Total hour: 60

Course objective: to introduce concept, planning framework and instrument and to explore the role of remote sensing and GIS for sustainable and resilient city. To develop student as urban planning professionals for competitive global job opportunities.

Learning outcome:

- Student will be proficient to comprehend concept, framework and planning instrument
- Hands on practice on the use of geoinformation science for sustainable and resilient city at national to global context.
- Student will be professional to carry out independent research on contemporary Sustainable and Resilient city challenges.

Unit I: Introduction to Sustainable City **15 Hours**

- Concept and theory of sustainable city
- Planning framework for sustainable city
- Indicators of sustainable city
- Sustainable city at local to global context

Unit II: Introduction to Resilient City **15 Hours**

- Concept and theory of resilient city
- Planning instruments for resilient city
- Climate resilient city
- Resilient city at local to global context

Unit III: Sustainable City **15 Hours**

- Introduction of Geoinformation science for sustainable city
- Geoinformation database management for sustainable city
- Geostatistics for sustainable city
- GIS-Based models for sustainable city

Unit IV: Resilient City **15 Hours**

- Geoinformation science for resilient city
- Geoinformation database management for resilient city
- Geostatistics for resilient city
- GIS-Based multi-scenario models for resilient city

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

Suggested readings:

- Kemp, R. & et al. (2005). Governance for sustainable development: moving from theory to practice, *Int. J. Sustainable Development*, 8(1/2), 12-30.
- Ness, B. & et al. (2007). Categorising tools for sustainability assessment, *Ecological Economics*, 60, 498–508.
- Sharifia, A., & Yamagata, Y. (2014). Resilient Urban Planning: Major Principles and Criteria, *Energy Procedia*, 61, 1491-1495. https://doi.org/10.1016/j.egypro.2014.12.154.
- Zhang, X. & Li, H. (2018).Urban resilience and urban sustainability: What we know and what do not know?*Cities*, 74(A), 141-148. https://doi.org/10.1016/j.cities.2017.08.009