AC –
Item No. –

As Per NEP 2020

University of Mumbai

Title of the program
(M.A. / M.Sc. Geography)

Syllabus for

Semester – Sem.- III & IV
Ref: GR dated 16th May, 2023 for Credit Structure of PG

(With effect from the academic year 2024-25)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:_____ B**	**M.A. / M.Sc. Geography**
2	**Scheme of Examination** **R: _____**	**NEP** **50% Internal** **50% External,** **Semester End Examination** **Individual Passing in Internal and External Examination**
3	Standards of Passing **R: _____**	**40%**
4	Credit Structure **R: _____**	**Attached herewith**
5	Semesters	**Sem. III & IV**
6	**Program Academic Level**	**6.5**
7	**Pattern**	**Semester**
8	**Status**	**New**
9	**To be implemented from Academic Year**	**2024-25**

Sign of the BOS
Chairman
Dr. R. B. Patil
BOS

Sign of the Offg. Dean

Prof. (Dr.) Anil Kumar Singh
Dean (Interdisciplinary Studies), University of Mumbai

(As per NEP 2020)

PREAMBLE

1. Introduction:

Geography is interdisciplinary subject that integrates natural sciences and social science to create an interface for both the streams to converge and produce an integrated sphere of knowledge. Geography has yet another unique dimension and that is the application of Geospatial technologies. So broadly the sub disciplines of Geography introduced in the department have been grouped under four heads :

- Physical Geography,
- Human Geography,
- Interface of Physical and Human Geography and
- Geospatial technology

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

Sub disciplines of Physical Geography is largely based to study:

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

Sub disciplines of Human Geography helps:

1. To understand the interaction and interconnectedness between the physical world and human response, i.e. to understand the man and environment relationships and how these relationships produce different human landscapes and cultures.
2. To explore the spatial organisation of economy at local, regional, national and international levels and its interconnectedness to grasp the spatial patterns of development and underdevelopment
3. To identify various forces and processes that shape society, culture and people and analyse the resultant socio-spatial impacts across cross sections of society through gender, ethnicity, regional identities and so on.
4. To investigate the very nature of political processes shaping human life, civic sense and political life. Geopolitics and international relations would be another area where students are expected to have deliberations.
5. The study of spatial variation of settlements such as urban, rural and rurban settlements and spaces, their demographic features and population studies, social relations and cultural settings.
6. To study the processes of exclusion, marginalisation, polarisation at social, societal, political and economic levels
7. To suggest various planning and policy measures at regional, local and national level
8. To analyse the impact of media, telecommunication, etc. on society
9. To inculcate the comprehensive understanding of human systems and encourage to arrive at appropriate suggestions

Interface of Physical and Human Geography

1. To understand the impact of anthropogenic interventions on earthen systems like environment, atmosphere, etc. and resources like water, energy and so on
2. To track the evolutionary development of various resources, factors and processes that impact the state of resources and their connectedness with the social wellbeing
3. To strike for equitable efficient, optimum utilisation and distribution of resources
4. To promote the values of sustainable and eco-friendly pattern of production, consumption and distribution

Geospatial technology

1. Application of GIS and Remote sensing in providing technological solutions in efficient management of the resources
2. Using Geospatial technologies in management of various urban civic facilities like infrastructure, transport, waste management, etc.
3. Application of GIS in safety and security of spaces
4. Application of E-Governance and smart technologies for smoother and faster administration
5. Digitisation of resources to manage and monitor resources in a careful manner, for example, forest resources, water resources can be easily counted with the help of technology.

The holistic approach in learning, research and solution provision, provided by Geography has become a key to resolve several persisting issues in the society. Keeping in mind, the central role geography would play in near future the department has planned Masters in Geography with specialisations in following broad categories

A. Physical Geography and the earth Systems - I
B. Urban and Regional Planning and Development - I
C. Climate Change and Sustainability Studies - I
D. Human Geography and human Ecology - I
E. Geospatial Technology - I

2. Aims and Objectives:

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

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

- Culminating the integrated understanding of Place, Space and Time through *Integrating classroom teaching, laboratory exercises, and study tours to correlate the theoretical phenomenon with ground reality by fieldwork.*
- Geography being an interdisciplinary subject offers knowledge, understanding and output that is integrated and Interdisciplinary in nature that includes the branches of specialization in physical and social sciences.
- Quality, inclusive and focused education through
    - Research – Economy, Society, Ecology and Environment
    - Sensitization and skill/capacity building
    - Environmental, socio-cultural, economic and political understanding to nurture finest professionals and individuals through participation in various academic, extra and co-curricular activities
- Technical and applied Courses on Remote sensing, Geo-informatics and advanced quantitative

techniques to provide technological solutions to current social, economic and environmental problems

3. **Learning Outcomes:**

Students who complete the course will understand the following

- The students will attain professional skills required in the industry, research, and academia.
- To contribute to the larger welfare of society at local, regional and national levels by addressing the national issues.
- The students will develop holistic thinking and scientific approach in professional and personal spheres of life.
- Inculcating universal values and ethics, professionalism and rational approach through the most appropriate curriculum

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

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

R_____

Post Graduate Programs in University **Parishista 1**

Exit option: PG Diploma (44 Credits) after Three Year UG Degree									
II	**6.5**	**Sem III**	**GEOG 601** Advanced studies in Physical Geography- III **(4*) (TH)** **GEOG 602** Advanced Studies in Human Geography -III **(4*) (TH)** **GEOG 603** Practical component based on major and electives **(4*) (PR)** **GEOG 604** Landuse and land cover Change Detection using Geographic data and Geospatial technologies **(2*) (PR)**	**GEOG 606 Specialisations 4*** A. Physical Geography and the earth Systems - III B. Urban and Regional Planning and Development - III C. Climate Change and Sustainability Studies - III D. Human Geography and human Ecology - III E. Geospatial Technology - III			**GEOG 605** Dissertation **4***	**22**	**PG Degree After 3-Yr UG**
		Sem IV	**GEOG 607** Advanced studies in Physical Geography- IV **(4*) (TH)** **GEOG 608** Advanced Studies in Human Geography- IV **(4*) (TH)** **GEOG 609** Practical component based on major and electives **(4*) (PR)**	**GEOG 611 Specialisations - Credits 4** A. Physical Geography and the earth Systems - IV B. Urban and Regional Planning and Development - IV C. Climate Change and Sustainability Studies - IV D. Human Geography and human Ecology - IV E. Geospatial Technology - IV			**GEOG 610** Dissertation **6***	**22**	

Cum. Cr. for 1 Yr PGDegree	**26**	**8**			**10**	**44**	
Cum. Cr. for 2 Yr PGDegree	**54**	**16**	**4**	**4**	**10**	**88**	

Note: * The number of courses can vary for totaling 14 Credits for Major Mandatory Courses in a semester as illustrated.

Sign of the HOD
Prof. Sanjukta Sattar
Department of Geography, University of Mumbai

Sign of the Dean
Prof. (Dr.) Anil Kumar Singh
Dean (Interdisciplinary Studies), University of Mumbai

Guidelines and Instructions

1. **Kindly refer to the nomenclature used in the curriculum**

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

2. **50 marks Internal (CIE) and 50 External (ESE) evaluations will be done.**
3. **Students are expected to complete on-job-training as it is a compulsory component under National Educational Policy 2020.**
4. **Every student need to complete Research project for 10 credits which is a compulsory component under National Educational Policy 2020.**
5. **There are five broad specialisations. Within each specialization, there are sub-specialisations. Students are expected to select one specialisation in the component of electives. They are expected to complete all four semesters with the same specialization. Within each specialization, students are offered the flexibility of selecting and switching among the sub-specialisation of their choice.**

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

Semester III

Semester III

Title of the Course – Advanced Studies in Physical Geography -III								
Year - 2				**Semester – III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE - 3	GEOG 601	04	00	04	60	50	50	100

Course Objectives:

1. To enhance knowledge about the major geomorphic systems of the world
2. To reveal the importance of climate change in connection with the geomorphic systems
3. To impart knowledge on weather elements and their interrelationships
4. To through light on the techniques of weather forcasting
5. To impart basic knowledge and understanding of the ocean water circulation
6. To familiarize the learner with knowledge of the processes in the Indian Ocean and tidal activities
7. To learn more about the runoff process and hydrograph.
8. To know more about water harvesting structures.

Course Outcomes:

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

CO1. know the geologic evolution and characteristics of mega landforms on the earth
CO 2. understand different oceanic circulation.
CO 3. understand applications of weather predictions
CO 4. understand hydrographs and different rainwater harvesting structures.
CO 5. know the geologic evolution and characteristics of mega landforms on the earth
CO 6. correlate climate change and geomorphic systems

Unit 1: Geomorphic Systems on the Earth and Mega Landforms (15 hours)

1.1 Origin and geomorphic evolution of mountain chains on the earth
1.2 Origin and geomorphic evolution of major water regions and river systems of the earth and their characteristics
1.3 Origin and geomorphic evolution of coasts of the world and their characteristics
1.4 Origin and geomorphic evolution of hot and cold deserts, glaciers, paleoenvironments

Unit 2: Weather analysis and forecasting, air pollution and the changing climate (15 hours)

2.1 Weather analysis and forecasting- weather analysis, gathering data, weather maps; weather forecasting using computer and other methods; upper airflow and weather forecasting; long-range forecasts; satellites in weather forecasting.
2.2 Air pollution- The threat of air pollution, sources and types of air pollution, trends in air quality, meteorological factors affecting air pollution, acid precipitation.
2.3 The changing climate- the climate system, how is climate change detected, natural causes of climate change; carbon dioxide, trace gases, and climate change; climate feedback-mechanisms, Some possible consequences of global warming.
2.4 El Nino and La Nina and the southern oscillation- Impact of El Nina Impact of La Nina, Southern Oscillation. Impact of El Nina on monsoon.

Unit 3: Ocean Circulations (15 hours)

3.1 Surface heat budget of the ocean.
3.2 Oceanic processes: Upwelling/sinking, mesoscales eddies, oceanic fronts, major upwelling regions of world oceans.
3.3 Water masses and thermohaline circulation.
3.4 Langmuir circulation

Unit 4: Runoff (15 hours)

4.1 Runoff – Introduction- component of stream flow - Classification of Streams
4.2 Physical Factors affecting Runoff
4.3 Runoff generation mechanisms – Soil properties
4.4 Runoff estimation method

Suggested Reading Materials:

1. Bird, E. (2010). *Encyclopedia of the World's Coastal Landforms*. Springer Science & Business Media.
2. Carter, R. W. G., & Woodroffe, C. D. (1994b). Coastal Evolution. Cambridge University Press.
3. Christiansen, E.H., & Hamblin, W. K. (2014). Dynamic Earth.
4. Cilek, V. (2009). Earth System: History and Natural Variability - Volume III. EOLSS Publications.
5. Dingman, S. L. (2015). *Physical Hydrology, 2nd edition, Prentice Hall.*
6. Du Climat, G. D. I. S. L. (2015). Climate Change 2014.
7. Green, E. K. (2009). Deserts. Blastoff! Readers.
8. Gupta, A. (2022). Large Rivers. John Wiley & Sons.
9. Hamblin, W. K., & Christiansen, E. H. (1995). Earth's Dynamic Systems. Macmillan College.
10. Hornberger, G. M., Wiberg, P. L., Raffensperger, J. P., & D'Odorico, P. (2014). *Elements of Physical Hydrology*. The Jhon Hopkins University Press, Maryland, USA.
11. Inness, P. M., & Dorling, S. (2012). Operational Weather Forecasting. John Wiley & Sons.
12. Johnson, J. A., & Krueger, B. J. (2009). Deserts: Hot or Cold? Lorenz Educational Press.
13. Jones & Bartlett Publishers.
14. Kusky, T. M. (2010). Climate Change. Infobase Publishing.
15. Lynn, D. A. (1976). Air Pollution, Threat and Response. Addison Wesley Publishing Company.
16. McPhaden, M. J., Santoso, A., & Cai, W. (2020). El Niño Southern Oscillation in Changing Climate. John Wiley & Sons.
17. Murty, J. V. S. (2013). *Watershed Management*. *New Age International Publishers.*
18. Neumann, G., & Pierson, W. J. (1966). *Principles of Physical Oceanography*. Prentice Hall.
19. Oldfield, F., Richardson, K., Schellnhuber, H. J., Turner, B. L., & Wasson, R. J. (2005). Global Change and the Earth System. Springer Science & Business Media.
20. Ollier, C., & Pain, C. (2004). The Origin of Mountains. Routledge.
21. Pickard, G. L., & Emery, W. J. (2016). *Descriptive Physical Oceanography: An Introduction*. Elsevier.
22. Pizarro, K. A. (2010). SP026: Traveling America's loneliest road: A geologic and natural history tour through Nevada along U.S. Highway 50, with GPS coordinates. NV Bureau of Mines & Geology.
23. Reade, T. M. (2016). The Origin of Mountain Ranges Considered Experimentally, Structurally, Dynamically, and in Relation to Their Geological History. Palala Press.
24. Sears, J. W. (2024). Landscape Evolution of Continental-Scale River Systems. Elsevier.
25. Singh, V. P. (1992). *Elementary Hydrology*. Pearson College Division.
26. Steffen, W., Sanderson, R. A., Tyson, P. D., Jäger, J., Matson, P. A., Moore, B.,

27. Stewart, R. H. (2009). *Introduction to Physical Oceanography*. Orange Grove Text Plus.
28. Subramanya, K. (2013). *Engineering Hydrology, Tata Mc-Graw Hill.*
29. Todd, D. K., & Mays, L. W. (2004). *Groundwater Hydrology*. John Wiley & Sons.
30. Van Bakker, E. Z. (2020). Antarctic Glacial History and World Palaeoenvironments. CRC Press.
31. Viessman, W., & Lewis, G. L. (2003). *Introduction to Hydrology*. Pearson.
32. Woodroffe, C. D. (2002). Coasts. Cambridge University Press.
33. Alan H. Strahler. (2013). *Introducing Physical Geography* (6th ed.). John Wiley & Sons.
34. Edward J. Tarbuck, Frederick K. Lutgens, & Dennis G. Tasa. (2014). *Earth Science* (14th ed.). Pearson Education, .
35. Frederick K. Lutgens, & Edward J. Tarbuck. (2013). *The Atmosphere An Introduction to Meteorology* (12th ed.). Pearson.
36. James Petersen, Dorothy Sack, & Robert E. Gabler. (2011). *Fundamentals of Physical Geography* (1st ed.). Brooks/Cole.
37. Joseph Holden. (2010). *An Introduction to Physical Geography and the Environment* (2nd ed.). Pearson Education, Limited.
38. Robert E. Gabler, James F. Petersen, & L. Michael Trapasso. (2007). *Essentials of Physical Geography* (8th ed.). Thomson Brooks/Cole.

Title of the Course – Advanced Studies in Human Geography - III								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC – 3	GEOG 602	04	00	04	60	50	50	100

Course Objectives:

1. To study the economic processes and forces that shape the patterns of production, distribution and consumption
2. To make the student understand the recent trends in spatial organisation of economic activities

Course Outcomes:

CO 1. The students are expected to be very well versed with the complex nature of economic activities and their spatial organisation

CO 2. How these activities shape the world patterns of production, consumption and distribution

Unit 1 : Organisation of an economy as a dynamic spatio-social system: Basic concepts (15 hours)

1.1 Economic organization and spatial change- Spatial division of labour and Interdependence

1.2 Geographic fixity and mobility- typology of distance-Spatial interaction and diffusion

1.3 Typology of Space - Absolute and Relative – Time and space convergence Production of economic space

1.4 Economic organization of world economy in post world war II period – Emergence of supranational institutions – their role in shaping the patterns of economic development – World Bank, IMF, WTO **–** Emergence of Multinational corporations – Patterns and processes of Globalisation – Status of Global South

Unit 2 : Organisation of Production: Agriculture and Industry - Global Patterns and Trends (15 hours)

2.1 Primary activities – world distribution of major primary activities – patterns of trade – Global North vs. Global South

2.2 changing patterns of agriculture – challenges and issues – Crisis of agriculture- Aspects of Food security and world patterns of hunger

2.3 World Industrial Regions – Factors and processes Influencing Location of industries – critical assessment of theories of industrial location

2.4 Globalisation and shifting location of industries - New Industrial Regions- EPZs and SEZs- South east and East Asian economies **–** relevant models of economic development from Global North and South

Unit 3: Transport, Trade and Services: Global Patterns and trends (15 hours)

3.1 Organisation of transport - Bases of Spatial Interaction – Factors influencing the development of transport systems - Role of transport cost- nodes-places, networks and flows – Gravity models

3.2 Transport and spatio-social accessibility – Indian Examples - various models of transport development and transport system

3.3 International Trade : contemporary patterns and structures – Contribution of Global South – Trade related policies of India and China

3.4 Logic of Regional Integrations- Types and levels - Significance of regional integration as a strategy for the periphery - Case Studies - EU, OPEC, ASEAN, BRICS, etc.

Unit 4 : Finance , Linearity and circularity (15 hours)

4.1 Role of finance in shaping the patterns of production, consumption – Spatio-sectoral allocation of finance and resultant pattern of economic organisation

4.2 Concept of linear Economy - Problems and issues related with linear economy – association with resource depletion and climate change

4.3 Alternatives for sustaining the economic development – Circular economy – genesis, base and definition – circular economy and sustainability – Cities and circular economy

4.4 Case studies on circular economy from Global North and Global South

Suggested Reading Materials:

1. Knox Paul, Agnew John and McCarthy Linda, (2008): The Geography of the World Economy, Hodder Education, UK.
2. Sheppard Eric and Barnes Trevor J., (eds.) (2000): A Companion to Economic Geography, Blackwell, Massachusetts.
3. Wood Andrew and Roberts Susan, (2011): Economic Geography- Places, network and flows, Routledge, London and New York.
4 Bryson John, Henry Nick, Keeble David and Martin Ron, (eds.) (1999): The Economic Geography Reader- Producing and Consuming Global Capitalism, John Wiley and Sons Ltd.,New York.
5. Hartshorn A. Truman and Alexander W. John, Third edition, (2010): Economic Geography, PHI Learning Private Ltd., New Delhi
4. Liemt van Gijsbert, (eds.) (1992): Industry on the move- Causes and consequences of International Relocation in the Manufacturing Industry, International Labour Office, Geneva.
5. Harrington J.W. and Warf Barney, (1995): Industrial Location- Principle, Practice and Policy, Routledge, London and New York.
6. Rodrigue Jean-Paul, Comtois Claude and Slack Brian, (2006): The Geography of Transport System, Routledge, London and New York.
7. Harrington J.W. and Warf Barney, (1995): Industrial Location- Principle, Practice and Policy, Routledge, London and New York.
8. Berry, B. J. L. et. Al. (1976): Geography of Economic Systems, Prentice Hall, Englewood Cliff.
Cambell-Johnston, K., Cate, J. T., Petrovic, M. E.-., & Gupta, J. (2019, October 20). City level circular transitions: Barriers and limits in Amsterdam, Utrecht and The Hague. *Journal of Cleaner Production*, *235*(october), 1232 - 1239. https://www.google.com/url?q=https://doi.org/10.1016/j.jclepro.2019.06.106&sa=D&source=apps-viewer-frontend&ust=1711617924643088&usg=AOvVaw1BAb0v_AJ1gL5dx1fGnaef&hl=en
9. Chandran, P., & Abubaker, M. (2015, October 28). *Glimpses of Recycling in Dharavi – Stories of Waste and Waste Workers – Live Blog of Hasiru Dala*. Stories of Waste and Waste Workers – Live Blog of Hasiru Dala. Retrieved March 26, 2024, from https://wastenarratives.com/2015/10/27/glance-of-recycling-in-dharavi/
10. Chertow, M., & Ehrenfield, J. (2012). Organizing self-organizing systems: Toward a theory of industrial symbiosis. *Journal of Industrial Ecology*, *16*(1), 13-27. https:// doi.org/10.1111/j.1530-9290.2011.00450.x
11. Cong, H., Meng, H., Chen, M., Song, W., & Xing, H. (2023). Co-processing paths of agricultural and rural solid wastes for a circular economy based on the construction concept of "zero-waste city" in China. *Circular Economy*, *2*(100065), 1 - 10. https://www.google.com/url?q=https://www.journals.elsevier.com/circular-

economy&sa=D&source=apps-viewer-frontend&ust=1711616888699693&usg=AOvVaw17XuqSHRkl3Dv14f8r2cdf&hl=en
12. Ellen MacArthur Foundation. (n.d.). *What is a circular economy?* Ellen MacArthur Foundation. Retrieved March 27, 2024, from https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Title of the Course – Tools and Techniques of Geographic Analysis								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC - 3	GEOG 603	00	04	04	120	00	100	100

Course Objectives:

1. To familiarize with data analysis using a statistical software package like SPSS. To provide skills for research analysis and increase employability.
2. To lay a foundation for advance data analysis.
3. To reveal the importance of techniques which are used for data analysis.
4. To impart knowledge about multi criteria decision making methods and methods used for demarcation of flood prone areas and drought assessment.
5. To through light on the techniques used for sea level change data analysis.

Course Outcomes:

CO1. Understand basic functions of statistical software package for managing variables and generate descriptive statistics to describe the data and analyze data through graphs and charts.

CO 2. Understand data structures and identify clusters in data.

CO 3. Understand applications of Multi- criteria decision making methods and flood prone areas demarcation methods.

CO 4. Students will understand how analyze the sea level change data.

Common compulsory practical exercises (Unit 1 & 2)

Unit 1: Similarity and Dissimilarity (20 hours)

1.1 Lorenz curve, Gini Coefficient, location quotient,

1.2 Functional hierarchy, Population and settlement hierarchy, rank-size rule, primate city rule

Unit 2 : Techniques in Agricultural Analysis (20 hours)

2.1 Methods of Crop Concentration and Diversification: Bhatia, Jasbir Singh, Gibbs and Martin

2.2 Crop Combination Techniques: Weaver, Thomas, Rafiullah

2.3 Measurement of Agricultural Efficiency: Bhatia and Kendell

2.4 Agriculture Density, Nutritional Density, Caloric Density

Unit 3: Geographical Data analysis using SPSS software (20 hours)

3.1 Introduction to SPSS - Data Entry, storing and retrieving files, recoding variables- Graphs- and Descriptive statistics

3.2 Inferential statistics: Introduction; Hypothesis Testing - Chi square test, T-test applications; Analysis of variance (ANOVA)

3.3 Correlation: Types of correlation; Methods of correlation- Spearman's Rank Correlation - Karl Pearson's coefficient of correlation; Partial correlation

3.4 Time Series Analysis

Elective based practical exercises (Unit 4 & 5)

A. Physical Geography and Earth Systems

Unit 4: (Physical Geography) (30 hours)

3.1 Collection of wave parameters (height, frequency, period, wavelength); data from the field and analysis

3.2 Analysis of tide data from tide tables and buoys, sea-level change data analysis

3.3 Delineation of drainage basin, and morphometric analysis, construction of longitudinal profile of stream, calculation of Hack's Stream Gradient Index.

3.4 Textural (grain size) analysis of soil/beach/riverine sediments

Unit 5: (Physical Geography) (30 hours)

4.1 Epicentral plots with tectonic elements and interpretation,

4.2 Identification of landslide-prone zones by applying AHP technique,

4.3 Delineating flood-prone areas

4.4 Calculation of drought indices – PDSI, SPI;

B. Urban and Regional Planning, Climate Change and Sustainability Studies and Human Geography and Human Ecology

Unit 4 Tools of Economic and Socio-cultural Analysis (30 hours)

4.1 Transportation Models : General approaches to land use and transportation forecasting

4.2 Economic Analysis :- Multipliers, Input-Output Analysis,

4.3 Brief introduction to projection techniques like ratio and econometric methods

4.4 Economic Rate of Returns - Social dimensions and impact assessment – calculating social cost – cost of rehabilitation and redevelopment - Use of social assessment methods - Social-Cost-Benefit Analysis, UNIDO

Unit 5 Urban Climate and Environment (30 hours)

5.1 Vulnerability Assessment using various data sets – climate data sets - remote sensing data

5.2 Measuring and mapping urban pollution - various data sets – methods – mobile apps and portals

5.3 Environmental Impact Assessment – various stages and methods

5.4 Preparation of climate action plan

C. Geospatial Technologies

Unit 4 : Application of Statistical and Cartographic Techniques: (25 hours)

Chorochromatic maps, Dot maps, Proportional symbol maps, Proportional diagram maps, Pie graphs, Flowline maps, Isoline maps, Equal distance or equal travel time, Cartogram, Prism map, Choropleth maps, Methods in QGIS.

Unit 5. Case study-Integration of Geospatial Data: (35 hours)

Overlay analysis with processing together- remote sensing multispectral satellite data, Digital Elevation Model data, S.O.I. Topographical Maps data and administrative boundary data; Conversion from raster to vector and vector to raster; data classification methods and its application; and related geodata processing - **Map composition in QGIS** 2D and 3d data visualization and dissemination of geo data; Visual exploration of geodata; Use of Bertin's visual (graphic) variables; Selection of map projection.

Suggested Reading Materials:

1. Agency, E., & Garrad, P. (2002). *Identification of Flood Indicators*.
2. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis

3. Cressie, N.(1991): Statistics for Spatial Data, John Wiley and Sons, New York
4. Council, N. R., Studies, D. O. E. a. L., Resources, B. O. E. S. A., & Technologies, C. O. F. M. (2007). *Elevation Data for Floodplain Mapping*. National Academies Press.
5. Earle, M. D., Mcgehee, D. D., & Tubman, M. W. (1995). Field Wave Gaging Program, Wave Data Analysis Standard.
6. F, I. B. (1991). Soil Dynamics and Earthquake Engineering V. CRC Press.
7. Gardiner, V. (1975). Drainage Basin Morphometry.
8. Ganesh, A.(2006): GPS Principles and Applications, Satish Series Publishing Houses
9. Hilton, P. et.al (2012): SPSS Explained, Rutledge, London.
10. Ibbeken, H., & Schleyer, R. (2013). Source and Sediment. Springer Science & Business Media.
11. Karimpour, A. (2018). Ocean Wave Data Analysis.
12. Levin, J. (1973): Elementary Statistics in Social Research, Harper and Row, New York
13. Lawrence S, Meyers, Glenn C, Gamst, Guranio A.J (2018) Performing Data analysis using SPSS, Wiley Publication
14. Malczewski, J. (1999). GIS and Multicriteria Decision Analysis. John Wiley & Sons.
15. Parker, D. E. (1968). Use of Soil Mapping Units and Aerial Photographs to Delineate Flood Plains in a Glaciated Area.
16. Norcliff, G.B.(1982):Inferential Statistics for Geographers, Hutchinson, London
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30. Lilles T. M., & Kiefer, R. W. (2015). *Remote Sensing and Image Interpretation*. John Wiley & Sons.
31. Longley, P. A., Googdchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographical information systems* (Second). John Wiley & Sons, Inc.
32. Menno-Jan Kraak, & Ferjan Ormeling. (2021). *Cartography Visualization of Geospatial Data* (Fourth Edition). CRC Press.
33. Otto Huisman, & Rolf A. de By. (2009). *Principles of Geographic Information Systems- An introductory textbook*. The International Institute for Geo-Information Science and Earth Observation (ITC),.
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Title of the Course – Landuse and Land Cover Change Detection using Geographic Data and Geospatial Technologies								
Year - 2				**Semester – III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSC - 1	GEOG 604	**Theory**	**Practical**	02	60	**CIE**	**ESE**	**Total**
		00	02			00	50	50

Course Objective:

1. The main objective of this practical course is to give hand on training to students on how convert continuous remote sensing satellite data to thematic data i.e., Land use/cover.

Course Outcomes: After completion of this practical course students will learn;

CO 1. about opensource software and geospatial data required for LU/LC analyses.
CO 2. to process remote sensing Panchromatic and Multispectral data to derive land use/cover thematic data.
CO 3. to assess the accuracy of thematic data.
CO 4. to detect the changes of thematic data over specific time.
CO 5. to apply sampling strategy wherever required.
CO 6. all scientific background for all above practical task.

Unit 1. Preparation for Satellite Image Classification: (30 hours)

1.1. Overview of Landsat, LISS-III, AWiFS and Sentinel multispectral data and its metadata.
1.2. Image statistic; band selection criteria; generation of multispectral image; image fusion.
1.3. Sampling Strategy to train the classifier and to assess the accuracy: Systematic sampling, simple random sampling, stratified random sampling.
1.4. Visual image classification vs Digital image classification; Advantages of multispectral image classification; Problems associated with image classification-pixel based problem, landcover/Land use problem, mixed pixel problem, spatial resolution problem, etc.; Alternative method for multispectral image classification.
1.5. Introduction to pixel-based methods of multispectral image classification- supervised and unsupervised; alternative classification method-Object Based Image Analysis (OBIA) for high resolution multispectral satellite data.

Unit 2. Satellite Image Classification (30 hours)

1.1. Introduction to QGIS and SAGA GIS.
1.2. Image space vs feature space; plotting feature space- distances and clusters in feature space, training sample statistics.
1.3. Unsupervised classification; Advantages and disadvantages of unsupervised classification.
1.4. Digital image classification with (algorithms);
  1.4.1. box classifier,
  1.4.2. minimum distance to mean classifier,
  1.4.3. Maximum likelihood classifier, etc. their characteristics and disadvantages.
  1.4.4. Filter operations and application of majority filter on classified image layer.
1.5. Evaluating classification: Error matrix and interpretation of error matrix- overall accuracy, users accuracy, producers accuracy, error of commission and error of omission, kappa coefficient, etc.

1.6. Change detection and visualization of output- change detection histogram, donught diagram; LU/LC map- elements, marginal information, map layout, map layout balance, inset and legends.

Suggested Reading Materials:

1. Alfred Stein, Freek van der Meer, & Ben Gorte. (2002). *Spatial Statistics for Remote Sensing* (First). Kluwer Academic Publishers.
2. Atkinson, P. (2002). Spatial Statistics. In A. Stein, F. Meer, & B. Gorte (Eds.), *Spatial Statistics for Remote Sensing* (Vol. 1, pp. 57–81). Springer Netherlands. https://doi.org/10.1007/0-306-47647-9_5
3. Blaschke, T. (2010). Object based image analysis for remote sensing. *ISPRS Journal of Photogrammetry and Remote Sensing*, *65*(1), 2–16. https://doi.org/https://doi.org/10.1016/j.isprsjprs.2009.06.004
4. Chang, K. (2009). *Introduction to geographic information systems* (Fifth). Tata McGraw-Hill publishing company limited.
5. Joseph, G. (2008). *Fundamentals of remote sensing* (Second). Universities press (India) private limited.
6. Karlekar, S. (2006). *Remote sensing* (First). Diamond publications.
7. Lilles T. M., & Kiefer, R. W. (2015). *Remote Sensing and Image Interpretation*. John Wiley & Sons.
8. Longley, P. A., Googdchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographical information systems* (Second). John Wiley & Sons, Inc.
9. Menno-Jan Kraak, & Ferjan Ormeling. (2021). *Cartography Visualization of Geospatial Data* (Fourth Edition). CRC Press.
10. Otto Huisman, & Rolf A. de By. (2009). *Principles of Geographic Information Systems- An introductory textbook*. The International Institute for Geo-Information Science and Earth Observation (ITC),.
11. Tempfli, K., Kerle, N., Huurneman, G., & Janssen, L. (2009). *Principles of Remote Sensing* (4th ed.). ITC, Enschede, The Netherlands.

Title of the Course – Dissertation								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSC - 3	GEOG 605	**Theory**	**Research Project**	04	60	**CIE**	**ESE**	**Total**
		00	04			0	100	100

Course Objectives:

1. The research project would be conducted to develop critical thinking, deep understanding about the geographical issues and problems through research

Course Outcomes:

CO 1. Students should able to develop critical thinking, develop scientific aptitude and knowledge to understand, analyse and resolve the given research problem and emerge with appropriate solutions for the society

The students are expected to complete following tasks

1. **Finalisation of topic**
2. **Complete literature review**
3. **Pilot survey to confirm data collection methods and sources of primary data**
4. **Compilation of secondary data**
5. **Finalisation of study area, research methodology, data processing techniques**
6. **Finalisation and presentation of Research Proposal**
7. **Outline plan of research work to be completed in fourth semester**

Specialisation I : Physical Geography and Earth Systems

Title of the Course – Tropical Geomorphology								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60601	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. Main objective is to learn tropical environment, geomorphic process and landforms.

Course Outcomes:

CO 1. The tropical environment
CO 2. Processes operating in humid and arid tropics
CO 3. Landform assemblages in humid and arid tropics

Unit 1. Tropical Environment: (15 hour)

1.1. Tropical Region: Definition and characteristics of tropical region, nature, scope and development of tropical geomorphology, Concept of morphogenetic region.
1.2. Major Controls on tropical landscape: Tectonic processes, climate, anthropogenic activities.
1.3. Geomorphic processes in tropics: Weathering, mass wasting and exhogenetic processes
1.4. Quaternary inheritance in tropical landscape: Effect of climate change on coasts (sea level change), mountains (Pleistocene glaciation), fluvial systems.

Unit 2. Landform Assemblages in Tropics: (15 hours)

2.1 Structural Landforms in Tropical areas: Precambrian shield, mountain chains, volcanos
2.2 Formation and distribution of Doms, Bornhardts and Tors in tropical areas.
2.3 Planation surfaces: etchplain, peneplain, pediplain and inselbergs
2.4 Structural landforms in tropical part of India with special reference to Deccan Plateaus; planation surfaces in India.

Unit 3. Weathering and Slopes: (15 hours)

3.1 Weathering process and factors of deep weathering profiles; products of weathering.
3.2 Duricrusts and types: laterite, calcrete, silcrete processes of formation, profiles and landforms.
3.2 Slope processes and development in humid tropics: hill slopes, pediments and gullies
3.3 Mass wasting processes and types

Unit 4. Exogenic Processes and typical forms in Humid and Arid Tropics: (15 hours)

4.1 Fluvial Processes: Nature of fluvial processes tropics, fluvial landscapes in tropics river terraces, flood plains, alluvial fans
4.2 Coastal Processes: Nature of coastal processes in tropics and typical coastal landforms in tropics Mangroves and Mudflats, Corals, Deltas.
4.3 Glacial processes in tropical highlands:
4.4 Aeolian Processes in tropical areas: Badland Morphogenesis,

Suggested Reading Materials:

1. Birot, P. (1968): Cycle of Erosion in Different Climates, B. T. Batsford, London.
2. Bloom, A.L. (2002): Geomorphology: A Systematic analysis of late Cenozoic Landforms, Prentice-Hall of India, New Delhi.
3. Bombay Geographical Association (1970-71): Geddes Memorial Volume: Maratha Lands, Bombay.
4. Dikshit, K.R., Kale, V.S., and Kaul, M.N. (1994): India Geomorphological Diversity, Rawat, Jaipur.
5. Douglas, J. and Spencer, I. (1985): Environmental Change and Tropical Geomorphology, George Allen and Unwin, London.
6. Faniran, A. and Jeje, L.K. (1983): Humid Tropical Geomorphology, Longman, London.
7. Garner, H.F. (1974): Origin of Landscapes A synthesis in Geomorphology, Oxford University Press, New Delhi.
8. Huggett, R. (2007): Fundamentals of Geomorphology, Routledge, London.
9. Jog, S.R. (ed.) (1995): Indian Geomorphology, vols. I and II Rawat, Jaipur.
10. Kale, V.S. and Gupta, A. (2001): Introduction to Geomorphology, Orient Longman, Calcutta.
11. Mcfarlane, M. J. (1976): Laterite and Landscape, Academic Press, London.
12. Sharma, H. S. (1986): Tropical Geomorphology, Concept, New Delhi.
13. Sharma, H. S. (ed.) (1991): Indian Geomorphology, Concept, New Delhi.
14. Sharma, A. (1993): Ecology of Landslide Damages, Poiter, Jaipur.
15. Slaymaker, O. et.al. (2009): Geomorphology and Global Environmental Change, Cambridge Univeristy Press, UK.
16. Thomas, M.F. (1994): Geomorphology in the Tropics: A study of weathering and denudation in low latitudes, John Wiley and Sons, Chichester.
17. Tricart, J. and Coilleux, A. (1972): Introduction to Climatic Geomorphology, Longman Green, London.
18. Twidle, C.R. (1971): Structural Landforms, the MIT, Cambridge.

Wirthmann, A. (2013): Geomorphology of the Tropics, Springer Science & Business Media

Title of the Course – Applications of Artificial Neural Networks in Hydrology - III								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60602	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Learning Objectives:

1. To Understand the fundamentals of neural networks and their relevance to hydrology.
2. Explore different types of neural network architectures and their applications in hydrological modeling.
3. Learn how to preprocess data and train neural networks for hydrological applications
4. Gain practical experience in applying neural networks to solve real-world hydrological problems
5. Analyze the strengths and limitations of neural network approaches in hydrology.

Course Outcomes (Cos):

Co 1. Clear understanding of the basic concepts of Neural networks
CO 2. Understanding of types neural networks their strength and limitations.
CO 3. Understand the preprocess of data for Neural network model.
CO4. Understanding of how to use neural network model to solve real world hydrological problems.

UNIT 1: Introduction to Neural Networks (15 hours)

1.1 Overview of artificial neural networks (ANNs)- Biological inspiration and historical development
1.2 Basic components of a neural network: neurons, layers, and activation functions
1.3 Feedforward and backpropagation algorithms
1.4 Types of Neural networks

UNIT 2: Activation function and Optimization Techniques (15 hours)

2.1 Activation function – Rectified Linear Unit (ReLU), Sigmoid function (Logistic), Softmax, Threshold
2.2 Loss functions and optimization algorithms- Gradient descent
2.3 Regularization techniques: dropout, weight decay- Hyper parameter tuning and model selection
2.4 Handling imbalanced datasets and overfitting

UNIT 3: Data Preprocessing for Hydrological applications (15 hours)

3.1 Data collection and quality control- normalization and feature scaling
3.2 Handling missing data and outliers
3.3 Time series data preparation
3.4 Spatial data preprocessing techniques

UNIT 4: Application of NN in Hydrology (15 hours)

4.1 Rainfall-Runoff modeling
4.2 Flood forecasting

4.3 Groundwater potential zone mapping
4.4 Performance Metrics for Model Evaluation and validation- Mean square error (MSE), Root mean square error (RMSE), R-squared coefficient (R^2)
4.5 Opportunities and challenges in adopting neural network techniques in hydrology

Suggested reading materials:

1. Haykin S. (1994) Neural Networks: A Comprehensive Foundation, Prentice Hall PTR Upper Saddle River, NJ, USA
2. Tariq R (2016) Make Your Own Neural Network, Amazon digital services, https://www.amazon.in/Make-Your-Own-Neural-Network/dp/1530826608
3. Trask A (2019) Grokking Deep Learning, Manning publication, New York https://www.manning.com/books/grokking-deep-learning
4. Kinsley H (2022) Neural Networks from Scratch in Python, MBA bookstore, https://www.mbabookstore.com/product/neural-networks-from-scratch-in-python-harrison-by-kinsley-daniel-kukiela/
5. Krohn Jon and Bassens A (2019) Deep Learning Illustrated, Addison-Wesley publisher; 1st edition https://www.amazon.in/DEEP-LEARNING-ILLUSTRATED-Jon-Krohn/dp/0135116694
6. Datta A and Singh P () Neural Networks in Hydrology and Water Resources Engineering
7. Artificial Neural Networks in Hydrology by Abhijit Datta
8. Hydroinformatics: Data Integrative Approaches in Computation, Analysis, and Modeling" edited by David E. Watkins and Dan Rosbjerg
9. Neural Networks for Hydrological Modeling" by Robert J. Abrahart, Linda M. See, and Daniel P. Solomatine
10. Artificial Neural Networks in Hydrology and Reservoir Management by E. Jothiprakash and R. Manavalan
11. Advances in Neural Networks Research for Hydrological Modelling and Water Resources Management by Stefano Alvisi and Valentina Colla
12. Hydroinformatics: Data-Driven Approaches in Hydrology, Hydraulics, and Water Resources by David E. Watkins and Dan Rosbjerg

Title of the Course – Mass Movements (Landslides) – Hazard Assessment and Mitigation								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60603	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To impart knowledge on landslide hazard assessment
2. To give an idea about techniques of identification of landslide-prone zones and risk assessment
3. To enhance the understanding of the landslide-prone regions of India and levels of preparedness therein

Course Outcomes:

CO 1. Identify landslide-prone zones
CO 2. Carryout risk and vulnerability analysis for landslide-prone areas
CO 3. Understand the levels of preparedness for landslide hazard

Unit 1: Mass movements – Classifications, causes and impacts (15 hours)

1.1 Mass movements: slope failure processes, types of mass movements based on process of failure
1.2 Morphology of landslides, properties of material, topography, climate
1.3 Landslide types based on speed and material
1.4 Causal factors for landslides

Unit 2: Landslide zone identification and impacts (15 hours)

2.1 Potential landslide indicators
2.2 Identifying landslide areas – conventional methods and methods using remote sensing and GIS techniques
2.3 Induced landslides - Interrelationship of landslides with other hazards – floods, storms, earthquakes, volcanos
2.4 Effects and consequences of landslides

Unit 3: Landslide database (15 hours)

3.1 Landslide inventory and database generation,
3.2 Landslide hazard assessment, hazard zonation mapping, scale of mapping
3.3 Landslide prevention measures – structural
3.4 Landslide prevention measures – non-structural

Unit 4: Geographic distribution of landslides and landuse-landcover (15 hours)

4.1 Distribution and characteristics of landslide-prone areas in India
4.2 Landslide-prone areas and landuse-landcover, land utilization patterns in India
4.3 Global policies to prevent landslides and case studies
4.4 Landslide warning systems – present status and prospects in India and in the world.

Suggested Reading Materials:

1. Arbanas, E., Bobrowsky, P. T., Konagai, K., Sassa, K., & Takara, K. (2020). Understanding and Reducing Landslide Disaster Risk. Springer Nature.
2. Arnold, M. (2006). Natural Disaster Hotspots Case Studies. World Bank Publications.
3. Aversa, S., Cascini, L., Picarelli, L., & Scavia, C. (2018). Landslides and Engineered Slopes. Experience, Theory and Practice. CRC Press.
4. Choi, Y. (2020). Recent Advances in Geographic Information System for Earth Sciences. MDPI.
5. Council, N. R., Studies, D. O. E. a. L., Resources, B. O. E. S. A., & Strategy, C. O. T. R. O. N. L. H. M. (2002). Assessment of Proposed Partnerships to Implement a National Landslide Hazards Mitigation Strategy. National Academies Press.
6. Earle, S. (2019). *Physical Geology – 2nd Edition*. Victoria, B.C.: B C campus.
7. Evans, S. G., Mugnozza, G. S., Strom, A., & Hermanns, R. L. (2007). Landslides from Massive Rock Slope Failure. Springer Science & Business Media.
8. Gao, J. (2023). Remote Sensing of Natural Hazards. CRC Press.
9. Gautam, N. C. (2004). Land Use, Land Cover and Management Practices in India.
10. Guzzetti, F., Arbanas, S. M., Reichenbach, P., Sassa, K., Bobrowsky, P. T., & Takara, K. (2020). Understanding and Reducing Landslide Disaster Risk. Springer Nature.
11. Norris, J. E., Stokes, A., Mickovski, S. B., Cammeraat, E., Van Beek, R., Nicoll, B. C., & Achim, A. (2010). Slope Stability and Erosion Control: Ecotechnological Solutions. Springer.
12. Pradhan, B., & Buchroithner, M. (2012). Terrigenous Mass Movements. Springer Science & Business Media.
13. Ray, R., & Lazzari, M. (2020). Landslides. BoD – Books on Demand.
14. Sarkar, R., Shaw, R., & Pradhan, B. (2022). Impact of Climate Change, Land Use and Land Cover, and Socio-economic Dynamics on Landslides. Springer Nature.
15. Sassa, K., Canuti, P., & Yin, Y. (2014). Landslide Science for a Safer Geoenvironment. Springer.

Specialisation II :Urban and Regional Planning and Development

Title of the Course – Urban and Regional Infrastructure Planning								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE – 3	GEOG 60604	04	00	04	60	50	50	100

Course Objectives:

1. To introduce the students about the different types of infrastructure.
2. To acquaint the students about the different infrastructure and amenities necessary for sustainable urban and regional development
3. To familiarize the students about the different policies framed and initiatives taken for the development of necessary infrastructure

Course Outcome:

It is expected that course will equip the students in

CO 1. Understanding the role and significance of efficiently planned infrastructure development.

CO 2. Appraising the various policies and initiatives taken for infrastructure planning, development and management.

Unit 1 Infrastructure (15 hours)

1.1 Meaning and history of infrastructure development
1.2 Types and sub-sectors of Infrastructure – Physical, Digital, Social, Utilities and services
1.3 Role and Importance of infrastructure development and planning
1.4 Characteristics of infrastructure development and management - Challenges and issues

Unit 2 Infrastructure sub-sector – Roads (15 hours)

2.1 Road Infrastructure – categories and types
2.2 Importance of road infrastructure
2.3 Road infrastructure planning – key elements
2.4 Road infrastructure in India – growth and development – current status – major initiatives

Unit 3 Infrastructure sub-sector – Housing (15 hours)

3.1 Definition and meaning – classifications of housing – by structural types, materials used, ownership
3.2 Factors influencing housing design and form
3.3Location of Housing- travel-cost minimization theory - travel cost and housing cost trade off theory – Maximum housing expenditure theory – locational theory and housing policy
3.4 Housing market and housing finance – Housing policies

Unit 4 Infrastructure sub- sector – Sanitation, Drinking water & Power/Water, Sanitation & Power (15 hours)

4.1 Clean water and sanitation services – requirements and significance – availability and access - link with health & well-being
4.2 Clean water and sanitation services – challenges faced- current scenario – solutions and strategies and targets - SDG 6
4.3 Urban Energy System – components – energy sources - purpose of energy use – energy efficiency
4.4 Renewable energy policies for cities – power sector - energy policies in India – State Energy and Climate Index

Suggested Reading Materials:

1. Constantinides, P. (2012) Introduction: Historical Review of Infrastructure Development. In Constantinides, P.
2. Perspectives and Implications for the Development of Information Infrastructures, p. 1-18, IGI Global, Hershey.
3. Constantinides, P. (2012). Introduction: Historical Review of Infrastructure Development. In P. Constantinides (Ed.) *Perspectives and Implications for the Development of Information Infrastructure* (pp.1-18). IGI Global, Hershey.
4. Heathcott, J. Soffer, J. & Zimmerman, R. (Eds.). (2022). *Urban Infrastructure: Historical and Social Dimensions of an Interconnected World.* University of Pittsburgh Press.
5. IRENA (2021). *Renewable Energy Policies: Power Sector.* International Renewable Energy Agency.
6. Jadhav, P. & Choudhary, R.N.(Eds.). (2024). *Infrastructure Planning and Management in India: Opportunities and Challenges.* Springer.
7. Krizek, K.J. & King, D.A. (2021). *Advanced Introduction to Urban Transport Planning.* Edward Elgar Publishing.
8. Kumar, A. & Meshram, D.S. (Eds.). (2022). *Future of Cities.*Routledge.
9. Moss, T., Guy, S. & Marvin,S. (Eds.). (2000). Urban Infrastructure in Transition: Networks, Buildings and Plans. Routledge.
10. Nath, K.J. & Sharma, V.P. (2017). *Water and Sanitation in the New Millennium.* Springer Link.
11. Parkin, J.V., Sharma, D. (1999). *Infrastructure Planning.* Thomas Telford Publishing.
12. Government of India.(2023). *Economic Survey 2022-23.* Ministry of Finance, Department of Economic Affairs Economic Division.
13. Sengupta, U., Shaw, A. & Kundu, D.(Eds.). (2024). *Housing India: Programmes, Policies and Governance.* Routledge.

Title of the Course : Climate Change, Cities and Regions								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 3	GEOG 60605	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce the students about changing urban climates
2. To acquaint the students about the different Types of issues an problems related with urban climate change

Course Outcome:

CO 1. Understanding the complexities of the urban climates with reference to climate change
CO 2. Making the students aware about various issues localized at the city and region level

Unit 1 : Environment and Development (15 hours)

1.1 The ideology of Creative Destruction – consequences – 'big is beautiful' idiom – resultant patterns of spatial development in industrial and post-industrial era –Capitalist development and state of environment – Neoliberalism, MNCs and commodification of environment – compromised environment in developing and underdeveloped countries

1.2 Environmental movements – origin, evolution and achievement – peoples movement, case studies – Ngoisation of environmental movements and associated contradictions – the present 'state' and status of movements

1.3 Environmental issue – local, regional and international – Global Warming and climate change – consequences

1.4 Environmental politics – Urban regions and cities – Challenges of urban environmental planning

Unit 2 : Climate Change, Cities and Regions (15 hours)

2.1 The urban system – geographical location of major urban systems – consequences in the light of sea-level change – Impact of other environmental issues – vulnerable groups

2.2 Indicators of urban environmental quality – air quality, water quality, terrestrial systems and solid waste pollution – case studies from Global North and South – direct and indirect impact of climate – vulnerabilities – shocks and stresses – responses of various socio-economic groups

2.3 Urban natural disasters – geographical factors – planning induced disasters – urban landuse, morphology, faulty planning of infrastructure, building constructions, layout , architecture, drainage and sanitations system – consequences of inefficient city planning – case studies – urban heat islands - weather and micro climatic changes

2.4 Rapid pace of urbanization and population densities – stresses and pressures on natural resources – scarcity and unequal access - land as a resource – rapid conversion of land into artificial city-scapes - consequences and contradiction –urban and community health – diseases, epidemics and general deterioration – psychological stress and mental health

Unit 3 : Climate change, Cities and regions (15 hours)

3.1 Climate change and impact on agricultural systems – droughts and floods - impact on rural

population – vulnerability, displacement and dispossession
3.2 Contemporary form of spatial development – 'urban' oriented pattern of development - Rapid conversion of agricultural lands into non-agricultural for various purposes – land scams and politics – state sponsored and other forms of land acquisitions - loss of resources and livelihoods – state - food security – community health - induced rural –urban migration and pressures on cities
3.3 International legislation – IPCC – Greenpeace - UNEP conventions and regulations - repercussions on urban and regional planning
3.4 The climate change risk calculation and equation – planning of disaster resilient communities and cities – resilient planning and designing – street, drainage, sewerage, building, architectural planning – bench marks – disaster management and GIS – case studies

Unit 4 : Environmental Policies, Legislations and movements (15 hours)
4.1 Urban and other local governmental bodies - legislation – environmental legislations regarding industries, Developmental projects, green spaces, agricultural lands, coastal lands, salt pans, etc. – newer policies of sustainable urban development – rainwater harvesting, solid waste management – Environmental Impact Assessment

4.2 Role of State, Centre and other constituted bodies in environmental planning – powers and limitations – implication on urban environment – Impact of new economic policy on urban environment – new regionalism and environmental deterioration
4.3 Funding climate change prevention: market and non-market based approaches, role of institutional actors: Government, NGOs, Multilateral agencies and citizen groups – elitist environmentalism – environmental management vs. ecological restoration
4.4 Indian planning visions to climate change and building resilient cities - Climate action plan – schemes and policies – vision plans hi-tech, eco-friendly cities – policy and implementation – case studies

Suggested Reading Materials :

1. Asian Cities Climate Change Resilience Network. 2011. Surat City Resilience Strategy, The Rockefeller Foundation, Surat Municipal Corporation, The Southern Gujarat Chamber of Commerce and Industry, TARU Leading Edge.
2. Asian Cities Climate Change Resilience Network. 2013. ACCCRN City Projects, The Rockefeller Foundation Asia Office.
3. Arup. 2014. City Resilience Framework. The Rockefeller Foundation, City Resilience Index.
4. G. Bhat, U. Raghupathi, and U. Rajasekar. 2013. Urbanisation – Poverty –Climate Change: A Synthesis Report, India, Volume I and II.
5. A. Brown, A. Dayal, and C. Rumbaitis Del Rio, 2012,From practice to theory: emerging lessons from Asia for building urban climate change resilience, Environment and Urbanization. pp. 24–531.
6. A. Brown and S. Kernaghan, 2011, Beyond Climate-Proofing: Taking an Integrated Approach to Building Climate Resilience in Asian Cities. UGEC Viewpoints, No. 6.Challenge to Change and Hue University. 2009. Hazard, Capacity &Vulnerability Assessment in Da Nang. ACCCRN, The Rockefeller Foundation.
7. J. da Silva, S. Kernaghan, and A. Luque. 2012. A systems approach to meeting the challenges of urban climate change, International Journal of Urban Sustainable Development. pp.1-21.
8. UN Habitat. 2013. Planning for Climate Change – Toolkit. A strategic, values-based approach for urban planners Cities and Climate Change Initiative. UN Habitat.

Title of the Course – Socio-cultural and psychological Dimensions of Urban and Regional Planning								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE - 3	GEOG 60606	04	00	04	60	50	50	100

Learning Objectives:

1. To Understand the socio-logical aspects of the city planning
2. Explore the role of psyche and perceptions in mapping

Course Outcomes (Cos):

CO 1. To incorporate the sociological and psychological dimensions in urban and regional planning

Unit 1 : Urban Society (15 hours)

1.1 Being and becoming – a dialectical analysis – perceptions studies and making of mind – the process of socialization – factors and processes

1.2 Urban populations – ethnic and cultural diversity – segregation and/ or acculturation

1.3 intergroup relations – social and cultural harmony and / or socio-cultural conflict

1.4 social and cultural segregation – ethnicity , gender , sexuality, etc – the resultant mental spaces and maps – inclusion and exclusion

Unit 2 : Urban Issues and Stresses (15 hours)

1.1 urban poverty and inequality – 'have's and have not's' – scarcity and competition – resultant perspectives towards individual and life

1.2 Issues of crime and violence – drug and substance abuse – euphoria and utopia

1.3 Urban regeneration and gentrification – neighbourhood replacements – identity crisis – displacement, dispossession and neurological problems

1.4 Urban systems and everyday stress – psychosomatic disorders and malfunctioning – increasing incidences of depression

Unit 3 : Transience and the city (15 hours)

3.1 *Future Shock* and Alvin Toffler – transience and city life – modular man – spaces as nomads – globalisation and new class of international migrants

3.2 Man- space relations – a disconnect - individual and social discontinuities – erosion of place attachment in local Communities - Place attachment in the working class under threat - Complexities in understanding community - behavior and experience – metropolitan consciousness

3.3 Changing cities – geography of ethics and morals – cognitive and emotional responses – indifferences - technological transience - rise of the Internet and virtual forms of communication – simulations – cognitive and emotional responses and behaviours – individual and social wellbeing

3.4 Analysis of how changing global conditions (economic, social, societal and individual) affect psychological processes such as environmental cognition, information processing and are responsible for stress - coping strategies and defence mechanisms at gross and individual level – its impact on individual and community life

Unit 4 : Planning the Healthy Cities (15 hours)

4.1 Psychology and institutions : neighbourhood planning and youth development, improved parental practices in urban context, institutional interventions to support urban communities – case studies

4.2 community efforts and citizens groups as a catalyst in creating healthy and supportive environment – case studies - experiments of mohalla committees in Bhiwandi city

4.3 Initiatives by voluntary associations and faith-based associations – dealing with drug abuse, substance abuse – slum improvement and moral education

4.4 Intergroup Relations, Acculturation, and Identity Formation in Urban Multi-ethnic Contexts - Advocate for Services for the Urban Poor - Develop New Programs and Services In Critical Areas – counselling centres and helplines

Suggested Reading Materials :

1.Aldwin, C.M., 2007. Stress, Coping, and Development: An Integrative Approach. Guilford, New York.

2. Appleton, J., 1975. The Experience of Landscape. John Wiley, London.

3. Atkinson, R.L., Atkinson, R.C., Smith, E.E., Bem, D.J., Nolen-Hoeksema, S., 1996, Hilgard's Introduction to Psychology. Harcourt Brace College Publishers, Fort Worth.

4. Ayres, J.A., 1983. Sensory Integration and the Child. Western Psychological Services, Los Angeles.

5. Bell, S., 1999. Landscape. Pattern, Perception and Process. E&FN Spon, New York van den Berg, A.E., Koole, S.L., van der Wulp, N.Y., 2002. Environmental preferenceand restoration: (How) are they related? J. Environ. Psychol. 23, 135–146.

6. Björk, J., Albin, M., Grahn, P., Jacobsson, H., Ardö, J., Wadbro, J., et al., 2008.Recreational values of the natural environment in relation to neighbourhood satisfaction, physical activity, obesity and wellbeing. J. Epidemiol. Commun. H62, e2.

7. Cowen, T. (2002). *Creative destruction: How globalization is changing the world's cultures.* Princeton, NJ: Princeton University.

8. Crane, J. (1991). The epidemic theory of ghettos and neighborhood effects on dropping out and teenagechildbearing. *American Journal of Sociology, 96,*1226-1259.

9. Culhane, D. P., & Lee, C. M. (1997). *Where homeless families come from: Toward a prevention-orientation approach in Washington, DC.* Washington, DC: Fannie Mae Foundation.

10. Dankelman, I., & Davidson, J. (1988). *Women and environment in the Third World: Alliance for the future.* London: Earthscan Publications.

11. Darley, J. M., &Latane, B. (1968). When will people help in a crisis? *Psychology Today, 12,* 54-57, 70-71.

11. Darling-Hammond, L. (1997a). *The right to learn: A blueprint for creating schools that work.* San Francisco: Jossey-Bass.

12. D'Augelli, A., & Garnets, L. (1995). Lesbian, gay, and bisexual communities. In A. D'Augelli & C. Patterson (Eds.), *Lesbian, gay, and bisexual identities over the lifespan: Psychological perspectives* (pp. 293-320). New York: Columbia University Press.

13. D'Emilio, J. (1983). *Sexual politics, sexual communities: The making of a homosexual minority in theUnited States, 1940-1970.* Chicago: University of Chicago Press.

14. R. F. Ferguson & W. T. Dickens (Eds.),*Urban problems and community development* (pp. 381-435). Washington, DC: Brookings Institution Press.

14. Dinh, K. T., Roosa, M. W., Tein, J. Y., & Lopez, V. A.(2002). The relationship between acculturation and problem behavior proneness in a Hispanic youth sample: A longitudinal mediation model .*Journal of Abnormal Child Psychology, 30,* 295-309.

16. Drake, R. E., Osher, F. C., & Wallach, M. A. (1991).Homelessness and dual diagnosis. *American Psychologist, 46,* 1149-1158.

17. Neighborhoods and adolescent development: How can we determine the links? In A. Booth & A.

C. Crouter (Eds.), *Does it take a village? Community effects on children, adolescents, and families* (pp.105-136). Mahway, NJ: Lawrence Erlbaum.
18. Dunlap, E. (1992). Impact of drugs on family life and kin networks in the inner-city African-American single-parent household. In A. V. Harrell & G. E. Peterson (Eds.), *Drugs, crime, and*
19. Report of the APA Task Force on Urban Psychology towards an Urban Psychology: Research, Action, and Policy, year not defined
20. Toffler, A. (1967) : *Future Shock*, ABC Books, US

Specialisation III : Climate Change and Sustainability Studies

Title of the Course – Climate Change and Agriculture								
Year – 2				**Semester - 3**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSC – 3	**GEOG - 60607**	**Theory**	**Practical**	**04**	**60**	**CIE**	**ESE**	**Total**
		04	**00**			**50**	**50**	**100**

Course Objectives:

1. To study the geography of climate change and agriculture
2. To understand the history of and world agriculture system
3. To understand the factors that affect crop productivity
4. Understanding the agricultural models, cropping patterns and climate variability.

Course Outcomes:

CO 1. The students are expected to be very well versed the chronology of subject content.
CO 2. Relational aptitude to be developed to understand variability of climate and agriculture would be learned by the students.
CO 3. Student are expected to develop scientific approach through logical and rational thinking

Unit:1. Agriculture and Geography (15 Hours)

1.1 Agriculture Geography: A historic perspective, approaches
1.2 Evolution of Agriculture- origin, domestication in agriculture, Agriculture in early age, Agriculture in ancient Asia, Agriculture in medieval, Scientific Agriculture in 20^{th} Century.
1.3 World Agriculture system
1.4 Land classification- qualitative and quantitative land classification,

Unit: 2. Factors affecting on Agricultural productivity (15 Hours)

2.1 Factors affecting crop productivity-physical, climatical, socio-economic
2.2 Agricultural models -normative or economic model, descriptive model
2.3 Agricultural Productivity-Agricultural efficiency, cropping intensity
2.4 Agricultural productivity- productivity and efficiency, measuring agricultural productivity, energy subsidy in agriculture

Unit: 3. Climatic variability (15 Hours)

3.1 Extreme Events -Cyclones and storms, heat waves, hurricanes, droughts, flood, El- Nino, La Nina-food production vulnerability
3.2 Global warming and climate change- GHG emissions- impact of GHG on environment and agriculture – mitigation strategies
3.3 Ozone depletion and Acid Deposition
3.4 Microclimatic indicators and agriculture

Unit: 4. Climate Impacts on Agriculture (15 Hours)

4.1 Causes and impact of climate change on agriculture
4.2 Sectoral Impacts of Climate Change- Field crops, Horticulture, Livestock, Poultry and Fishery

4.3 The Biological effects of climate Change on Yields
4.4 Agricultural adaptation and mitigation to climate change

List of Reading:

1. Akhilesh Gupta and H. Pathak (2016), Climate Change and Agriculture
2. Aman Kumar (2020), Effects of Climate Change on Agriculture, www.foodagrispectrum.org
3. Article *in* Journal of Plant Biology · 78 (lO): 911-19, November 2008
4. Bhabesh gogoi (2019), Problem, Prospect and Role of Agriculture in Rural Development in North-East India, *International Journal of Applied Social Science Volume 6 (7), July (2019) : 1944-1951*
5. Ch. Srinivasa Rao, Ravi Shankar Prasad and Trilochan Mohapatra (2019), Climate Change and Indian Agriculture: Programmes and Policy Impacts, Coping Strategies, Published by Director General Indian Council of Agricultural Research Department of Agricultural Research and Education Government of India New Delhi
6. Climate change and Food Security: Risk and Responces, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS | 2015 ISBN 978-92-5-108998-9
7. Eda Ustaoglu, Arif Çagdaş Aydinoglu (2019**)** Theory, Data, and Methods:A Review of Models of Land-Use Change *Gebze Technical University, Turkey* https://www.researchgate.net/publication/333118364
8. Gerald C. Nelson, Mark W. Rosegrant, September 2009, Climate Change Impact on Agriculture and Costs of Adaptation International Food Policy Research Institute Washington, D.C.
9. in India
10. Lalita Purty, Parikshita Khatua (2020) Problems and Prospects of Agriculture Marketing for Sustainable Development in India: an Analysis, Journal of Engineering Sciences, Vol11,Issue2, ISSN NO: 0377-9254
11. National Sustainable Agriculture Coalition. 2019. Agriculture and Climate Change: Policy Imperatives and Opportunities to Help Producers Meet the Challenge. Washington D.C.
12. Pkaggarwau (2008) Impact of climate change on Indian agriculture
13. *William R. Cline (2018).Global Warming and Agriculture,* Finance & Development March 2008

Title of the Course – Climate Change, Oceans and terrestrial ecosystems								
Year – 2				**Semester - 3**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC – 3	**GEOG - 60608**	**04**	**00**	**04**	**60**	**50**	**50**	**100**

Course Objectives:

5. To understand the interaction between various elements of climate and oceans
6. To understand the role of oceans in maintaining the earth atmospheric balance
7. To explore how the terrestrial and ocean ecosystems respond to climate change

Course Outcomes:

CO 1. The students are expected to develop deep understanding on role of oceans in maintaining the global climatic systems

CO 2.To help students analyse the impact of climate change of ocean and terrestrial ecosystem

Unit 1: Climate and Ocean Interactions

1.1 Physical interaction between ocean and atmosphere; ocean – processes and factors responsible for the interaction

1.2 wind stress and drag coefficient with respect to wind speed; momentum transfer, atmospheric impact on oceanic circulation

1.3 Walker circulation, Ferrel Cell, Hadley cell, Jet Streams in ocean atmospheric circulation, southern oscillations – major elements contributing to marine habitats

1.4 Major marine habitats – formation, evolution and development

Unit 2 : Climate Change and Oceanic Ecosystems

2.1 Major Marine Ecosystems and habitats – World Distribution, Significance and contribution to world biodiversity – marine ecosystems as major resources

2.2 Issues and problems with marine ecosystems – tropicalisation – coral bleaching – alteration of ocean ecosystems and biodiversity – patterns and trends

2.3 Plastic and microplastic pollution as major threats to marine ecosystems

2.4 Sea surface temperature change and rising ocean temperatures – ocean acidification

Unit 3 : Climate and Terrestrial Ecosystems

3.1 Major terrestrial ecosystems – World Distribution, Importance and contribution to world biodiversity - Identification of biodiversity hotspot – species distribution and growth

3.2 Phytoclimatic zones of the earth and the shifts due to climate change – Global Circulation model and predictions

3.3 Impact of Climate Change on major terrestrial ecosystems – forest, grasslands. Tundra and desserts – mountain ecosystems and climate change

3.4 Identification of threatened biomes and biodiversity loss – flora and fauna – impact on livelihood and communities

Unit 4 : Climate Change modelling

4.1 Basics of Climate Change modelling –Basic principles and components – climate model – basic elements of climate models
4.2 General Circulation Models – Downscaled Climatic Models – different sets of scenarios and climate testing
Climate model testing – using scenario to predict Ocean model
4.3 Prerequisite for ocean model - different bases for ocean modelling – micro-algae to understand the workings of the oceans
4.4 Contemporary researches on climate modelling – literature review

Suggested Reading Materials ;

1. Bigg GR. Physical interaction between the ocean and atmosphere. In: *The Oceans and Climate*. Cambridge University Press; 2003:35-90.
2. Trujillo (2015) Essential of Oceanography
3. Garrison, T (2012) . Oceanography: An Invitation to Marine Science
4. https://ebooks.inflibnet.ac.in/geop14/chapter/ocean-atmosphere-interaction/
5. https://libguides.humboldt.edu/ocn/reference
6. https://www.noaa.gov/
7. https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/ch7s7-1-1.html#:~:text=Terrestrial%20ecosystem%20photosynthetic%20productivity%20changes,from%20the%20atmosphere%20is%20enhanced.
8. https://www.nature.com/articles/s41559-024-02333-89
9. https://www.ocean-climate.org/wp-content/uploads/2016/10/161011_FactSheets_EN.pdf
10. https://race-synthese.de/ocean-and-climate-modelling#:~:text=An%20ocean%20model%20consists%20of,horizontal%20currents%20and%20vertical%20convection)
https://www.climatehubs.usda.gov/hubs/northwest/topic/basics-global-climate-models
https://theconversation.com/climate-modelling-micro-algae-to-better-understand-the-workings-of-the-ocean-204412

Title of the Course : Climate change, Cities and Regions								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE – 3	GEOG 60609	04	00	04	60	50	50	100

Course Objectives:

1. To introduce the students about changing urban climates
2. To acquaint the students about the different Types of issues an problems related with urban climate change

Course Outcome:

CO 1.Understanding the complexities of the urban climates with reference to climate change
CO 2. Making the students aware about various issues localized at the city and region level

Unit 1 : Environment and Development (15 hours)

1.1 The ideology of Creative Destruction – consequences – 'big is beautiful' idiom – resultant patterns of spatial development in industrial and post-industrial era –Capitalist development and state of environment – Neoliberalism, MNCs and commodification of environment – compromised environment in developing and underdeveloped countries

1.2 Environmental movements – origin, evolution and achievement – peoples movement, case studies – NGOisation of environmental movements and associated contradictions – the present 'state' and status of movements

1.3 Environmental issue – local, regional and international – Global Warming and climate change – consequences

1.4 Environmental politics – Urban regions and cities – Challenges of urban environmental planning

Unit 2 : Climate Change, Cities and Regions (15 hours)

2.1 The urban system – geographical location of major urban systems – consequences in the light of sea-level change – Impact of other environmental issues – vulnerable groups

2.2 Indicators of urban environmental quality – air quality, water quality, terrestrial systems and solid waste pollution – case studies from Global North and South – direct and indirect impact of climate – vulnerabilities – shocks and stresses – responses of various socio-economic groups

2.3 Urban natural disasters – geographical factors – planning induced disasters – urban landuse, morphology, faulty planning of infrastructure, building constructions, layout , architecture, drainage and sanitations system – consequences of inefficient city planning – case studies – urban heat islands - weather and micro climatic changes

2.4 Rapid pace of urbanization and population densities – stresses and pressures on natural resources – scarcity and unequal access - land as a resource – rapid conversion of land into artificial city-scapes - consequences and contradiction – urban and community health – diseases, epidemics and general deterioration – psychological stress and mental health

Unit 3 : Climate Change, cities and regions (15 hours)

3.1 Climate change and impact on agricultural systems – droughts and floods - impact on rural population – vulnerability, displacement and dispossession

3.2 Contemporary form of spatial development – 'urban' oriented pattern of development - Rapid

conversion of agricultural lands into non-agricultural for various purposes – land scams and politics – state sponsored and other forms of land acquisitions - loss of resources and livelihoods – state - food security – community health - induced rural –urban migration and pressures on cities
3.3 International legislation – IPCC – Greenpeace - UNEP conventions and regulations - repercussions on urban and regional planning
3.4 The climate change risk calculation and equation – planning of disaster resilient communities and cities – resilient planning and designing – street, drainage, sewerage, building, architectural planning – bench marks – disaster management and GIS – case studies

Unit 4 : Environmental Policies, Legislations and movements (15 hours)
4.1 Urban and other local governmental bodies - legislation – environmental legislations regarding industries, Developmental projects, green spaces, agricultural lands, coastal lands, salt pans, etc. – newer policies of sustainable urban development – rainwater harvesting, solid waste management – Environmental Impact Assessment
4.2 Role of State, Centre and other constituted bodies in environmental planning – powers and limitations – implication on urban environment – Impact of new economic policy on urban environment – new regionalism and environmental deterioration
4.3 Funding climate change prevention: market and non-market based approaches, role of institutional actors: Government, NGOs, Multilateral agencies and citizen groups – elitist environmentalism – environmental management vs. ecological restoration
4.4 Indian planning visions to climate change and building resilient cities - Climate action plan – schemes and policies – vision plans hi-tech, eco-friendly cities – policy and implementation – case studies

Suggested Reading Materials:

1. Asian Cities Climate Change Resilience Network. 2011. Surat City Resilience Strategy, The Rockefeller Foundation, Surat Municipal Corporation, The Southern Gujarat Chamber of Commerce and Industry, TARU Leading Edge.
2. Asian Cities Climate Change Resilience Network. 2013. ACCCRN City Projects, The Rockefeller Foundation Asia Office.
3. Arup. 2014. City Resilience Framework. The Rockefeller Foundation, City Resilience Index.
4. G. Bhat, U. Raghupathi, and U. Rajasekar. 2013. Urbanisation – Poverty –Climate Change: A Synthesis Report, India, Volume I and II.
5. A. Brown, A. Dayal, and C. Rumbaitis Del Rio, 2012,From practice to theory: emerging lessons from Asia for building urban climate change resilience, Environment and Urbanization. pp. 24–531.
6. A. Brown and S. Kernaghan, 2011, Beyond Climate-Proofing: Taking an Integrated Approach to Building Climate Resilience in Asian Cities. UGEC Viewpoints, No. 6.Challenge to Change and Hue University. 2009. Hazard, Capacity &Vulnerability Assessment in Da Nang. ACCCRN, The Rockefeller Foundation.
7. J. da Silva, S. Kernaghan, and A. Luque. 2012. A systems approach to meeting the challenges of urban climate change, International Journal of Urban Sustainable Development. pp.1-21.
8. UN Habitat. 2013. Planning for Climate Change – Toolkit. A strategic, values-based approach for urban planners Cities and Climate Change Initiative. UN Habitat.

Specialisation IV: Human Geography and Human Ecology

Title of the Course – Indian Foreign Policy and International Relations								
Year – 1				**Semester - I**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE – 3	GEOG 60610	04	00	04	60	50	50	100

Course Objectives:

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

Course Outcome:

It is expected that course will equip the students in

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

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

Unit 1: Indian Foreign Policy (15 hours)

1.1 Historical background and evolution of Indian foreign policy – Determinants, Institutions and actors in the making of Indian Foreign policy

1.2 Strategic and core philosophy and drivers of foreign policy like Panchsheel, Nonalignment Movement – neighbourhood first

1.3 Indian Diplomacy – Various aspects of Indian Diplomacy – key features of Indian Diplomacy – various strategies of diplomacy

1.4 – Recent shift in Indian foreign policy – comparison between post-independence period and post globalistion period – shifts and drifts – Impact on the relations with neighbouring countries and external powers

Unit 2: Various policies and their role in building the international relations (15 hours)

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

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

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

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

Unit 3: International Relations and India (15 hours)

3.1 Various theoretical approached to understand the formation of international relations – Western and Indian Approaches

3.2 India and the world – colonial, post-colonial period and changes international relation policy

3.3 Post-globalisation period - Post-structural, Feminist, Green Politics and Post-colonial approaches

3.4 Case studies on various approaches

Unit 4: India and the world (15 hours)

4.1 Indo – US relations

4.2 Indo – Russia Relations
4.3 Indo – China Relations
4.4 India at various international platforms like UN, G7 , G77, etc.

Suggested Reading Materials:

1. Jain, B. M., Global Power: India's Foreign Policy 1947-2006 (Lexington Books, 2008).
2. Rajan, Mannaraswamighala Sreeranga, Studies on India's Foreign Policy (ABC Pub. House,1993)
3. Jayapalan, N., Foreign policy of India (Atlantic Publishers & Distributors, 2001
4. Gupta, K.R. & Vatsala Shukla, Foreign Policy of India (Atlantic Publishers & Distributors,2009)
3. Mansingh, Lalit et al,eds., Indian Foreign Policy: Agenda for the 21st Century, Vol.1 and 2, New Delhi: Foreign Services Institute with Konark, 1998)
4. Sinha, A. and M. Mohta (eds), Indian Foreign Policy: Challenges and Opportunities, (New Delhi: Academic Foundation. 2003)
5. P. M Kamat, Emerging International Order and Foreign Policy Options for India (Indian Academy of Social Sciences, 1999
6. Khanna, V N. Foreign Policy of India. new delhi: Vikas Publishing House, 2018.
7. Bandyopadhyay, Jayantanuja, The Making of India's Foreign Policy (Calcutta: Allied Publishers, 2003)
8. Chandra, Bipan, India After Independence 1947-2000 (New Delhi: Penguin, 2000)
9. Harshe, Rajen and K.M.Seethi (eds.), Engaging With the World: Critical Reflections on India's Foreign Policy (Hyderabad: Orient Longman, 2005), pp.25-40
10. Kapur, Harish, India's Foreign Policy – Shadows and Substance (New Delhi: Sage,1994)
11. Ramakrishnan, A.K., "Neoliberal Globalist Transformations in India's Foreign Policy: Implications for West Asia and North Africa", in Anwar Alam (ed.), India and West Asia in the Era of Globalisation (New Delhi: New Century Publications, 2008), pp.25-30
12. Shastri, Amita and Wilson, Jeyaratnam (Eds), The Post-Colonial States of South Asia Democracy, Development and Identity (Palgrave Macmillan 2001)
13. J. N Dixit Assignment Colombo (New Delhi: Konarak Publishers, 1998)
14. Stephen P. Cohen, India Emerging Power, New Delhi, Oxford University Press, 2002
15. Wilson, Jeyaratnam and Dalton, Dennis (Eds), The States of South Asia (New Delhi: Vikas)
16. https://www.mcrhrdi.gov.in/5th_mesfc2023/week9/INDO-CHINA%20RELATIONS-An%20Overview.pdf
17. https://www.state.gov/united-states-india-relations/
18. https://www.mea.gov.in/Portal/ForeignRelation/Bilateral_Brief_as_on_09.10.2023.pdf

Title of the Course – Tourism Development and Planning - III								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 3	GEOG 60611	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To provide students a comprehensive knowledge about impacts of tourism and its role as a driver towards sustainable development.
2. This course also aims to introduce the students with basic concepts, component and need of tourism planning which is essential for successful and sustainable tourism development and management

Course Outcome:

CO 1. The wide spectrum of impacts of tourism
CO 2. Tourism's link to cultural heritage and its role in the conservation of cultural heritage
CO 3. The concept of sustainable tourism and its importance as a driving force for achieving SDGs
CO 4. Tourism planning, its need and applications

Unit 1 : Tourism Impacts (15 hours)

1.1 Economic Impacts – direct, indirect & induced impacts – multiplier effect – economic leakages
1.2 Socio-cultural Impacts – impact on household well-being – impact on culture (language, food, dress)
1.3 Environmental Impacts – positive and negative impacts- carrying capacity – tourism ecological footprints
1.4 Cost – Benefit analysis– host community perception - host-guest interactions – contribution to regional development

Unit 2 : Tourism & Cultural Heritage (15 hours)

2.1 Cultural resources for tourism – tangible and intangible cultural heritage
2.2 Heritage-scapes -tourism potential of cultural resources
2.3 Conservation of cultural heritage – role of tourism – methods and process of conservation and managing of heritage resources
2.4 Cultural tourism – festival and cultural event-based tourism - Examples from World and India

Unit 3 : Sustainable Tourism (15 hours)

3.1 Sustainable tourism development- definition & criteria– eco-tourism, responsible tourism, agri-tourism
3.2 Sustainable Tourism-Eliminating Poverty (ST-EP) - tourism as sustainable livelihood
3.3 Transforming tourism for Climate Action – Glasgow Declaration – tourism and climate change – transport related CO_2 emissions from tourism sector

3.4 Tourism and sustainability linkage – principles and contributions to SDG – sustainable tourism resolutions

Unit 4 : Tourism Planning **(15 hours)**

4.1 Meaning, Concept, component, Need, Importance, benefits
4.2Approaches to tourism policy and planning
4.3Types and Levels of Tourism Planning
4.4Tourism strategies and Master plan – concept – importance – applications and benefits – tourism master plan of Maharashtra

Suggested Reading Materials:

1. Cooper, C., Volo, S., Gartner, W.C. & Scott, N. (Ed.) (2018). *The Sage handbook of Tourism Management: Theories, Concepts and Disciplinary Approaches to Tourism.* Sage reference.
2. Fennell, D.A. & Cooper, C. (2020). *Sustainable Tourism: Principles, Contexts and Practices.* Channel View Publications.
3. Government of India (n.d.). Sustainable Tourism for India: Criteria and Indicators, Applicable to Accommodation Sector and Tour Operators. *Ministry of Tourism.* https://tourism.gov.in/sites/default/files/2020-01/Document.pdf
4. Mckercher, B. & Du cros, H. (2002). *Cultural Tourism: The Partnership Between Tourism and Cultural Heritage Management: 1st Edition.* Routledge.
5. Mathieson, A. & Wall, G. (1982). *Tourism: Economic, Physical, and Social Impacts*. Longman.
6. Pearce, Douglas, G. (1989). *Tourism Development,* Volume 2. Topics in applied geography. Longman Scientific & Technical.
7. UNEP/WTO (Ed.)(2005): Making Tourism More Sustainable: a guide for policy makers. http://www.uneptie.org/pc/tourism/library/A%20Guide%20for%20Policy%20Makers.htm
8. Ritchie, Brent, J.R. & Goeldner, Charles R. (2011). *Tourism: Principles, Practices, Philosophies*. Wiley.
9. Robinson, H. (1976). *A Geography of Tourism.* Macdonald and Evans.
10. Smith, V. L. (1989). *Hosts and Guests. The Anthropology of Tourism* (2nd Ed). University of Pennsylvania Press.
11. Timothy, D.J. (2011). *Cultural Heritage and Tourism: An Introduction: 2nd Edition* Channel View Publications.
12. UNEP/WTO (Ed.)(2005): Making Tourism More Sustainable: a guide for policy makers. http://www.uneptie.org/pc/tourism/library/A%20Guide%20for%20Policy%20Makers.htm
13. Weaver, D. (2005). *Sustainable Tourism.* Routledge. https://sdg12hub.org/sdg-12-hub/see-progress-on-sdg-12-by-target/12b-tourism
14. World Tourism Organization (Ed.)(2004). *Indicators of sustainable development for tourism destinations. A guidebook. - Madrid*. http://www.world-tourism.org/frameset/frame_sustainable.html
15. World Tourism Organization and International Transport Forum (2019). *Transport-related CO_2 Emissions of the Tourism Sector – Modelling Results.* UNWTO. https://www.e-unwto.org/doi/epdf/10.18111/9789284416660

Title of the Course – Spatial Demography								
Year – 2				**Semester – III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE 3	GEOG 60612	04	00	04	60	50	50	100

Course Objectives:

1. To understand conceptual framework related to Spatial Demography and Population Geography.
2. To understand demography in spatial frame and application of spatial frameworks to demographic processes.
3. To acquire knowledge of spatial concepts and its application in cartography.
4. To analyze statistical concepts viz-a-viz spatial analysis in demographic processes.

Outcomes:

CO 1. The students will be able to relate demographic processes and patterns over geographical scale.
CO 2. Learn to link micro to macro demography in spatial frame.
CO 3. Carry out spatial and non-spatial data analysis and associated local indicators for analysis.
CO 4. Apply right statistical techniques for spatial analysis of demographic processes.

UNIT 1: Conceptual Framework (15 Hours)

1.1 Methodological difference between Spatial Demography and Population Geography, Demography as spatial science.

1.2 Concept of space, place and region, types of spaces – concrete and abstract spaces, absolute, relative and relational spaces.

1.3 Spatial Pattern and Processes; location distance and area; Distance and decay relationship and spatial hierarchy

1.4 Demographic processes by geographical scale; nature of disaggregated data- Census and secondary sources.

UNIT 2: Demography in Spatial Frame (15 Hours)

2.1 Linking micro, meso and macro demography in spatial frame, Application of spatial frameworks to demographic processes

2.2 Space and determinants of population , Spatial pattern of fertility, mortality and diseases

2.3 Distance as factor in access to health care and health planning, accessibility to facility.

2.4 Migration and distance -gravity model; space , culture and migration, urban sprawl, sub-urbanization and peri-urbanization

UNIT 3: Spatial Concepts and Cartography (15 Hours)

3.1 Spatial parameters: Site and Location; Scale, Plane and Spherical Coordinate..

3.2 Map Projection-UTM, Types of Maps: Cadastral, toposheet, thematic maps, Representation of spatial and non-spatial data.

3.3 Discrete data, point and polygon data, Raster and Vector data , layouts preparation

3.4 Exploratory Spatial Data Analysis (ESDA) and Local Indicators of Spatial Association (LISA) in Geoda.

UNIT 4: Statistical Concepts and Spatial Analysis (15 Hours)

4.1 Bar Diagram , Frequency polygon, Frequency curve; Test of significance, confidence intervals.

4.2 Univariate and Multivariate Statistics: Correlation and Regression, Matrix algebra; Auto-correlation , Kriging, Moran's I Index.

4.3 Population distribution on dot and sphere /circle ,cubes and combined cartograms.

4.4 Density map , Polygraph , Cumulative curve and Carogram for determinants of population

Suggested reading materials:

1. Anselin, L. (2005). Exploring Spatial Data with GeoDa ; A Workbook .UC Santa Barbabra, CA: Center for Spatially Integrated Social Science, available on http://geodacenter.asu.edu/.

2. Chen,X., Orum A. M., and Paulsen K.E. (2013). Introduction to Cities: How place and Space shape Human Experience. West Sussex, Willey-Blackwell.

3. Kurland K.S., Gorr W.L. (2007) .GIS tutorial for Health. Redlands, CA,ESRI Press.

4. Lo,C.P. and Young A.K.W. (2002) : Concepts and Techniques of Geographic Information Systems, New Delhi ,Prentice Hall of India.

5. Thomas, R. K. (2018) Concepts, Methods and Practical Applications in Applied Demography. Springer.

Title of the Course –Geography of Culture, Heritage, and Indigenous Peoples								
Year – 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 2	GEOG 60613	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objective:

1. To impart basic knowledge about culture and heritage and its relationship with geography.
2. The course aims to provide a broad overview of the key concepts and approaches of cultural geography and its significance
3. To make students understand the evolution of cultural characteristics and practices over time and space as a result of the interaction between humans and their environment which adds to the diversity of culture.
4. To make the students learn about racial and cultural diversity and distribution.

Course Outcome:

CO 1. At the end of this course the students will be able to comprehend and account for the cultural differences, distribution, cultural production, consumption and geographical-historical evolution of the landscape, human rights and issues.

Unit 1: Introduction to Cultural Geography (15 Hours)

1.1 Meaning of Culture – introduction to cultural geography- scope & content
1.2 Classical Cultural Geography- Landschaft - Cultural Landscape
1.3 New Cultural Geography – power geometries -cultural politics
1.4 Cultural Diffusion – Acculturation – Assimilation – Folk culture and Popular culture – tribal culture – examples from India

Unit 2 : Cultural Heritage and Historical Geography (15 Hours)

2.1 Cultural Heritage – tangible and intangible heritage, living heritage – examples from India
2.2 Importance of Cultural heritage – its protection, preservation — Human Right Council resolution for cultural rights and protection of cultural heritage - Contribution of Cultural Heritage to sustainable development – World Heritage Convention
2.3 Heritage awareness and conservation in India – role of INTACH - schemes for safeguarding intangible cultural heritage
2.4 Landscape and Historical Geography – Historic Urban Landscape (HUL) - historical-geographical evolution of urban cultural landscape – case study of Mumbai

Unit 3 : Indigenous People (15 Hours)

3.1 Meaning of the Term ‘Indigenous’, Defining Indigenous Peoples
3.2 Contemporary Global Distribution of Tribes.
3.3 Differentials in tribal living – Location, environment, economy, society and culture of tribes.
3.4 Indigenous tradition knowledge, Ethnoscience

Unit 4 : Rights of Indigenous Peoples **(15 Hours)**

4.1 United Nations Declaration on the Rights of Indigenous Peoples
4.1 United Nations human rights- system, function
4.2 Indigenous peoples' issues
4.3 UN agencies' work on indigenous peoples' issues.

Suggested Reading Materials:

1. Anderson, K. (2003). Handbook of Cultural Geography.Sage Publications.
2. Crang, M. (1998). Cultural Geography. Routledge.
3. De Blij, H.J. & Muller , P.O. (1977). Human Geography: Culture Society and Space. John Wiley & Sons.
4. Knox, Paul, and Sallie Marston. 2015. Human Geography: Places and Regions in Global Context, 7th Edition. Upper Saddle River, NJ: Pearson Prentice Hall.
5. Makhloufi, L. (Ed.) (2024). Tangible and Intangible Heritage in the Age of Globalisation. OpenBook Publishers https://doi.org/10.11647/OBP.0388
6. Spencer, J.E. & Thomas, W.L. (1973). Introducing Cultural Geography. John Wiley & Sons.
7. Human Rights United Nations, Indigenous Peoples and the United Nations Human Rights System Fact Sheet No. 9/Rev.2 UNITED NATIONS New York and Geneva, 2013
8. Biswas, R. K. (2006): "Demographic Study of Primitive Tribe-A Comparative Framework", Saad Publications, New Delhi
9. Anderson, K. (2003). Handbook of Cultural Geography.Sage Publications.
10. Crang, M. (1998). Cultural Geography.Routledge.
11. De Blij, H.J. & Muller , P.O. (1977). Human Geography: Culture Society and Space. John Wiley & Sons.
12. Knox, Paul, and Sallie Marston. 2015. Human Geography: Places and Regions in Global Context, 7th Edition. Upper Saddle River, NJ: Pearson Prentice Hall.
13. Makhloufi, L. (Ed.) (2024). *Tangible and Intangible Heritage in the Age of Globalisation.* Open Book Publishers https://doi.org/10.11647/OBP.0388
14. Spencer, J.E. & Thomas, W.L. (1973). Introducing Cultural Geography. John Wiley & Sons.
15. Human Rights United Nations, Indigenous Peoples and the United Nations Human Rights System Fact Sheet No. 9/Rev.2 UNITED NATIONS New York and Geneva, 2013
16. Arun, K. (2000): "Dimensions of Population Growth and its Social Implications", Anmol Publications, New Delhi.
17. Bhende, A. and Kanitkar, T. (2000): "Principles of Population Studies", Himalaya Publishing House, Mumbai.
18. Biswas, R. K. (2006): "Demographic Study of Primitive Tribe-A Comparative Framework", Saad Publications, New Delhi

Specialisation V: Geospatial Technology

Title of the Course – Digital Image Processing								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60614	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1.To introduce basic and advance satellite digital image processing in Geospatial Technology.

Course Outcomes:

After completion of the course, student will be able to;

CO 1. Do basic image processing.

CO 2. Correct the errors associated with the satellite image.

CO 3. Perform the digital image classification.

CO 4. Assess the accuracy of the outcome;

CO 5. Perform some the advance digital image processing task.

Unit 1. Basics of image processing (15 hours)

1.1 Digital image, Basic operations - Image arithmetic, Image thresholding, Cross correlation

1.2 Filters- Convolution filters, smoothing, edge detection; Gradient operators, Förstner filter; Mathematical Morphology- Binary images, Subset, Intersection, Completion, Erosion, Dilation, Opening, Closing, Morphological gradient, Top-hats

1.3 Contrast enhancement: image histogram, distribution parameter, linear contrast stretch, histogram equalisation, logarithmic and exponential stretch

1.4 Image indices: NDVI, SAVI, NDSII, LWM, NDWI, NDMI

Unit 2. Digital image pre-processing /Types of errors and methods of correction (15 hours)

2.1 Sensor errors and corrections: random pixels, line/column dropouts, line start problem; correction methods: line (pixel) replacement, line average, adjusted line average.

2.2 Atmospheric errors and corrections: Absolute and relative corrections, de-hazing, normalisation within scene and between dates, Conversion of Digital Number to reflectance, reflectance to radiance, noise removal.

2.3 Geometric errors and corrections: types of errors - systematic, unsystematic corrections Georeferencing, registration (image to image), ortho-rectification, true ortho-rectification.

2.4 Resampling techniques: Nearest Neighbour, Bilinear Interpolation, Cubic Convolution.

Unit 3. Digital image classification (15 hours)

3.1 Image processing workflow, Overview of classification methods, image space, feature space, distance and clusters in feature space, image classification process and preparation

3.2 Supervised classification: training sample statistics; classification algorithms – Box classifier, Minimum Distance to mean classifier, Maximum likelihood classifier

3.3 Accuracy Assessment: error matrix, validation terminology

3.4 Unsupervised classification (clustering) ; Change detection

Unit 4. Advance image analysis (15 hours)

4.1 Expert/ rule-based classifiers: Rule-based/expert vs. other classification methods, Basic concepts, Imagine' Expert Classifier, Knowledge Engineer, Setting up of rules, Integration of graphic models, Output evaluation

4.2 Object based image analysis: Segmentation, Thresholding, Edge detection, Region-based segmentation, Split and Merge segmentation, Texture image segmentation

4.3 Artificial Neural Network: Introduction, training Neural network & algorithm, parameters of the training process, advantages and disadvantages of neural networks.

4.4 Image fusion: Image fusion- resolution merge, data merge; Fusion algorithms -Band selection, Pixel addition, multiplication, Intensity, Hue & Saturation, Principle components, Wavelets, HPF.

Suggested Reading Materials:

1. Cambell, J. B. (2002). *Introduction to Remote Sensing*. Taylor & Francis.
2. Duda, R. O., & Hart, P. E. (1973). *Pattern Classification and Scene Analysis*. Wiley.
3. Gibson, P. J. (2000a). *Introduction to Remote Sensing - Digital Image Processing and Applications*. Routledge - Taylor & Francis.
4. Gibson, P. J. (2000b). *Introduction to Remote Sensing - Principles and Concepts*. Routledge - Taylor & Francis.
5. Gonzalez, R. C., & Wintz, P. (2010). *Digital Image Processing*. Prentice Hall.
6. Jain, A. K. (2012). *Fundamentals of Digital Image Processing*. Prentice Hall, Information and System Sciences Series, Kailath, T. (Series Ed.).
7. Lilles T. M., & Kiefer, R. W. (2015). *Remote Sensing and Image Interpretation*. John Wiley & Sons.
8. Pratt, W. K. (2001). *Digital Image Processing* (Third Edition). John Wiley & Sons, Inc.
9. Russ, J. C. (1992). *The Image Processing Handbook*. CRC Press .
10. Sabins (Jr.) F. F. (1986). *Remote Sensing - Principles and Interpretation*. W. H. Freeman & Co.
11. Sahu, K. C. (2008). *Text Book of Remote Sensing and Geographical Information System*. Atlantic Publishers and Distributors (P) Ltd.,.
12. Schowengerdt, R. A. (2006). *Remote Sensing - Models and Methods for Image Processing*. Elsevier India Pvt. Ltd., .
13. Umbaugh, S. E. (2005). *Computer Imaging: Digital Image Analysis and Processing*. The CRC Press.

Journals:

1. IEEE: Transactions on Image Processing
2. IEEE: Transactions on Neural Networks
3. IEEE: Transactions on Geoscience and Remote Sensing
4. Photogrammetric Engineering and Remote Sensing

International Journal of Remote Sensing.

Title of the Course – 60615. Geo-Information Science for Disaster Studies.								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60615	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce Geo-information Science and its application in geohazards.

Course Outcomes:

After completion of the course, student will be able to;

CO 1. Learn about use of geospatial information in pre and post disaster situation.

CO 2. Learn about the complexities involved in disaster situation.

CO 3. Translate the result into an integrated planning.

Unit 1. Disaster Management: Concepts and Overview (15 hours)

1.1 The terminology of hazards, risk, vulnerability and disaster management; Introduction to Disaster risk assessment.

1.2 Disaster Management Support (DMS): status in India for use of space inputs-cyclones, flood, drought, earthquake, tsunami, landslide, food security.

1.3 Elements at risk mapping

1.4 Vulnerability assessment- land use, population, attributes, data sources.

Unit 2. Geospatial Information Technology for Emergency Response (15 hours)

2.1 Real-time data collection and information generation using airborne sensors- assessment criteria, airborne platforms, sensors and product

2.2 Satellite remote sensing for near-real time data collection - satellite orbits, sensors and images; image products and impact of spatial and spectral characteristics, challenges in data availability.

2.3 Why disaster monitoring- Disaster response, Data collection (real-time vs. near real-time), International support projects – data acquisition, data processing, regional support

2.4 Information on some selected geospatial data: Landsat, LISS-III, AWiFS, Sentinel, SRTM DEM, Cartosat-1 DEM, Aster DEM, etc.

Unit 3. High Resolution Aerospace Image Analysis for Natural Hazards Assessment (15 hours)

3.1 An introduction to high resolution satellite data and its characteristics.

3.2 Remote Sensing Imagery for the assessment of Geo-hazard, Visual image interpretation for geohazard assessment.

3.3 Digital Elevation Model; Terrain Analysis & Classification using Aerospace Imagery.

3.4 Lithological and structural mapping using aerospace data; Remote sensing for landslide monitoring and mapping

Unit 4. Some selected applications (15 hours)

4.1 Geo-morphological approach to flood hazard mapping using image interpretation.

4.2 Soil erosion and its impact on terrain; Empirical modelling- Soil erosion.

4.3 Landslide types, causes and identification; Landslide susceptibility assessment and empirical modelling.

4.4 Coastal processes and hazards.

Suggested Reading Materials

1. Alatorre, L. C., & Begueria, S. (2009). Identification of eroded areas using remote sensing in a badlands landscape on marls in the central Spanish Pyrenees. *CATENA*, *76*(3), 182–190. https://doi.org/10.1016/j.catena.2008.11.005
2. Alexander, D. (1993). *Natural disasters*. UCL Press Ltd., University College.

Atkinson, P. (2002). Spatial Statistics. In A. Stein, F. Meer, & B. Gorte (Eds.), *Spatial Statistics for Remote Sensing* (Vol. 1, pp. 57–81). Springer Netherlands. https://doi.org/10.1007/0-306-47647-9_5

3. Baas, S. , S., & Ramasamy, et al. (2008). *Disaster Risk Management Systems Analysis A guide book*.

Blaikie, P. (1994). *At risk : natural hazards, people's vulnerability and disasters.* Routledge.

4. Chandra, A. M., & Ghosh, S. K. (2006). *Remote sensing and geographical information system* (First). Narosa publishing house pvt. ltd.
5. *DISASTER MANAGEMENT IN INDIA -A STATUS REPORT*. (2004). NDM Division, Ministry of Home Affairs, Govt. of India.
6. Gutiérrez, R., Gibeaut, J., Smyth, R., Hepner, T., Andrews, J., Weed, C., Gutelius, W., & Mastin, M. (2001). Precise airborne LiDAR surveying for coastal research and geohazards applications. *International Archives of Photogrammetry and Remote Sensing*, *XXXIV*, 185–192.
7. Harp, E. L., Castaneda, M., Held, M. D., & Survey, U. S. G. (2002). Landslides triggered by Hurricane Mitch in Tegucigalpa, Honduras. In *Open-File Report*. https://doi.org/10.3133/ofr0233
8. Jörn Birkmann. (n.d.). *Measuring vulnerability Measuring Vulnerability to Natural Hazards Towards Disaster Resilient Societies.* http://www.ehs.unu.edu/article:279.
9. Joseph, G. (2008). *Fundamentals of remote sensing* (Second). Universities press (India) private limited.

Journal_Volume. (2003). *Journal of the indian society of remote sensing*. *31*(4), 237–314.

10. Kale, V. S. (2003). The spatio-temporal aspects of monsoon floods in India: Implications for flood hazard management. *Disaster Management: Universities Press, Hyderabad*, 22–47.
11. Karlekar, S. (2006). *Remote sensing* (First). Diamond publications.

Kerle, N., Heuel, S., & Pfeiffer, N. (2008). *Real-time data collection and information generation using airborne sensors* (pp. 43–74).

12. Li, Z., Zhu, Q., & Gold, C. (2004). *Digital Terrain Modeling: Principles and Methodology*. CRC Press.
13. Longley, P. A., Googdchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographical information systems* (Second). John Wiley & Sons, Inc.
14. Mastin, M. C. (2002). Flood-hazard mapping in Honduras in response to Hurricane Mitch. In *Water-Resources Investigations Report*. https://doi.org/10.3133/wri014277
15. Nsangou, D., Kpoumié, A., Mfonka, Z., Ngouh, A. N., Fossi, D. H., Jourdan, C., Mbele, H. Z., Mouncherou, O. F., Vandervaere, J.-P., & Ndam Ngoupayou, J. R. (2022). Urban flood susceptibility modelling using AHP and GIS approach: case of the Mfoundi watershed at Yaoundé in the South-Cameroon plateau. *Scientific African*, *15*, e01043. https://doi.org/https://doi.org/10.1016/j.sciaf.2021.e01043
16. Olsen, R., & Villanueva, E. (2007). *GEOTHECHNICAL EVALUATION OF THE MASSIVE EL BERRINCHE LANDSLIDE IN HONDURAS*.
17. Otto Huisman, & Rolf A. de By. (2009). *Principles of Geographic Information Systems- An introductory textbook*. The International Institute for Geo-Information Science and Earth Observation (ITC),.
18. Pathak, S., Liu, M., Jato-Espino, D., & Zevenbergen, C. (2020). Social, economic and environmental assessment of urban sub-catchment flood risks using a multi-criteria approach: A case study in Mumbai City, India. *Journal of Hydrology*, *591*, 125216. https://doi.org/https://doi.org/10.1016/j.jhydrol.2020.125216
19. R.K. Bhandari. (2006). Disaster Management in India : A New Awakening. *Disaster & Development*,

1(1), 1–27.
20 .Taubenböck, H., Esch, T., Wurm, M., Roth, A., & Dech, S. (2010). Object-based feature extraction using high spatial resolution satellite data of urban areas. *Journal of Spatial Science*, *55*(1), 117–132. http://www.informaworld.com/10.1080/14498596.2010.487854
21. Tempfli, K., Kerle, N., Huurneman, G., & Janssen, L. (2009). *Principles of Remote Sensing* (4th ed.). ITC, Enschede, The Netherlands.
22. UN. (2004). *Living with Risk.* United Nation.
United Nations-International Strategy for Disaster Reduction (UN-ISDR). (2006). *United Nations. Bureau for Crisis Prevention and Recovery. Reducing Disaster Risk: A Challenge for Development.* http://www.undp.org/bcpr/disred/rdr.htm.
23. W. Nick Carter. (2008). *Handbook of Disaster Management* (Second). Asian Development Bank.
Zlatanova, Siyka., & Li, Jonathan. (2008). *Geospatial information technology for emergency response*. Taylor & Francis.

Title of the Course – Thermal and Hyperspectral Remote Sensing								
Year - 2				**Semester - III**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 3	GEOG 60616	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To understand the principles of thermal infrared radiation and its interaction with the Earth's surface.
2. To gain theoretical knowledge about Hyperspectral and thermal infrared imagery and its interpretation.
3. Recognize how to collect and Pre-process hyperspectral data.
4. To explore applications of thermal remote sensing and Hyperspectral Remote Sensing in different domains.

Course Outcomes (Cos):

CO 1. Clear understanding of the basic concepts and principles of Thermal and Hyperspectral Remote Sensing.
CO 2. Students will interpret Hyperspectral and thermal infrared imagery.
CO 3. Students will understand difference between thermal and hyperspectral data.
CO 4. Students will use Hyperspectral and Thermal Remote Sensing knowledge to solve Geographical problems

UNIT 1: Introduction to Thermal Remote Sensing **(15 hours)**

1.1 Definition and Principles of Thermal Remote Sensing
1.2 Characteristics of thermal infrared radiation
1.3 Platforms and sensors used in thermal remote sensing
1.4 Basic Principles of thermal emission - Planck's law and Stefan-Boltzmann law

UNIT 2: Thermal image interpretation and Analysis **(15 hours)**

2.1 Spectral properties of materials in the thermal infrared region
2.2 Preprocessing of Thermal Imagery
2.3 Interpretation of thermal infrared imagery
2.4 Thermal infrared remote sensing in hydrology and water resources management

UNIT 4: Hyperspectral Remote Sensing **(15 hours)**

4.1 Introduction – Spectroscopy- Hyperspectral Remote Sensing
4.2 Hyper-spectral satellite systems: Sensors, orbit characteristics, description of satellite Systems
4.3 The Airborne visible/infrared Imaging spectrometer
4.4 Data Processing techniques – The image cube, Spectral Matching, Spectral Mixing analysis- Spectral Angle mapping

UNIT 4: Hyperspectral Remote Sensing Applications **(15 hours)**

4.1 Vegetation mapping / LULC
4.3 Soil mappings
4.3 Water

4.4 Urban mapping

Suggested Reading Materials:

1. Borengasser, M., W.S. Hungate, and R.Wadkins, 2004. Hyperspectral Remote Sensing: Principles and Applications. CRC Press, ISBN-10: 1566706548, ISBN-13: 9781566706544
2. Campbell, J. B. (2007). Introduction to remote sensing (4th ed.). Guilford Press.
3. Chander, G., & Markham, B. (2003). Revised Landsat-5 TM radiometric calibration procedures and postcalibration dynamic ranges. IEEE Transactions on Geoscience and Remote Sensing, 41(11), 2674-2677.
4. Dimitris G. M, Ronald B. L, Thomas W.C (2016) Hyperspectral Imaging Remote Sensing: Physics, Sensors, and Algorithms, Cambridge University Press, ISBN-13: 978-1107083660.
5. Eismann, M.T., 2012. Hyperspectral Remote Sensing, ISBN: 9780819487872
6. Freek van der Meer and Steven de Jong, 2001. Imaging Spectrometry: Basic Principles and Prospective Applications. Springer Academic Publishers, ISBN 1-4020-0194-0.
7. Kalacska, M., and G.A. Sanchez-Azofeifa, 2008. Hyperspectral Remote Sensing of Tropical and Sub-Tropical Forests. CRC Press, ISBN: 9781420053418
8. Kaufman, Y. J., & Wald, A. E. (Eds.). (2012). Thermal infrared remote sensing: Sensors, methods, applications. Springer.
9. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2014). Remote sensing and image interpretation (7th ed.). Wiley.
10. Thenkabail, P.S., J. G. Lyon, and A. Huete, 2011. Hyperspectral Remote Sensing of Vegetation. CRC Press, ISBN: 9781439845370
11. Weng, Q. (2012). Remote Sensing and GIS Integration: Theories, Methods, and Applications. McGraw-Hill Education.

M.A. / M.Sc. Geography

Semester IV

Semester IV

Title of the Course – Advanced Studies in Physical Geography - IV								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC - 4	GEOG 607	04	00	04	60	50	50	100

Course Objectives:

1. To impart knowledge about the mechanics of geohazards.
2. To reveal the tools and techniques of disaster management.
3. To introduce aspects of soil science and biogeography.
4. To impart the knowledge of chemical processes of ocean and climate change.
5. To introduce various concepts of groundwater to students.
6. To understand the monitoring methods of ground water.

Course Outcomes (Cos):

CO 1. To know the applications of Geomorphology in the management of geohazards.
CO 2. After completion of this paper, students will gain concepts in soil science and aspects of global biogeography.
CO 3. Understand the various linkages of ocean and climate.
CO 4. Students will understand various concepts related to groundwater hydrology.

Detailed Syllabus:

UNIT 1: Geohazards (15 hours)

1.1 Understanding and management of hazards – Earthquakes, tsunami, volcanos
1.2 Understanding and management of hazards – Floods and drought
1.3 Understanding and management of hazards – mass movements
1.4 Impact of anthropogenic activities on geomorphic setups and climate

UNIT 2: Global Soils and Global Biogeography: (15 hours)

2.1 The nature of the soil- Introducing the soil, Soli color and texture, soil structure; Soil chemistry- Acidity and alkalinity, soil colloids, mineral alteration; Soil moisture- Soil-water storage, soil water balance.
2.2 Soil development- Soil horizon, soil forming processes, factors of soil formation; The Global scope of Soils- Soils characterized by maturity, Soils characterized by climate, Soils characterized by parent materials, soils high in organic matters
2.3 Exploitation of the low latitude rainforest ecosystem, natural vegetation, structure and life form of plants, terrestrial ecosystems- The biomes: Biomes, formation classes, and climate.
2.4 Forest Biome: Low latitude rainforest, monsoon forest, subtropical evergreen forest, midlatitude deciduous forest, needleleaf forest, sclerophyll forest, deforestation; Savanna and grassland biomes; Dessert and Tundra biomes.

UNIT 3: Ocean-climate change (15 hours)

3.1 Ocean acidification – trends, issues of ocean acidification
3.2 Ocean deoxygenation- impacts
3.3 Chemical equilibria
3.4 Nutrient cycling and isotropic anomalies

UNIT 4: Groundwater (15 hours)

4.1 Darcy's Law
4.2 Water resources management in a changing world
4.3 Wells: cavity formation in open wells- Springs: formation and types
4.4 Groundwater monitoring network in India-Sea water intrusion

Suggested reading materials:

1. Abate, R. (2015). *Climate Change Impacts on Ocean and Coastal Law: U.S. and International Perspectives*. Oxford University Press, USA.
2. Alan H. Strahler. (2013). Introducing Physical Geography (6th ed.). John Wiley & Sons.
3. Dingman, S. L. (2015). *Physical Hydrology, 2nd edition, Prentice Hall.*
4. Edward J. Tarbuck, Frederick K. Lutgens, & Dennis G. Tasa. (2014). Earth Science (14th ed.). Pearson Education.
5. Frederick K. Lutgens, & Edward J. Tarbuck. (2013). The Atmosphere An Introduction to Meteorology (12th ed.). Pearson.
6. Geiger, W. F. (1987). *Manual on Drainage in Urbanized Areas: Planning and design of drainage systems*. UNESCO.
7. Grigg, N. S. (1986). Urban water infrastructure: planning, management, and operations. In *Krieger Pub. Co. eBooks*. https://ci.nii.ac.jp/ncid/BA31652848
8. Hengeveld, H., & De Vocht, C. (1982). Role of water in urban ecology. *Urban Ecology*, *6*(1–4), 5–347. https://doi.org/10.1016/0304-4009(82)90022-5
9. Hornberger, G. M., Wiberg, P. L., Raffensperger, J. P., & D'Odorico, P. (2014). *Elements of Physical Hydrology*. The Jhon Hopkins University Press, Maryland, USA.
10. James Petersen, Dorothy Sack, & Robert E. Gabler. (2011). Fundamentals of Physical Geography (1st ed.). Brooks/Cole.
11. Joseph Holden. (2010). An Introduction to Physical Geography and the Environment (2nd ed.). Pearson Education, Limited.
12. López-Carresi, A., Fordham, M., Wisner, B., Kelman, I., & Gaillard, J. (2013). Disaster Management. Routledge.
13. Madu, C. N., & Kuei, C. H. (2017). Handbook of Disaster Risk Reduction & Management. World Scientific Publishing Company.
14. Overton, D. E., & Meadows, M. E. (2013). *Stormwater Modeling*. Elsevier.
15. Ranke, U. (2015). Natural Disaster Risk Management. Springer.
16. Robert E. Gabler, James F. Petersen, & L. Michael Trapasso. (2007). Essentials of Physical Geography (8th ed.). Thomson Brooks/Cole.
17. Singh, V. P. (1992). *Elementary Hydrology*. *Pearson College Division.*
18. Subramanya, K. (2013). *Engineering Hydrology*, *Tata Mc-Graw Hill.*
19. Subramanian, R. (n.d.). Disaster Management. Vikas Publishing House.
20. Todd, D. K., & Mays, L. W. (2004). *Groundwater Hydrology*. John Wiley & Sons.
21. Viessman, W., & Lewis, G. L. (2003). *Introduction to Hydrology*. Pearson.
22. Warner, R., & Schofield, C. H. (2012). *Climate Change and the Oceans: Gauging the Legal and Policy Currents in the Asia Pacific and Beyond*. Edward Elgar Publishing.
23. Zielinski, T., Weslawski, M., & Kuliński, K. (2015). *Impact of Climate Changes on Marine Environments*. Springer.

Title of the Course – Advanced Studies in Human Geography IV								
Year – 2				**Semester – IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC 4	GEOG 608	04	00	04	60	50	50	100

Course Objectives:

1. To provide students with a comprehensive understanding of the physical geography of India, including its landforms, climate, soil, and natural resources.
2. To examine the human geography of India, focusing on population distribution, urbanization, cultural patterns, and economic activities.
3. To enable students to conduct in-depth regional analyses of different parts of India, understanding their unique geographical characteristics and challenges.
4. To foster awareness about contemporary issues and sustainable development practices in the Indian context, highlighting the interrelationship between human activities and the environment.

Course Outcomes:

CO 1. Students will be able to identify and describe the major physical features of India, including mountain ranges, rivers, plateaus, and coastal regions.
CO 2. Students will be able to analyze and explain the population distribution, demographic trends in India.
CO 3. Students will gain insights into the regional variations in economic activities across India, understanding how geography influences agriculture, industry, and transport.
CO 4. Students will develop the skills to assess environmental issues such as deforestation, pollution, and climate change in India, and understand its implications.

UNIT 1: India: Location, Physiography and Climate (15 Hours)

1.1. India-Location, size, extent and Space relationship with neighboring countries
1.2 Major Physiographic Regions and their Characteristics.
1.3 Drainage System (Himalayan and Peninsular).
1.4 Climate: Seasonal Weather Characteristics, Climatic Divisions, Indian Monsoon (mechanism and characteristics), Jet Streams and Himalayan Cryosphere

UNIT 2: Resources and Agriculture of India (15 Hours)

2.1. Types and Distribution of Natural Resources: Soil, Vegetation, Water, Mineral and Marine Resources.
2.2. Agriculture (Production, Productivity and Yield of Major Food Crops)
2.3. Major Crop Regions, Regional Variations in Agricultural Development, Environmental, Technological and Institutional Factors affecting Indian Agriculture
2.4. Agro-Climatic Zones, Green Revolution, Food Security and Right to Food

UNIT 3: Industries and Transportation of India (15 Hours)

3.1 Industrial Development since Independence
3.2. Industrial Regions and their characteristics, Industrial Policies in India
3.3 Development and Patterns of Transport Networks (railways, roadways, waterways, airways and

pipelines)
3.4 Internal and External Trade (trend, composition and directions)

UNIT 4: Population, Regional Development and Contemporary issues in India (15 Hours)

4.1. Population Characteristics (spatial patterns of distribution)
4.2. Growth and Composition (rural-urban, age, sex, occupational, educational, ethnic and religious), Determinants of Population, Population Policies in India
4.3 Development Planning in India, Globalization and its impact on Indian Economy
4.4 Natural Disasters in India (Earthquake, Drought, Flood, Cyclone, Tsunami, Himalayan Highland Hazards and Disasters.)

Suggested reading materials:

1. Gautam, A. (2006): Advanced Geography of India, Sharda Pustak Bhawan, Allahabad
2. Johnson, B.L.C. (1963): Development in South Asia. Penguin Books, Harmondsworth
3. Krishnan, M.S. (1982): Geology of India and Burma, CAS Publishers and Distributors, Delhi.
4. Khullar, D.R. (2007): India: A Comprehensive Geography, Kalyani Publishers, New Delhi
5. Nag, P. and Gupta, S. S. (1992): Geography of India, Concept Publishing Company, New Delhi.
6. Rao, B.P. (2007): Bharat kee Bhaugolik Sameeksha, Vasundhara Prakashan, Gorakhpur.
7. Sharma, T.C. and Coutinho, O. (2003): Economic and Commercial Geography of India, Vikas Publishing House Private Ltd. New Delhi.
8. Singh , J. (2003): India: A Comprehensive Systematic Geography. Gyanodaya Prakashan, Gorakhpur
9. Singh, J. (2001): Bharat: Bhougolik Aadhar Avam Ayam, Gyanodaya Prakashan, Gorakhpur.
10. Singh, R.L. (ed.) (1971): India: A Regional Geography. National Geographical Society of India, Varanasi.
11. Spate, O.H. K., Learmonth A. T. A. and Farmer, B. H. (1996): India, Pakistan and Sri Lanka. Methuen, London, 7th edition.
12. SukhwaI, B.L. (1987): India: Economic Resource Base and Contemporary Political Patterns. Sterling Publication, New Delhi
13. Tiwari, R.C. (2007): Geography of India, Prayag Pustak Bhawan, Allahabad.
14. Wadia, D. N. (1959): Geology of India. Mac-Millan and Company, London and student edition, Madras.

Title of the Course – Tools and Techniques of Geographical Analysis III								
Year – 2				**Semester – IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC 4	GEOG 609	04	00	04	60	50	50	100

Course Objectives:

1. Main objective is to get acquainted with various geographical tools useful for analysis of various physical and human aspects and representation of data.

Course Outcomes:

CO 1. The students are expected to learn how various geographical tools can be used for geographical analysis, representation of data and application of special data.

CO 2. Students will get acquainted with various techniques like geomorphic, analysis of climatic data, representation and application of special data.

Unit I : Regression Analysis using SPSS software

1.1 Testing relationship between variables

1.2 Linear Regression – Simple Linear regression,

1.3 Multiple Linear regression,

1.4 Regression residuals and mapping and interpretation

Unit 2: Cluster and Factor Analysis using SPSS software

2.1 Cluster Analysis: Hierarchical cluster analysis, K means cluster analysis,

2.2 Factor analysis / Principal Components analysis

Based on Specialisation Physical Geography and Earth Systems

Unit 3: Hazard Analysis for Earthquakes and Floods (30 hours)

3.1 Epicentral plots with tectonic elements - spatial distribution, source regions (using QGIS and Excel)

3.2 Analysis of earthquake records – data download, cleaning and time series plots (using QGIS and Excel)

3.3 Delineating flood-prone areas on Google images, maps and reference to field data

3.4 Rapid visual survey of built structures for vulnerability to floods

3.4 Calculation of drought indices – PDSI, SPI

Unit 4: Hazard Analysis for Landslides and Preparation of Disaster Management Plan (30 hours)

4.1 Identification and delineation of landslide-prone areas on Google images, maps and reference to field data

4.2 Rapid visual survey of built structures for vulnerability to landslides

4.3 Preparedness for local-level hazards – survey
4.4 Preparation of disaster management plan

Based on specialisations Urban and Regional Planning, Climate Change and Sustainability Studies and Human Geography and Human Ecology

Unit 3: GIS and Planning (30 hours)
3.1 Network analysis for urban transport analysis, Proximity analysis and site suitability analysis
3.2 Urban utility mapping, Crime mapping, Safety and security
3.3 Use of various models for change predictions in population, resources, etc.
3.4 Natural environmental resource mapping

Unit 4: Making of various base maps and plans for planning using GIS and Remote sensing data (30 hours)
4.1 Remote sensing data sets – validations and usage for creating various layers of information
4.2 Land Information System – cadastral mapping and finalization – creation of base maps
4.3 Data representations and visualization techniques – Maps, Graphs, creative diagrams, etc.
4.4 Use of various software like DIA for diagram making software

Based on specialization Geospatial Technology

Unit 3 : Introduction to python, data structures and basic libraries: (30 Hours)
3.1 Python data types, variables, expressions, statements, functions, Iteration, and data manipulation
3.2 Exercise on python data structures: Strings, Lists, Tuples, Dictionaries and files.
3.3 Introduction to python libraries, exercise on Linear Algebra and NumPy; Exercise on Matplotlib and statistical plotting.

Unit 4. Scientific Geocomputing with Python: (30 Hours)
4.1 Introduction libraries for spatial data handling in python programming- GDAL, matplotlib, NumPy, rasterio, Python Imaging Library (PIL), OGR, OSR, geopandas, pandas, pyproj and related libraries.
4.2 Exercise on writing algorithms with integration of scientific open-source libraries for spatial data handling in python programming-
4.2.1 Geoprocessing with raster data- Multispectral Satellite Image, Digital Elevation Model, etc. and
4.2.2 Geoprocessing with vector data- Shape file, etc.

Suggested Reading Materials:

1. Hilton, P. et.al (2012): SPSS Explained, Rutledge, London.
2. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis A Reader in Statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.
3. Levin, J. (1973): Elementary Statistics in Social Research, Harper and Row, New York
4. Yeates, W.M.(1974): An Introduction to Quantative Analysis in Human Geography, McGraw Hill, New York.
5. Norcliff, G.B.(1982):Inferential Statistics for Geographers, Hutchinson, London.
6. Cressie, N.(1991): Statistics for Spatial Data, John Wiley and Sons, New York
7. Gregory. S. (1971): Statistical Methods in Geography. Longman, London
8. Taylor, P.J. (1977): Quantitative Methods in Geography, Houghton and Mifflin co, Boston
9. Yeates, M. (1974): An Introduction to Quantitative Analysis in Economic Geography, McGraw Hill Book Co., New York

10. Yeates, M. (1974): An Introduction to Quantitative Analysis in Human Geography, McGraw Hill Book Co., New York
11. Mahmood Aslam.(1977): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi
12. Ashis Sarkar (2015); Practical Geography A Systematic ApproachOrient Blackswan Pvt,Ltd. Hyderabad, Third Edition.
13. R. B. Mandal (1982), Statistics for Geographers and Social Scientist, Concept Publication Company Pvt. Ltd. New Delhi-110059
14. Dr. Shrikant Karlekar, Dr. Mohan kale ((2006), Stastical Analysis of Geographical Data, Diamond Publication Pune 30.
15. R.L.Singh (1992), Elements of Practical Geography, Kalyani Publisher, New Delhi-110002
16. Prijushkanti Saha, Partha Basu (2004) Advanced Practical Geography, Arunabha Sen Books and Allied (P0 Ltd.Kolkata- 700009
17. Markandey, K. and simhadri, S. (2009): Urban Environment and Geoinformatics, Rawat Publications. ISBN 10-8131602567, 13-978-8131602560.
18. Martin, D. (1996): Geographical Information Systems: Socio-economic Applications, (2nd Edition), Routlege, London and New York.
19. Masser, Ian (1998): Government and Geographical Information Systems,Taylor & Francis Group, London
20. Morain, Star (1998): GIS Solutions in Natural Resource management: balancing the Technical-Political Equations, Onward Press, London.
21. Nathawat MS (ed), (2008), Geoinformatics for Decentralized Planning and Governance, Rawat Publications, Jaipur
22. Nyerges, T. and Jankowaski, P. (2010): Regional and Urban GIS: A Decision Support Approach; Rawat Publication. ISBN: 9788131603697, 8131603695.
23. Obermeyer, Nancy J. and Jeffrey K. Pinto (1995): Managing Geographical Information Systems, The Guilford Press, New york.
24. Pamuk, Ayse, (2006), Mapping Global Cities: GIS Methods in Urban Analysis, ESRI Press, Redlands, California.
25. Pickles, John (Ed.) (1995): Ground Truth : The Social Implications of Geographical Information Systems, The Guilford Press, New York.
26. Allen Downey. (2012). *Think Python- How to Think Like a Computer Scientist* (Version 2.0.17). Green Tea Press .
27. Christine Garrard. (2016). *Geoprocessing with Python*. Manning.
28. Erik Westra. (2013). *Python Geospatial Development, Second Edition* (Second). Packt Publishing.
29. Fabrizio Romano. (2015). *Learning Python Learn to Code Like a Professional with Python - an Open Source, Versatile, and Powerful Programming Language*. Packt Publishing.
30. Göktürk Üçoluk, S. K. (2012). *Introduction to Programming Concepts with Case Studies in Python* (First). Springer.
31. Joel Lawhead. (2017). *QGIS Python Programming Cookbook* (Second Edition). Packt Publishing.
32. John Guttag. (2016). *Introduction to Computation and Programming Using Python* (Second). MIT Press.
33. Scott Shell. (2014). *An introduction to Numpy and Scipy*.

Title of the Course – Dissertation								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSC - 4	GEOG 610	**Theory**	**Practical**	06	90	**CIE**	**ESE**	**Total**
		04	00			0	150	150

Course Objectives:

1. The research project would be conducted to developing critical thinking, deep understanding about the geographical issues and problems

Course Outcomes:

CO 1. Students should able to develop critical thinking, develop scientific aptitude and knowledge to understand, analyse and resolve the given research problem and emerge with appropriate solutions for the society

The students are expected to complete following tasks

1. Compilation and finalisation of primary data,
2. Processing and Visualisation of data
3. Analysis and interpretation of data
4. Critical evaluation of the findings and understanding the emerging trends and patterns
5. Completion of thesis
6. Finalisation and Presentation of research

Specialisation I : Physical Geography and Earth Systems

<table>
<tr><td colspan="9">Title of the Course – Soil and River Basin Management</td></tr>
<tr><td colspan="4">Year - 2</td><td colspan="5">Semester - IV</td></tr>
<tr><td>Course Type</td><td>Course code</td><td colspan="2">Credit Distribution</td><td>Credits</td><td>Allotted Hours</td><td colspan="3">Allotted Marks</td></tr>
<tr><td rowspan="2">DSE - 4</td><td rowspan="2">GEOG 61101</td><td>Theory</td><td>Practical</td><td rowspan="2">04</td><td rowspan="2">60</td><td>CIE</td><td>ESE</td><td>Total</td></tr>
<tr><td>04</td><td>00</td><td>50</td><td>50</td><td>100</td></tr>
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Course Objectives:

1. To introduce in depth soil and river basin characteristics and their application in applied geomorphology.

Course Outcomes:

After completion of the course, student will be able to explain;

CO 1. Soil formation, its properties, characteristics and constituents.

CO 2. River basin characteristics.

CO 3. Integrate the soil and river basin characteristics to solve the real-world problems.

Unit 1. Process of Soil formation: (15 hours)

1.1 Soil, Weathering and Pedogenesis

1.2 Soil formers - Physical: parent rock/ material, time, topography and climate; Role of biotic factors

1.3 Soil profile - idealized profile – master horizons and sub horizons, soil profile of tropical soils

1.4 Concept of soil catena

Unit 2. Properties, characteristics and constituents of soils: (15 hours)

2.1 Physical properties of Soils: Texture, Structure, Moisture, Colour, Bulk density, Porosity and Permeability, Water holding capacity, Field capacity and Wilting point

2.2 Soil constituents - organic and inorganic matter, soil organisms, soil air and water, Soil pH

2.3 Soil Classification – Genetic and Soil taxonomy

2.4 Soil fertility in tropics - nutrients, soil capability, suitability and productivity

Unit 3. River basin characteristics: (15 hours)

3.1 River Basin and its Geometric Characteristics: area, Shape, Relief

3.2 Drainage Network- Typology of Flow, Typology of Drainage, Topology of the Drainage Network, The Orders of a River, Characteristic Lengths and Slopes, The Development of the Drainage Network, Laws of Drainage Network Composition, Hack's Law,

3.3 Agro-Pedo Geological Characteristics: Soil Cover, Soil Type, Geology

3.4 Metrological Factors influencing Evaporation- Physical Factors involved in Evaporation Process

Unit 4. Integration- Soils and River Basin: (15 hours)

4.1 USLE for Soil degradation and erosion - causes and consequences, sediment yield

4.2 Prioritization of watershed, soil erosion models

4.3 Methods of soil and watershed conservation, Soils and environmental problems, Need for Soil conservation and Soil resource management in India

4.4 Trends in farming techniques Vermiculture, organic fertilizers, bio-pesticides, drip Irrigation.

Suggested Reading Materials:

1. Alatorre, L. C., & Begueria, S. (2009). Identification of eroded areas using remote sensing in a badlands landscape on marls in the central Spanish Pyrenees. *CATENA*, *76*(3), 182–190. https://doi.org/10.1016/j.catena.2008.11.005
2. Alfred Wirthmann. (1987). *Geomorphology of the Tropics*. Springer-Verlag.
3. André Musy, & Christophe Higy. (2011). *HYDROLOGY A Science of Nature* (First). CRC press.
4. Atkinson, P. (2002). Spatial Statistics. In A. Stein, F. Meer, & B. Gorte (Eds.), *Spatial Statistics for Remote Sensing* (Vol. 1, pp. 57–81). Springer Netherlands. https://doi.org/10.1007/0-306-47647-9_5
5. Avijit Gupta. (2011). *Tropical Geomorphology*. Cambridge University Press.
6. Bridges, E. M. (1970). *World Soils*. Cambridge University Press, U.K.
7. Bryan, R., & Yair, A. (1982). Badland geomorphology and piping. In *In Geo books* (pp. 1–11). University Press Cambridge.
8. Daji, J. A. (1970). *A Text Book of Soil Science*. Asia Publication House.
9. Datye, V. S. (1987). *Explorations in the Tropics*. Prof. K. R. Dikshit Fel. Vol.
10. De, N. K., & Sarkar, H. K. (1993). *Soil Geography*. Sribhumi Publishing Company.
11. Dohahue, E. L. (1987). *Soils: An Introduction to Soil and Plant Growth*. Prentice Hall of India.
12. Foth, H. D., & Schafer, F. W. (1980). *Soil Geography and Landuse*. John Wiley & Sons, Inc., Canada.
13. Foth, H. D., & Turk, L. M. (1972). *Fundamentals of Soil Science*. John Wiley & Sons, Inc., Canada.
14. G. Mathias Kondolf, & Hervé Piégay. (2016). *Tools in Fluvial Geomorphology* (First). Wiley.
15. Joseph, G. (2008). *Fundamentals of remote sensing* (Second). Universities press (India) private limited.
16. Kale, V. S., & Gupta, A. (2001). Introduction to geomorphology. *Orient Longman Ltd*.
17. Kerle, N., Heuel, S., & Pfeiffer, N. (2008). *Real-time data collection and information generation using airborne sensors* (pp. 43–74).
18. Leopold, L. P., Wolman, M. G., & Miller, J. P. (1964). *Fluvial process in geomorphology*. Eurasia publishing house.
19. Li, Z., Zhu, Q., & Gold, C. (2004). *Digital Terrain Modeling: Principles and Methodology*. CRC Press.
20. Longley, P. A., Googdchild, M. F., Maguire, D. J., & Rhind, D. W. (2005). *Geographical information systems* (Second). John Wiley & Sons, Inc.
21. Mastin, M. C. (2002). Flood-hazard mapping in Honduras in response to Hurricane Mitch. In *Water-Resources Investigations Report*. https://doi.org/10.3133/wri014277
22. Michael A. Summerfield. (2014). *Global Geomorphology*. Taylor & Francis.
23. Michael F. Thomas. (1994). *Geomorphology in the Tropics A Study of Weathering and Denuation in Low Latitudes*. Wiley.
24. Miller, R. W. (1995). *Soil in Our Environment*. Prentice Hall, U.S.A.
25. Nsangou, D., Kpoumié, A., Mfonka, Z., Ngouh, A. N., Fossi, D. H., Jourdan, C., Mbele, H. Z., Mouncherou, O. F., Vandervaere, J.-P., & Ndam Ngoupayou, J. R. (2022). Urban flood susceptibility modelling using AHP and GIS approach: case of the Mfoundi watershed at Yaoundé in the South-Cameroon plateau. *Scientific African*, *15*, e01043. https://doi.org/https://doi.org/10.1016/j.sciaf.2021.e01043
26. Otto Huisman, & Rolf A. de By. (2009). *Principles of Geographic Information Systems- An introductory textbook*. The International Institute for Geo-Information Science and Earth Observation (ITC),.
27. Paton, T. R., Humphreys, G. S., & Mitchell, P. B. (1995). *Soils: A New Global View*.
28. Peter W. Birkeland. (1984). *Soils and Geomorphology*. Oxford University Press.

29. Pitty, A. F. (1978). *Geography and Soil Properties*. Methuen and Co. Ltd.
30. Randall Schaetzl, & Sharon Anderson. (2005). *Soils Genesis and Geomorphology*. Cambridge University Press.
31. Ravi Shankar Dwivedi. (2017). *Remote Sensing of Soils* (First). Springer.
32. Raychaudhari, S. P. (1958). *Soils of India*. ICAR.
33. Richard J. Huggett. (2011). *Fundamentals of Geomorphology*. Routledge.
34. Ro Charlton. (2007). *Fundamentals of Fluvial Geomorphology* (First). Taylor & Francis.
35. Tempfli, K., Kerle, N., Huurneman, G., & Janssen, L. (2009). *Principles of Remote Sensing* (4th ed.). ITC, Enschede, The Netherlands.

Zlatanova, Siyka., & Li, Jonathan. (2008). *Geospatial information technology for emergency response*. Taylor & Francis.

Title of the Course – Hydrological Modeling in a Changing Climate - IV								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61102	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To understand the role of hydrological modelling in climate change studies.
2. To differentiate between various types of hydrological models, including conceptual, empirical, and physically-based models.
3. To identify and utilize various sources of climate change data.
4. To comprehend the structure and application of climate models and scenario analysis.
5. To integrate climate change data into hydrological models for impact assessment.

Course Outcomes (Cos):

After completion of this course students will:

CO 1. Students will be able to explain the importance of hydrological modeling in climate change studies.

CO 2. Students will be able to distinguish between conceptual, empirical, and physically-based Models, and between distributed and lumped models.

CO 3. Students will demonstrate the ability to calibrate and validate hydrological models.

CO 4. Students will identify and use meteorological observations, GCMs, downscaled climate data, and remote sensing data for hydrological studies.

CO 5. Students will develop and analyze climate scenarios using RCPs and SSPs.

UNIT 1: Types of Hydrological Models **(15 hours)**

1.1 Importance of hydrological modeling in climate change studies
1.2 Conceptual, empirical, and physically-based models
1.3 Distributed vs. lumped models
1.4 Introduction to model calibration and validation techniques

UNIT 2: Sources of Climate Change Data **(15 hours)**

2.1 Meteorological observations
2.2 Global climate models (GCMs) and
2.3 Downscaled climate data
2.4 Remote sensing data for climate variables

UNIT 3: Climate Models and Scenario Analysis **(15 hours)**

3.1 Introduction to climate models and their components
3.2 Scenario development: Representative Concentration Pathways (RCPs)
3.3 Shared Socioeconomic Pathways (SSPs)
3.4 Uncertainty analysis in climate projections

UNIT 4: Hydrological Modeling and Scenario Analysis **(15 hours)**

4.1 Incorporating climate change data into hydrological models

4.2 Scenario development for hydrological impacts assessment
4.3 Sensitivity analysis and model evaluation under different climate scenarios
4.4 Case studies on hydrological modeling in a changing climate- Interpretation of modeling results and implications for water resources management

Suggested reading materials:

1. Abbaspour, K. C. (Ed.). (2015). Computer Models of Watershed Hydrology. CRC Press.
2. Arnell, N. W. (2004). Hydrology and global environmental change. Routledge.
3. Beven, K., & Kirkby, M. (2013). Environmental Modeling: An Introduction (2nd ed.). CRC Press.
4. Brekke, L. D., Kiang, J. E., Murphy, C. C. D., & Nordin, R. W. (2013). Climate change and water resources management: A federal perspective. CreateSpace Independent Publishing Platform.
5. Duan, Q., Zhang, F., & Semazzi, F. H. M. (Eds.). (2016). Handbook of hydrometeorological ensemble forecasting. Springer.
6. IPCC. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Cambridge University Press.
7. Jain, S. K., & Kumar, V. (2012). *Hydrology and water resources of India*. Springer.
8. Keskitalo, E. C. H. (Ed.). (2013). Climate change and flood risk management: Adaptation and extreme events at the local level. Edward Elgar Publishing.
9. Liu, D., & Liu, H., & Meng, X. (Eds.). (2023). *Advanced hydrologic modeling in watershed scales*. MDPI. ISBN: 978-3-0365-7115-7 (Hardback), ISBN: 978-3-0365-7114-0 (PDF). Retrieved from https://www.mdpi.com/books/reprint/7036-advanced-hydrologic-modeling-in-watershed-scales
10. Maidment, D. R. (Ed.). (2000). Handbook of Hydrology. McGraw-Hill.
11. Prudhomme, C., Greuell, R., de Gouw, J. M. L., Guzman, J. M., Kilsby, E., Lenderink, G., & Jones, R. G. (2011). Modelling the impact of climate change on water resources. International Association of Hydrological Sciences (IAHS).
12. Singh, V. P. (Ed.). (2016). Handbook of applied hydrology (2nd ed.). McGraw-Hill Education.
13. Singh, V. P., & Frevert, D. K. (Eds.). (2005). Hydrologic modeling: Progress and future directions. Springer.
14. Singh, V. P. (1995). *Computer models of watershed hydrology*. Water Resources Publications.
15. Singh, S. K, Dhanya, C.T. (2019) Hydrology in a Changing World, Springer International Publishing, ISBNs, 978-3-03-002196-2, 978-3-03-002197-9
16. Tallaksen, L. M., & van Lanen, H. A. J. (2004). Hydrological drought: Processes and estimation methods for streamflow and groundwater. Elsevier.
17. Wagener, T., & Gupta, H. (2005). Model Identification for Hydrological Forecasting: Using Model Selection Criteria. Journal of Hydrology, 349(1-2), 329-349
18. Wheater, H., Sorooshian, S., & Sharma, K. D. (Eds.). (2007). Hydrological modelling in arid and semi-arid areas. Cambridge University Press.
19. Younos, T., & Grady, C. A. (Eds.). (2014). Climate change and water resources. Springer.

Title of the Course – Theoretical and Applied Geomorphology								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61103	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To enhance knowledge about the development of geomorphic thought – historical, recent and present status
2. To reveal the importance of geomorphic systems in the studies of natural hazards and natural resources.
3. To impart knowledge on applications of remote sensing and GIS in geomorphic studies.

Course Outcomes:

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

CO1. know the transitions throughout Quaternary period and related phenomenon.

CO 2. understand importance of geomorphology in managing disasters and resources.

CO 3. Apply remote sensing and GIS techniques for conservation of soil and water resources.

Unit 1: Conceptual Geomorphology (15 hours)

1.1 History and development of Geomorphology Hutton to Horton, Horton to Strahler- Hack; Space and time in Geomorphology, Time cyclic, graded and steady,

1.2 Fundamental Concepts, theories and fieldwork (field-based experiments) in Geomorphology,

1.3 Types of geomorphic systems (morphologic and cascading system); General System Theory.

1.4 Concept of equilibrium, types of equilibria; complex response and geomorphic thresholds

Unit 2: Geologic Time and Tectonics in Geomorphology (15 hours)

2.1 Quaternary geomorphology: Quaternary period and its importance in geological time, quaternary stratigraphic sequences and their importance in earth sciences, quaternary glaciation and related changes.

2.2 Tectonic geomorphology: Introduction to tectonic geomorphology, establishing time in landscape, dating methods; geomorphic and quantitative markers tectonic processes.

2.3 Seismotectonics of Indian plate: Tectonics of Indian plate, characteristics of seismogenic regions of India,

2.4 Seismic hazard and vulnerability assessment; seismic micro-zonation initiatives in India.

Unit 3: Applied Geomorphology (Resource geomorphology) (15 hours)

3.1 Soil resources: soil evolution processes, soil profile and problem of soil erosion, measures to control soil erosion

3.2 Application of remote sensing and GIS techniques for soil loss estimation: Identification of soil erosion areas in field, application of soil loss equation (RUSLE)

3.3 Water resources in India: water resources – surface and groundwater resources and types, rivers, Hydroelectric projects in India, dams and reservoirs in design and construction of canals,

field channels, underground pipelines, head-gates; occurrence of ground water

3.4 Application of remote sensing and GIS techniques for assessment of water resources for their quality and availability – surface water and groundwater

Unit 4: Applied Geomorphology (Geomorphology of Hazards) (15 hours)

4.1 Natural hazards: classifications based on origin, onset; disaster management – hazard and vulnerability assessment

4.2 Geomorphic hazards: – causes, types and controlling measures – mass movements and slope failures

4.3 Geomorphic hazards – causes, types and controlling measures - floods, droughts, desertification

4.4 Geomorphic hazards – Earthquakes, volcanos and tsunamis

References:

1. Brunsden, D. and Thornes, J.B. (1979). Landscape sensitivity and change, Transaction, Institute of British Geographers, 4:463-484.
2. Burbank, D.W. and Anderson, R. S. (2011). Tectonic Geomorphology (2nd Edition), Wiley-Blackwell publication.
3. Chorley, R. J. Schumm, S.A. and Sugden, D.E. (1984). Geomorphology, Methuen, London.
4. Chorley, R.J. (1962). Geomorphology and General System Theory, U.S. Professional Paper 500 B.
5. Goudie, A. (2013). Encyclopedia of Geomorphology. Routledge, London.
6. Hails, J.R. (1977). Applied Geomorphology. Elsevier, Amsterdam.
7. Hart, M.G. (1986). Geomorphology, Pure and Applied. George Allen and Unwin, London.
8. Kenzer. (2013). Applied Geography: Issues, Questions, and Concerns. Springer Science & Business Media.
9. Narula, P.L., Acharyya, S.K. and Banerjee, J. (Edts.) (2000). Seismotectonic Atlas of India and its Environs, Geological Survey of India, Delhi.
10. Pitty, A. F. (2020). The Nature of Geomorphology. Routledge.
11. Schumm, S.A. and Litchy, R.W. (1965). Time, space and causality in geomorphology, American Journal of Science, 263: 110-119.
12. Stoddart, D. (2013). Process and Form in Geomorphology. Routledge.
13. Wolman, M.G and Miller, W.P. (1960). Magnitude and frequency of forces in geomorphic processes, Journal of Geology, 68: 54-74.

Title of the Course – Floods and Drought hazards and management								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61104	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To impart knowledge on flood and drought hazard assessment
2. To give an idea about flood hazard analysis techniques
3. To give an idea about drought indices and hazard analysis techniques
4. To enhance the understanding of the flood and drought-prone regions of India and levels of preparedness therein

Course Outcomes:

CO 1. perform flood estimation, delineate flood-prone areas
CO 2. apply drought indices for automated analysis using GIS packages
CO 3. understand the severity of floods and droughts in India

Unit 1: Floods – classifications, estimation and forecasting (15 hours)

1.1 Floods: Types based on causes, based on relative magnitude (probable maximum flood, standard project flood, design flood, extreme events, spatio-temporal scales of flood-causing mechanisms, climate change and floods
1.2 Estimation of floods: need for flood estimations, methods of estimation (rational, empirical flood-frequency analysis, unit hydrograph method, watershed modelling)
1.3 Flood statistics: flood frequency methods – log normal, Gumbel's extreme value, Log – Pearson type – III distribution, depth-area analysis
1.4 Flood forecasting. Flood routing-channel routing, Muskingum method, reservoir routing, Modified Pul's method;

Unit 2: Flood Management: Hazard and Vulnerability Assessment (15 hours)

2.1 Flood hazard assessment – GIS-based hydraulic modeling and floodplain mapping using GIS packages, uncertainty in flood hazard and risk assessment
2.2 Flood vulnerability assessment – GIS-based physical and non-physical vulnerability assessment
2.3 Flood control measures – Structural and non-structural
2.4 Flood-prone regions of India, flood policies in India

Unit 3: Drought – classifications, estimation and forecasting (15 hours)

3.1 Drought – definition, causes and characteristics, sequence of drought occurrence; types of drought (*meteorological*, *hydrological*, *agricultural*, and *socioeconomic*), climate change and droughts
3.2 Drought hazard assessment – indices based on meteorological data (PDSI, CMI, SPI, EDI, SWSI, DIs, percentage of Normal and other rainfall deficiency indices)
3.3 Drought hazard assessment – indices based on flow data, low-flow analysis
3.4 GIS-based automated drought analysis using suitable packages (Spatsim package)

Unit 4: Drought Management: Hazard and Vulnerability Assessment (15 hours)

4.1 Drought vulnerability, Factors of vulnerability assessment – socio-economic, hydrological, land, dimensions of vulnerability and impact

4.2 Exposure to drought and risk assessment, impact of drought,

4.3 Drought mitigation measures and preparedness

4.4 Drought-prone regions of India, drought policies in India, levels of preparedness in various regions

Suggested Reading Materials:

1. Bagchi, K. S. (1991). *Drought-prone India*.
2. Balica, S. F. (2012). *Applying the Flood Vulnerability Index as a Knowledge Base for Flood Risk Assessment*. CRC Press.
3. Botterill, L. C., & Wilhite, D. A. (2005). *From Disaster Response to Risk Management*. Springer Science & Business Media.
4. Carmo, J. S. a. D. (2018). *Natural Hazards*. BoD – Books on Demand.
5. Di Baldassarre, G. (2012). *Floods in a Changing Climate*. Cambridge University Press.
6. French, R. H., & Miller, J. J. (2012). *Flood Hazard Identification and Mitigation in Semi- and Arid Environments*. World Scientific.
7. Iglesias, A., Garrote, L., Cancelliere, A., Cubillo, F., & Wilhite, D. A. (2009). *Coping with Drought Risk in Agriculture and Water Supply Systems*. Springer Science & Business Media.
8. Lamond, J., Booth, C., Hammond, F., & Proverbs, D. (2011). *Flood Hazards*. CRC Press.
9. Mathur, K., & Jayal, N. G. (1993). *Drought, Policy, and Politics in India*.
10. Mukolwe, M. M. (2017). *Flood Hazard Mapping: Uncertainty and its Value in the Decision-making Process*. CRC Press.
11. Paron, P. (2023). *Hydro-Meteorological Hazards, Risks, and Disasters*. Elsevier.
12. Sabha, I. P. L. (1955). *Floods in India*.
13. Schanze, J., Zeman, E., & Marsalek, J. (2007). *Flood Risk Management: Hazards, Vulnerability and Mitigation Measures*. Springer Science & Business Media.
14. Schanze, J., Zeman, E., & Marsalek, J. (2007b). *Flood Risk Management: Hazards, Vulnerability and Mitigation Measures*. Springer Science & Business Media.
15. Şen, Z. (2017). *Flood Modeling, Prediction and Mitigation*. Springer.
16. Smakhtin, V. U., & Hughes, D. A. (2004). *Review, automated estimation and analyses of drought indices in South Asia*. IWMI.
17. Speed, R., Tickner, D., Gang, L., Sayers, P., Yu, W., Yuanyuan, L., Moncrieff, C., Pegram, G., Jianqiang, L., Xiangyu, X., Aihua, L., & Bing, Q. (2016). *Drought risk management: a strategic approach*. UNESCO Publishing.
18. Svoboda, M. D., & Fuchs, B. A. (2016). *Handbook of Drought Indicators and Indices*.
19. Vazhacharickal, P. J., Raju, A., & Thomas, G. (n.d.). *Role of Information Technology in Flood Disaster Management in Kerala: a Brief Overview*. Prem Jose.

Specialisation II : Urban and Regional Planning

Title of the Course – Urban and Regional Transport Planning								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE – 4	GEOG 61105	04	00	04	60	50	50	100

Course Objectives:

1. To introduce the students about the important role transport plays in spatial development
2. To create expertise among the students about the analysis of transport patterns, modal choices and related analysis
3. To introduce the students about the role of technologies, like digital technologies, in the changing nature of mobilities
4. To acquaint to the students about importance of sustainable transportation in overall sustainable development

Course Outcome:

CO 1. Understanding the role of transport in development and formation of spatial pattern in development and urbanization
CO 2. Creating skill among the students of using data from different sources and using various statistical methods to analyze the data and find out the relation between various indices,
CO 3. Understanding the policies, methods and variables of transport planning for regional/urban development

Unit 1 Transport Geography (15 hours)

1.1 Introduction to transport geography – nature and scope - purpose and importance of transportation in regional and urban development – historical evolution
1.2 Transportation Systems – concepts and methods used - Sisyphus Analogy in transportation
1.3 Transportation network and urban form – topology & types of networks – networks and space – space/time relationships
1.4 Transportation and spatial organization – Global Regional and Local – influence on urban spatial structure

Unit 2 Urban Travel Patterns (15 hours)

3.1 Modal forms and diversity – modal competition – modal shift
3.2 Urban mobility patterns – evolution – types of urban mobility – urban transit
3.3 Travel behaviours and passenger mobility–factors affecting – trip generation -modal choice and modal split – trip assignment or routing – trip destination
3.4 Smart mobility – concept, forms and key principles of smart mobility – use of technologies –- integration with smart city– benefits and challenges – future of smart mobility

Unit 3 Transport Planning (15 hours)

2.1 Policy and planning – policy instruments – relevance
2.2 Transportation planning goals
2.3Transportation planning process - Digitalization of Transportation – major spheres
2.4 Transportation planning in India – National Urban Transport Policy – Integrated Transport Planning Agency (ITPA)

Unit 4 Sustainable Transportation (15 hours)

4.1 Sustainable transportation – concept and guiding principles - role of transport in sustainable development
4.2 Sustainable transport – types and sustainable mobility options – benefits
4.3 Sustainable vehicles – alternative fuels – fuel/energy efficiency – electromobility - decarbonization
4.4 Sustainable Urban Mobility Plan – goals and strategies

Suggested Reading Materials:

1. Favre, B. (2014). *Introduction to Sustainable Transports.* Wiley.
2. Hanson, S.& Genevieve, G. (ed) (2004). *The Geography of Urban Transportation.* The Guilford Press.
3. Hurst, E. (1973). *Transport Geography : Comments and Readings.* McGraw-Hill.
4. Hutton, B. (2013). *Planning Sustainable Transport.*Routledge.
5. Kansky, J. (1963). *The Structure of Transport Network.* University of Chicago.
6. Knowles, R. & Hoyle, B.S. (Ed.) (1999). *Modern Transport Geography. 2nd Edition.* Wiley. Rodrigue
7. Meyer, M.D. (2016). *Transportation Planning Handbook: Institute of Transportation Engineers.* Wiley.
8. Raza, M. & Aggarwal, Y. (1986). *Transport Geography of India.* Concept Publishing Company.
9. Rodrigue, J-P. (2024). *The Geography of Transport Systems.* Routledge.
10. Saxena, H.M. (2005). Transport Geography. Rawat Publications.
11. Taffe, E.J. & Gauthier, H.L. (1973). *Geography of Transportation.* Prentice Hall.
12. https://mohua.gov.in/upload/uploadfiles/files/TransportPolicy.pdf
13. https://www.unescap.org/blog/smart-mobility-new-paradigm-transport-services

Title of the Course – Climate Resilient and Sustainable Cities and Regions								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 4	GEOG 61106	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce the students with the concept of climate resilience, adaptation and mitigation
2. To create expertise among the students about the analysis of climate resilience framework with special reference to cities and regions

Course Outcome:

CO 1. A capacity building among the students to integrate climatic resilience in various discourses of life and profession

Unit 1 : Concepts of Urban Climate Resilience, Adaptation and Mitigation (15 hours)

1.1 Urban climate resilience - The concept of resilience – need and significance in the contemporary time – city preparedness – adaptations – risk reduction and mitigation

1.2 Guiding principals of urban resilience – integrated approach on climate proofing

1.3 Urban climate change modelling – various approaches and model building for future prediction

1.4 Strategies for adaptation and mitigation – case studies

Unit 2 : Green Infrastructure (15 hours)

2.2 Green infrastructure – origin, principles, policies and practice - Elements of urban green infrastructure – storm water management -

2.2 Different approaches to green infrastructure planning – case studies from Global North and Global South - performance, evaluation and monitoring

2.3 Green and Sustainable transportation systems – models, design and systems – policies and plans - walkability – promoting public transportation versus private transportation

2.4 Nature based solutions and designs – sponge cities – other innovations for urban climate mitigation

Unit 3 : Green Architecture (15 hours)

3.1 Green architecture – basic parameters of sustainable buildings – design, practices and technology

3.2 Indicators of green buildings – vernacular architecture and sustainability – Materials and resources and carbon footprint reduction – carbon foodprint and life cycle analysis

3.3. Sustainable outcomes guide – RIBA guide – outcome-based briefing and designing, Retrofit adaptation and reuse

3.4 Integrating low carbon designs into building architectures - micro-climate modifiers and building architecture - Rules and regulations by urban local bodies for promoting green architecture – case studies

Unit 4 : Stakeholders Engagements (15 hours)

4.1 City to city networking - production and exchange of knowledge – capacity building and

involvement of various stakeholders – local, regional and international collaborative efforts - training programmes

4.2 intra-city and inter-city governance panels - networking and funding opportunities - accelerating their urban resilience efforts – city working groups - C 40 cities

4.3 USAID's City Links Climate Partnership Program - City Strength Resilient Cities Program - Cities Development Initiative for Asia – diverge experiments – successes and failures

4.4 Role of nongovernmental organisations in building climate resilient city program – Knowledge transfer and application – case studies of NGOs like WRI, APAN, AFED, Climate Action Network, etc.

Suggested Reading Materials:

1. https://journal-buildingscities.org/articles/17/files/submission/proof/17-1-1940-2-10-20200731.pdf

2.https://pdf.sciencedirectassets.com/282307/1-s2.0-S2212095521X0003X/1-s2.0-S2212095521000882/main.pdf?X-Amz-Security

3. https://urbanclimate.gatech.edu/urban-climate-monitoring/

4.https://www.adb.org/sites/default/files/publication/149164/urban-climate-change-resilience-synopsis.pdf

5. https://www.bwsc.org/sites/default/files/2019-01/stormwater_gi_curriculum_grade_7.pdf

6.https://www.learningfornature.org/en/courses/green-infrastructure/#:~:text=Course%20topics,the%20US%2C%20and%20Latin%20America.&text=Module%204%3A%20brief%20introduction%20to,ecological%20economy%20and%20circular%20economy.

7. https://onlinecourses.nptel.ac.in/noc20_ar01/preview

8. https://study.unimelb.edu.au/find/courses/graduate/graduate-certificate-in-green-infrastructure/

9. https://study.unisa.edu.au/courses/154261

10. https://www.usgbc.org/resources/green-building-design-and-construction-curriculum-toolkit

11. https://www.architecture.com/education-cpd-and-careers/cpd/cpd-core-curriculum/sustainable-architecture

12. https://onlinecourses.nptel.ac.in/noc20_ar01/preview

13. https://sustainabledevelopment.un.org/topics/sustainabletransport

14.https://www.ukri.org/who-we-are/how-we-are-doing/research-outcomes-and-impact/sponge-cities-sustainable-places-using-nature-based-solutions/

Title of the Course – Inclusive and Liveable Cities								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 4	GEOG 61107	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce the students with the concept of inclusion and exclusion at various levels and scales in city making
2. To create expertise among the students to identify the ways and means of inclusion while planning any city or region

Course Outcome:

CO 1. A capacity building among the students to integrate climatic resilience

Unit 1 : Inequalities and Exclusions (15 hours)

1.1 Contemporary Cities – advanced economic activities vs. conventional industries sunrise and sunset industries - the 'fast' world and the 'slow' world –resulting economic disparities and social segregations – theories of social segregation

1.2 Creative Destruction – Joseph Schumpeter – Critical perspective by Harvey, McLeod, Smith and others - grandiose scale of planning – displacement, polarization and spatial purification

1.3 Geography of exclusion - forms, patterns and terrains of exclusion – spatial exclusion, social exclusion and economic exclusion

1.4 Exclusion vs. inclusion – Various approaches towards inclusive and sustainable development

Unit 2 : Inclusive Cities (15 hours)

2.1 Spatial inclusion – affordable housing – infrastructural development – accessibility to basic services and facilities – involvement of disadvantageous groups in planning - land titles and ownership

2.2 Social and economic inclusion – right to equality – equal status – participation and representation - identification of conventional and newer skills – skill based training and education – skill based employment generation – inclusion of disadvantageous groups – appropriate knowledge and technology

2.3 Strategies – multi-sector solutions - preventive and curative solutions –prioritizing investments - pro-poor policy initiatives – involvement of communities - participatory approach – partnerships at various levels - local capacity building – decentralized governance

2.4 Case Studies – Vietnam, Tanzania, Jamaica, Town and Village Enterprises (TVEs) China, India, etc.

Unit 3 : Liveable Cities (15 hours)

3.1 Urban space and gender – concept of gender budgeting – special infrastructural development for women – urban design and women safety and security – gender sensitive urban planning

3.2 Urban design, planning and various stake holders – elderly, transgender, children, physically challenged,

3.3 Public spaces – accessibility, affordability and livability - public spaces and urban poor – right to space – planning public spaces as corridors of freedom –

3.4 Planning for all – various users of public space – maintaining public goods and services – street shopping and weekly markets – neighborhood planning and mixed landuse - applying Jane Jacobs and her analysis - Case Studies from Global North and Global South

Unit 4 : Various Frameworks on Liveability and Sustainability (15 hours)

4.1 Various international frameworks and indices on measuring liveability and sustainability

4.2 Frameworks and indices on liveability in India – various policies and plan – success stories

4.3 Urban Sustainability framework – urban sustainability metrics – urban sustainability practices – case studies and examples

4.4 Urban circular economy – circularity and urban design – circular city actions framework - examples

Suggested Reading Material:

1. Florian Steinberg and Michael Lindfield (2011): *Inclusive Cities*, Urban Development Series, Asian Development Bank

2. United Nations International Strategy for Disaster Reduction, 2012 http://www.unisdr.org/we/inform/disaster-statistics

3. J. da Silva, Moench. M. 2010. The Urban Resilience Framework (URF), ISET. Arup, ISET International, Thailand Environmental Institute, Mercy Corps Indonesia, Gorakhpur Environmental Action Group. 2013. Actions on Urban Climate Resilience. ISET.

4. S. Kernaghan and J. da Silva. 2014. Initiating and sustaining action: Experiences building resilience to climate change in Asian cities, Urban Climate 7, pp. 47-63.

5. Arup. 2014, Understanding networks for cities and climate change. The Rockefeller Foundation, ACCCRN Network, Asian Development Bank.

6. A. Bahadur and T. Tanner. 2014. Transformational resilience thinking: putting people, power and politics at the heart of urban climate resilience, Environment and Urbanization, vol. 26 no. 1. pp. 200-214.

7. W. McBain, D. Wilkes, and M. Retter. 2010. Flood Resilience and Resistance for Critical Infrastructure. CIRIA C688. London, New York State Governor's Office. 2013. NYS 2100 Commission Report: Building Resilience in New York.

8. H. Reid, J. Phillips, and M. Heath. 2009. Natural resilience: healthy ecosystems as climate shock insurance. The International Institute for Environment and Development (IIED). IIED Briefing.

9. Siemens, Arup, RPA. 2013. Toolkit for Resilient Cities: Infrastructure, Technology and Urban Planning. Siemens, Arup, RPA.

10. The World Bank. 2012. Building Urban Resilience: Principles, Tools and Practice. The World Bank, Australian AID.

11. The World Bank. 2013. Building Resilience: Integrating Climate and Disaster Risk into Development. The World Bank, The Global Facility for Disaster Risk Reduction and Recovery (GFDRR).

12. https://www.researchgate.net/publication/329900145_Sustainable_Urban_Liveability_A_Practical_Proposal_Based_on_a_Composite_Indicator

Specialiation III : Climate Change and Sustainability Studies

Title of the Course – Climate Change and Adaptation in Indian Agriculture								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC – 4	GEOG-61108	04	00	04	60	50	50	100

Course Objectives:

1. To study the impact of climate change on Indian agriculture
2. To understand agricultural regionalization in India
3. To understand the models in agriculture geography and food security
4. To know Factors affecting climate of India

Course Outcomes:

CO 1. The students are expected to be very well sequential acquaintance of subject content.
CO 2. Relational aptitude develop to understand Indian agricultural development with climatic variability.
CO 3. Student are expected to develop scientific approach through logical and rational thinking about agricultural production and challenges of food security.

Unit: 1. Indian Agriculture **(15 Hours)**

1.1 Introduction to Indian Agriculture, Characteristics,
1.2 Programmes for Agriculture development,
1.3. Ancillary bases of Indian Agriculture
1.4 New dimension in Indian Agriculture

Unit: 2. Agricultural regionalization and Statistics **(15 Hours)**

2.1 Agricultural Statistics- Land utilization statistics -pattern
2.2 Data collection methods, Techniques and methods of sampling
2.3 Agriculture regionalization-delimitation of agricultural region
2.4 Argo climatical regions of India, Soil in Agro-ecological regions of India

Unit: 3. Modeling and Food security **(15 Hours)**

3.1 Modeling Approaches- land-use change models
3.2 Transformation and Adaptation in Indian Agriculture
3.3 Agricultural productivity – Problems and prospectus, Agricultural efficiency
3.4. Climate change and food security, sustainable development goals in India.

Unit: 4. Impact of Climate Change on India Agriculture **(15 Hours)**

4.1 Factors affecting climate of India, Climate and Weather Events in India
4.2 Climate Change Impacts in Indian- agriculture and allied sectors
4.3 National Innovations on Climate Resilient Agriculture (NICRA)- aims and function
4.4 Impacts of National Programmes and Policies

Suggested Reading List:

1. Akhilesh Gupta and H. Pathak (2016), Climate Change and Agriculture
2. Aman Kumar (2020), Effects of Climate Change on Agriculture, www.foodagrispectrum.org
3. Article *in* Journal of Plant Biology · 78 (lO): 911-19, November 2008
4. Bhabesh gogoi (2019), Problem, Prospect and Role of Agriculture in Rural Development in North-East India, *International Journal of Applied Social Science Volume 6 (7), July (2019) : 1944-1951*
5. Ch. Srinivasa Rao, Ravi Shankar Prasad and Trilochan Mohapatra (2019), Climate Change and Indian Agriculture: Programmes and Policy Impacts, Coping Strategies, Published by Director General Indian Council of Agricultural Research Department of Agricultural Research and Education Government of India New Delhi
6. Climate change and Food Security: Risk and Responses, Food And Agriculture Organization Of The United Nations | 2015 ISBN 978-92-5-108998-9
7. Eda Ustaoglu, Arif Çagdaş Aydinoglu (2019) Theory, Data, and Methods:A Review of Models of Land-Use Change *Gebze Technical University, Turkey* https://www.researchgate.net/publication/333118364
8. Gerald C. Nelson, Mark W. Rosegrant, September 2009, Climate Change Impact on Agriculture and Costs of Adaptation International Food Policy Research Institute Washington, D.C.
9. in India
10. Lalita Purty, Parikshita Khatua (2020) Problems and Prospects of Agriculture Marketing for Sustainable Development in India: an Analysis, Journal of Engineering Sciences, Vol11,Issue2, ISSN NO: 0377-9254
11. National Sustainable Agriculture Coalition. 2019. Agriculture and Climate Change: Policy Imperatives and Opportunities to Help Producers Meet the Challenge. Washington D.C.
12. Pkaggarwau (2008) Impact of climate change on Indian agriculture
13. *William R. Cline (2018).Global Warming and Agriculture*, Finance & Development March 2008

Title of the Course – Sustainable Oceans and Terrestrial Ecosystems								
Year – 2				**Semester - 4**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSC – 4	GEOG61109	04	00	04	60	50	50	100

Course Objectives:

1. To understand and develop critical understanding about ocean sustainability
2. To develop comprehensive understanding about terrestrial ecosystems and conservation efforts.

Course Outcomes:

CO 1. The students are expected to learn the effective models and practices that are undertaken by various stakeholders for eco-restoration and conservation.

Unit 1: Ocean Sustainability – Blue Economy (15 hours)

1.1 Concept of Ocean Sustainability – basic components in ocean sustainability
1.2 Marine spatial planning – climate smart oceans – components of sustainable oceans
1.3 Marine decarbonisation – alternative fuels – energy efficiency and optimisation – exhaust treatment and carbon capture
1.4 Marine ecosystem preservation – marine protected area – sustainable fishing – healthy oceans

Unit 2: Laws and conventions for the protection of oceans (15 hours)

2.1 UN Convention Territorial Waters, Continental Shelf, Exclusive, Economic Zone and other Maritime Zones Act, 1976 - Indian Ports Act, 1908 - Major Ports Authority Act, 2021 - Maharashtra Maritime Board Act, 1996
2.2 Indian Port Health & Indian Port Health Rules 1955, Oilfields (Regulation and Development) Act, 1948, Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008, Offshore Wind Policy, 2015
2.3 Marine Products Exports Development Act, 1972, State Marine Fisheries Regulation Act (MFRA)/ Maharashtra Marine, Fishing RegulationAct,1981, Coastal Aquaculture Authority Act, 2005
2.4 Maritime Arbitration and Alternative Dispute Resolution Modes, International Salvage Convention 1989, of 2000, SCOPIC, MARPOL, SOLAS and ISPS Code -Maritime Labour Convention 2006 - Hongkong Convention 2009 – OECD ocean policy action

Unit 3: Terrestrial Ecosystems and Biodiversity Conservation (15 hours)

3.1 Global conservation practices - International conventions and agreements on biodiversity preservation
3.2 Rules and Regulations for biodiversity preservation and conservation in India - Environment Protection Act, 1986 - Wildlife (Protection) Act, 1972 - Biodiversity Act, 2002 - Environmental Impact Assessment notification 2006 - Forest Conservation Act 1980 – wetland protection
3.3 Various conservation planning approaches – conceptual frameworks and theories of change
3.4 Conservation goals and indicators – various options for conservation management - Non intervention, remove or reduce, encourage or increase, physical protection, threat removal,

reintroduce/ reinforce, manage population, manage use, conserve ex situ, legal measures, awareness/advocacy.

Unit 4: Environmental Governance and Stakeholders engagements into conservation and sustainability (15 hours)

4.1 Elements of conservation action plan for species and ecosystems -
Feature, current status, desired condition, indicator, means of management, strategy, management actions, timing, responsibility, inputs and resources required
4.2 Environmental governance for ecosystem conservation
4.3 Identification of role of various stakeholders – community engagements in biodiversity conservations – wetland conservation – Western Ghat conservation movements
4.4 various case studies from global North and South

Suggested Reading Materials:

1. https://www.euvg.pt/2024/04/03/challenges-and-preservation-of-marine-ecosystems/
2. https://www.msc.org/for-teachers/teach-learn-about-ocean-sustainability
3. https://www.un.org/en/academic-impact/sustainable-ocean-series-education-ocean-sustainability
4. https://ocean.gatech.edu/research/ocean-sustainability
5. https://www.nature.com/articles/s44183-024-00045-x
6. https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/what-we-know/biodiversity/terrestrial-biodiversity/
7.https://www.exeter.ac.uk/study/studyinformation/modules/info/?moduleCode=BIOM4012&ay=2021/2&sys=0
8. https://www.europarc.org/wp-content/uploads/2015/12/Model-curriculum-for-Applied-biodiversity-conservation.pdf

Title of the Course – Climate Resilient and Sustainable Cities and Regions								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 4	GEOG 61110	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce the students with the concept of climate resilience, adaptation and mitigation
2. To create expertise among the students about the analysis of climate resilience framework with special reference to cities and regions

Course Outcome:

CO1. A capacity building among the students to integrate climatic resilience in urban and regional planning practices

Unit 1 : Concepts of Urban Climate Resilience, Adaptation and Mitigation (15 hours)

1.1 Urban climate resilience - The concept of resilience – need and significance in the contemporary time – city preparedness – adaptations – risk reduction and mitigation

1.2 Guiding principals of urban resilience – integrated approach on climate proofing

1.3 Urban climate change modelling – various approaches and model building for future prediction

1.4 Strategies for adaptation and mitigation – case studies

Unit 2 : Green Infrastructure (15 hours)

2.1 Green infrastructure – origin, principles, policies and practice - Elements of urban green infrastructure – storm water management -

2.2 Different approaches to green infrastructure planning – case studies from Global North and Global South - performance, evaluation and monitoring

2.3 Green and Sustainable transportation systems – models, design and systems – policies and plans - walkability – promoting public transportation versus private transportation

2.4 Nature based solutions and designs – sponge cities – other innovations for urban climate mitigation

Unit 3 : Green Architecture (15 hours)

3.1 Green architecture – basic parameters of sustainable buildings – design, practices and technology

3.2 Indicators of green buildings – vernacular architecture and sustainability – Materials and resources and carbon footprint reduction – carbon foodprint and life cycle analysis

3.3. Sustainable outcomes guide – RIBA guide – outcome based briefing and designing, Retrofit adaptation and reuse

3.4 Integrating low carbon designs into building architectures - micro-climate modifiers and building architecture - Rules and regulations by urban local bodies for promoting green architecture – case studies

Unit 4 : Stakeholders Engagements (15 hours)

4.1 City to city networking - production and exchange of knowledge – capacity building and involvement of various stakeholders – local, regional and international collaborative efforts - training programmes

4.2 intra-city and inter-city governance panels - networking and funding opportunities - accelerating their urban resilience efforts – city working groups - C 40 cities
4.3 USAID's City Links Climate Partnership Program - City Strength Resilient Cities Program - Cities Development Initiative for Asia – diverge experiments – successes and failures
4.4 Role of nongovernmental organisations in building climate resilient city program – Knowledge transfer and application – case studies of NGOs like WRI, APAN, AFED, Climate Action Network, etc.

Suggested Reading Materials:

1. https://journal-buildingscities.org/articles/17/files/submission/proof/17-1-1940-2-10-20200731.pdf
2.https://pdf.sciencedirectassets.com/282307/1-s2.0-S2212095521X0003X/1-s2.0-S2212095521000882/main.pdf?X-Amz-Security
3. https://urbanclimate.gatech.edu/urban-climate-monitoring/
4.https://www.adb.org/sites/default/files/publication/149164/urban-climate-change-resilience-synopsis.pdf
5. https://www.bwsc.org/sites/default/files/2019-01/stormwater_gi_curriculum_grade_7.pdf
6.https://www.learningfornature.org/en/courses/green-infrastructure/#:~:text=Course%20topics,the%20US%2C%20and%20Latin%20America.&text=Module%204%3A%20brief%20introduction%20to,ecological%20economy%20and%20circular%20economy.
7. https://onlinecourses.nptel.ac.in/noc20_ar01/preview
8. https://study.unimelb.edu.au/find/courses/graduate/graduate-certificate-in-green-infrastructure/
9. https://study.unisa.edu.au/courses/154261
10. https://www.usgbc.org/resources/green-building-design-and-construction-curriculum-toolkit
11. https://www.architecture.com/education-cpd-and-careers/cpd/cpd-core-curriculum/sustainable-architecture
12. https://onlinecourses.nptel.ac.in/noc20_ar01/preview
13. https://sustainabledevelopment.un.org/topics/sustainabletransport
14.https://www.ukri.org/who-we-are/how-we-are-doing/research-outcomes-and-impact/sponge-cities-sustainable-places-using-nature-based-solutions/

Speialisation IV: Human Geography and Human Ecology

Title of the Course – Political Practices, Geo-policies and Empowerment								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE – 4	GEOG - 61111	04	00	04	60	50	50	100

Course Objectives:

1. How politics can be shaped for policy making, advocacy, planning is the main objective of the course
2. To learn different methods, practices and successful models for Empowerment through political planning, policy making and effective implementation through different stake holders

Course Outcome:

CO 1. Students are expected to learn how to represent and address various issues and problems and bring them into the praxis of politics and political representation to finally get culminated for policy making through various stakeholders.

Unit 1: Fundamentals of Public Policy (15 hours)

1.1 Background, Meaning and Importance of Public Policy Basic concepts: Government, Politics, Policy Analysis
1.2 Principles of Public Policy : Moral coherent , Ethics, Economics, and Politics.
1.3 Ability to participate and influence decisions
1.4 Theories of public policy learning

Unit 2: Policy Process (15 hours)

2.1 Constitutional framework, Citizenship, fundamental rights
2.2 Directive principles of state policy and fundamental duties
2.3 The theories of policy cycle
2.4 Various tools and designs for policy formulation

Unit 3: Critical Analysis of various policies (15 hours)

3.1 Substantive policies – Education, criminal justice, immigration
3.2 Regulation policies – Environmental policies, food safety , labour regulations, financial , healthcare
3.3 Distribution policies – housing policies, social security programs, agricultural subsidies, education funding
3.4 Redistribtuion policies – progressive taxation, social safety nets, minimum wages

Unit 4: Case studies of political and economic empowerment (15 hours)

4.1 Role of various non-state actors in shaping the public policy – pressure groups and politics of advocacy
4.2 Various approaches in policy advocacy and policy making – steps in policy formations

4.3 Citizen engagements with policy process – social movements and coalitions – Public participation in service delivery
4.4 Various case studies and literature review – Mahila Rajsatta Andolan for political empowerment of women sarpanch in Maharashtra

Suggested Reading Materials:

1. Akkermans, Bram. "Public Policy (Orde public)." *European Property Law Journal* 8, no. 3 (May 12, 2020): 260–300. http://dx.doi.org/10.1515/eplj-2019-0015.
2. Langner, Barbara E. "Public policy." *Journal of Professional Nursing* 16, no. 6 (November 2000): 310. http://dx.doi.org/10.1053/jpnu.2000.18170.
3. Langner, Barbara E. "Public policy." *Journal of Professional Nursing* 17, no. 2 (March 2001): 69–70. http://dx.doi.org/10.1053/jpnu.2001.23535.
4. HOGWOOD, BRIAN W. "PUBLIC POLICY." *Public Administration* 73, no. 1 (March 1995): 59–73. http://dx.doi.org/10.1111/j.1467-9299.1995.tb00817.x.
5. Helmlinger, Connie. "PUBLIC POLICY." *American Journal of Nursing* 98, no. 4 (April 1998): 16. http://dx.doi.org/10.1097/00000446-199804000-00009.
6. Ellis, Bob. "Public policy." *ACM SIGGRAPH Computer Graphics* 33, no. 1 (February 1999): 39. http://dx.doi.org/10.1145/563666.563678.
7. https://www.ispp.org.in/exploring-the-different-types-of-public-policies-in-india/
8. https://gipe.ac.in/post-graduate/m-sc-public-policy/
9. Rios, Jo Marie (2015) "Towards Policy Advocacy — Activism, Advocacy and Political Empowerment: An Exploratory Study on Hispanic Environmental Justice Nonprofits," *Journal of Public Management & Social Policy*: Vol. 21: No. 1, Article 5.
Available at: https://digitalscholarship.tsu.edu/jpmsp/vol21/iss1/5
10. https://gsdrc.org/topic-guides/voice-empowerment-and-accountability/supplements/political-empowerment/

Title of the Course – Tourism Development and Planning - IV								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE – 4	GEOG 61112	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To acquaint the students about the growth and development of tourism in India and the processes of tourism planning adopted.
2. This course also provides some insight about the development of different types of tourism products with help of case studies from Maharashtra.

Course Outcome:

CO 1. This course will enable the students to have clear idea and understanding of the growth, evolution, and development of tourism in India and in the state of Maharashtra which will prepare them to emerge with creative solutions for addressing the crises faced by this sector and plan for sustainable tourism development.

Unit 1. Tourism development in India

1.1 Tourist Pattern & flow- yearly and monthly – seasonality – determining factors
1.2 Types of attraction & destinations; Case studies – Natural, Cultural, Religious, ecotourism – Niche tourism - tourism circuits & clusters
1.3 Tourism Organizational Structure – level, nature & scope of operation; types of ownership - tourism Public Private Partnership
1.4 Financial Management, Planning and Budgeting

Unit 2 Tourism Planning in India

2.1 Planning of tourism in India – levels of planning - tourism policies – tourism development initiatives in Five Year Plans, National Tourism Policy
2.2 Tourism schemes & initiatives — New Schemes – Swadesh Darshan, PRASHAD, Fairs and festivals, and tourism event celebrations, Bed & Breakfast scheme, Homestays,– NIDHI (National Integrated Database of Hospitality Industry) – National Green Tourism Mission, National Digital Tourism Mission – National Strategy for Sustainable Tourism
2.3 Destination development – elements of destination plan -significance of destination planning - destination management characteristics and system
2.4 Marketing, Branding Promotion and Publicity- objectives – different initiatives implemented– market research

Unit 3 Tourism development & Planning in Maharashtra

3.1 Tourist flow & Pattern - yearly and monthly – seasonality – determining factors
3.2 Tourism potential - major attractions and types of destinations –tourism infrastructure
3.3 Maharashtra Tourism Plans and Policies – Tourism Policy 2006, 2016 – Agri- Tourism Policy, Caravan Tourism Policy - different schemes of tourism development -
3.4 Tourism Organizations in Maharashtra – Department of Tourism, Maharashtra Tourism

Development Corporation Ltd – structure and role – role of NGOs

Unit 4 Case Studies from Maharashtra

4.1 Sustainable Coastal & Hill Tourism - Konkan region– types of activities and initiatives; impact on coastal environment and development

4.2 Development of Religious tourism – Nashik, Pandharpur, Kolhapur, Shirdi –characteristics; problems and prospects

4.3 Importance of Rural tourism in Maharashtra – Agri- tourism in Baramati, Patgaon – farm stays & homestays - its contribution to sustainable rural development

4.4 Heritage tourism– types of tangible & intangible attractions; role in conservation of history, cultural heritage and traditions; Mumbai, Pune, Chhatrapati Sambhajinagar - Ajanta & Ellora, Raigad fort

Suggested Reading Materials:

1. Babu, K.V. & Gade, J. (Ed.) (2014). *Tourism in India.* Zenon Academic Publishing.
2. Badan, B.S. & Bhatt, H. (2009). *Financial Management of Travel and Tourism.* Commonwealth Publishers.
3. Bhatia, A.K. (2002). *Tourism in India : Principles and Practices.* Sterling Publishers.
4. Chopra, S. (1992). *Tourism and Development in India.* South Asia Books.
5. Dixit, S.K. (2023). *Tourism in India: Marketing Perspectives.* Routledge.
6. Government of India (1992). *National Action Plan for Tourism.* Government of India , Ministry of Civil Aviation and Tourism. https://tourism.gov.in/sites/default/files/2019-10/National%20Action%20Plan%20For%20Tourism%201992compressed.pdf
7. Government of India (2022). *Draft National Tourism Policy, 12th July 2022.* Ministry of Tourism. https://tourism.gov.in/sites/default/files/2022-09/Draft%20National%20Tourism%20Policy%202022%20Final%20July%2012.pdf
8. Government of Maharashtra (2006). Tourism Policy of Maharashtra – 2006. *Department of Tourism and Cultural,* Mumbai. retrieved from https://tourism.gov.in/sites/default/files/2019-10/maharastra_0.pdf
9. Government of Maharashtra (2016). Tourism Policy of Maharashtra – 2016. *Department of Tourism and Cultural,* Mumbai. retrieved from https://ffo.gov.in/uploads/film_policy_file/Maharashtra-Tourism-Policy.pdf
10. Hannam, K. & Diekmann, A. (2015). *Tourism and India : A Critical Introduction.* Routledge.
11. Patel, V.A. (2018). *Development of Tourism Infrastructure in Maharashtra.* SSRN.
12.Sati, V.P. (2001). *Tourism Development in India.* Pointer Publishers.
13. Singh, S. (1996). *Profiles in Indian Tourism.* A.P.H. Publishing Corporation.

Title of the Course – Geo-Nutrition: Mapping Food and Health Dynamics								
Year – 2				**Semester – IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61113	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. Explore the interconnections between geography, agriculture, nutrition, and health, focusing on how geographic factors influence food production, distribution, and consumption patterns globally.
2. Study various agricultural systems, their productivity, sustainability challenges, and the role of women in agriculture.
3. Learn about common tools and indicators used in assessing nutrition and health, including the measures of hunger and malnutrition.
4. Critically evaluate interventions, policies, and programs aimed at improving agricultural productivity, nutrition, and health outcomes.

Course Outcomes:

CO 1. Students will be able to articulate the complex relationships between geographic factors and food systems, and how these impact nutrition and health at both local and global levels.
CO 2. Students will gain the ability to analyze and interpret food availability, accessibility and absorption and its mapping at various scale.
CO 3. Students will develop the skills to evaluate the effectiveness of different agricultural and health interventions, understanding their strengths and limitations.
CO 4. Through case studies and project work, students will apply theoretical knowledge to real-world scenarios, enhancing their practical understanding of the subject matter.

UNIT 1: Agriculture: Concepts, Tools and Indicators (15 Hours)

1.1 The interdependence of agriculture, nutrition, and health, agriculture and food security, types of agriculture systems, barriers to agricultural productivity.
1.2 Agricultural employment, role of women in employment, government spending on agriculture; public R&D spending in agriculture.
1.3 Arable and permanent cropland, land Gini index, irrigated area; measures of fertilizer consumption and
pesticide use, cereal production per capita, ; food production per capita and net cereal imports.
1.4 Interventions -to improve assets and capital, improve productivity and sustainability, s to diversify income on and off the farm

UNIT 2: Food Security: Concepts, Tools and Indicators (15 Hours)

2.1 Concept, Origin and Definitions: Food Security, types of food security, dimensions of food security.
2.2 Food Availability-Agriculture production, purchase from markets and role of Public distribution system. Food Accessibility- Per Capita income, livelihood opportunities, ownership of resources. Food Absorption- role of drinking water and toilets.
2.3 Household food security- issues and challenges, mapping of food security through Food Security Index.

2.4 Measures of food security and coping strategies-Household Dietary Diversity, Household Hunger Scale (HHS) and Household Food Insecurity Access Scale (HFIAS), Coping Strategies Index.

UNIT 3: Nutrition: Concepts, Tools and Indicators (15 Hours)

3.1 Concept of hunger ,various forms of malnutrition- chronic and acute undernutrition, stunting and wasting , overnutrition and micro-nutrient malnutrition

3.2 Anthropometry: Low height for a child's age, low weight for a child's height, low weight for a child's age, Body Mass Index (BMI), Mid-Upper-Arm Circumference (MUAC) .

3.3 Bio-chemical indicators-blood hemoglobin levels, serum vitamin A levels, urinary iodine levels, Clinical indicators and dietary indicators

3.4 Curative nutrition, Preventive nutrition-homestead food production, supplementation or fortification programs, ; direct provision of food or food vouchers, or conditional cash transfers, school feeding programs, social and behavior change communication (

UNIT 4: Health: Concepts, Tools and Indicators (15 Hours)

4.1 Health: Concept and Definition, factors affecting health, public health, clinical health and occupational health.

4.2 Food and water safety- food and water borne diseases, zoonotic diseases, concept of one health and its implications.

4.3 Health indicators- Infant Mortality Rate, Maternal Mortality Rate, Morbidity rates, treatment coverage, concepts of Disability or Quality Adjusted Life Years (DALYs/QALYs)

4.4 Health interventions-strengthening of health systems, capacity building, reproductive health, ; hygiene promotion, testing and treatment, Non-health interventions-provision of improved cooking stoves, to reduce smoke-induced respiratory illness

Suggested reading materials:

1. George W. Norton, Jeffrey Alwang, William A. Masters(2022). Economics of Agricultural Development World Food Systems and Resource Use. Routledge Textbooks in Environmental and Agricultural Economics, Taylor and Francis.

2. Global Panel on Agriculture and Food Systems for Nutrition. 2020. Future Food Systems: For people, our planet, and prosperity. London, UK.

3. IPC Food Security Country Analyses (2024). he Integrated Food Security Phase Classification (IPC) .

4. M S Swaminathan Research Foundation and World Food Programme (2016). Sustainability of Food Security Atlas of India.

5.William A. Masters, Amelia B. Finaret (2024).Food Economics Agriculture, Nutrition, and Health. Palgrave Textbooks in Agricultural Economics and Food Policy.

Title of the Course –Geography of Tribes in India								
Year – 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61114	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objective:

1.To impart basic knowledge about tribes and its relationship with geography.
2. The course aims to provide a broad overview of historical and theoretical concept of the Indian tribes.
3. To make students understand the evolution of tribal regions and characteristics of its society and culture of Indian tribes.
4. To make the students learn about economy and developmental plan for tribes in India.

Course Outcome:

CO 1. At the end of this course the students will be able to comprehend and account for the identity of differences, distribution, economy and welfare policy in view point of tribal development.

Unit 1: Introduction to Tribes of India (15 Hours)

1.1 Concept of Tribes, Scheduling and De-scheduling of Tribes in India
1.2 History of Indigenous people, Spatial distribution of Tribal population
1.3 Theories and Process: V. Elwin, G.S. Ghurye and J.L. Nehru.
1.4 India at the UN and Other International Fora

Unit 2: Tribal Region (15 Hours)

2.1 Evolution of Tribal Regions and Ethnic identities; Core and Periphery formation of Tribal Region
2.2 Indian Population: Historical Migrations, Census, Constituent Assembly debates, Supreme Court of India, Domestic Discourse, Current Administrative Status of STs,
2.3 Scheduled Areas and Tribal Areas: Fifth schedule, Sixth schedule and Autonomous district council, and Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA).
2.4 Society and Culture of Major Tribes of India: Naga, Khasi, Bhil, Baiga, Gond, Toda, Santhal, and Onge

Unit 3: Economy of Tribal Society (15 Hours)

3.1 Nature and Type of Tribal Economy
3.2 Transformation of Tribal economy in colonial contexts
3.3 Globalization and its Impact on Tribal Economy
3.4 Issues of Health, Education and poverty

Unit 4: Tribal Development policy (15 Hours)

4.1 Development Polices: (Isolation, Assimilation and Integration) and their impact on tribal Communities
4.2 Tribal welfare Policies of the State: Social Welfare approach, constitution provision, Five-year plan and tribal development
4.3 Reservation policy for Scheduled Tribes (PEASA Act 1966)
4.4 National Commission for Scheduled Tribe (NCST), Tribal sub plan (TSP), Role of NGO,

Suggested Reading Materials:

1. Arnab Chowdhury etd. (2021): The Role of Five Years Plans for Tribal Development in India: An Overview
2. Turkish Online Journal of Qualitative Inquiry (TOJQI) Volume 12, Issue 4, June 2021:902- 908
3. Anderson, K. (2003). *Handbook of Cultural Geography.*Sage Publications.
4. Crang, M. (1998). *Cultural Geography.*Routledge.
5. De Blij, H.J. & Muller , P.O. (1977). *Human Geography: Culture Society and Space.* John Wiley & Sons.
6. Knox, Paul, and Sallie Marston. 2015. *Human Geography: Places and Regions in Global Context, 7th Edition*. Upper Saddle River, NJ: Pearson Prentice Hall.
7. Makhloufi, L. (Ed.) (2024). *Tangible and Intangible Heritage in the Age of Globalisation.* OpenBook Publishers https://doi.org/10.11647/OBP.0388
8. Spencer, J.E. & Thomas, W.L. (1973). *Introducing Cultural Geography.* John Wiley & Sons.
9. Human Rights United Nations, Indigenous Peoples and the United Nations Human Rights System Fact Sheet No. 9/Rev.2 UNITED NATIONS New York and Geneva, 2013
10. Arun, K. (2000): "Dimensions of Population Growth and its Social Implications", Anmol Publications, New Delhi.
11. Bhende, A. and Kanitkar, T. (2000): "Principles of Population Studies", Himalaya Publishing House, Mumbai.
12. Biswas, R. K. (2006): "Demographic Study of Primitive Tribe-A Comparative Framework", Saad Publications, New Delhi
13. Chopra, G. (2006): "Population Geography", Commonwealth Publishers, New Delhi. Dashora, R. and
14. Sharma, A. (2003): "Role of Tribal Women in Education", Yojana, Vol-47, No.6, June, Pp.40-43.
15. Government of India, (1981, 1991& 2001): District Census Handbooks, Nashik District.
16. Pant, B. R. (2010): "Tribal Demography of India", Anamika Publisher and Distributers Private Limited, New Delhi.
17. Panwar, R. (2011): "Tribal and Indian Society-An Impact of Tribal Development", Signature Books International, New Delhi

Specialisation V : Geospatial Technologies

Title of the Course – Python Programming								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE - 4	GEOG 61115	04	00	04	60	50	50	100

Course Objectives:

1. To introduce basic programming as well as geospatial data processing with python.

Course Outcomes:

After completion of the course, student will be able to;

CO 1. Understand the principles of programming.
CO 2. Explain the principles and vocabulary of python programming.
CO 3. Perform the raster and vector data processing with python.
CO 4. Solve problems related to geoinformation processing using python programming.

Unit 1. Introduction to Programming and Python (15 hours)

1.1 The way of the program: Development of Python, Low-level language, Interpreter and Compiler, Types of errors, Formal and natural languages, The first Python program, Debugging. Python 2 / 3 differences [*Reading Chapter 1 from [1]*]

1.2 Variables, expressions and statements: Values and types, variables, variable names and keywords, operators and operands, expressions and statements, order of operations, string operations, comments, interactive mode and script mode. [Reading: Chapter 2 from[1]]

1.3 Conditional statements: Boolean expressions, Logical operators, Conditional execution, Chained and nested conditionals, [Reading: Chapter 5 from [1]]

1.4 Function: Definition, Parameters and arguments, Global and local variables, Composition and recursion, [Reading: Chapter 3 and 6 from [1]]. Iterations: While and for loop, break statement. [Reading: Chapter 7 from [1]].

Unit 2. Data Structures (15 hours)

2.1 Python Data Structures: Strings, Dictionaries, Tuple and Lists[Reading: Chapter 8, 10, 11, and 12 from [1]].

2.2 File Handling: Reading and writing in files. [Reading: Chapter 14 from [1]].

2.3 Classes and Objects: Objects and object-oriented programming, Classes, Operators overloading, Polymorphism, Inheritance. [Reading: Chapter 15, 17, and 18 from [1]].

Unit 3. Vector Data Processing with Python (15 hours)

3.1 Reading and writing vector data with OGR: Introduction to OGR, Reading vector data: accessing specific features, and displyaing data, writing vector data: Creating new data sources and new fields, Updating existing data. [Reading: Chapter 3 from [2]]

3.2 Filtering data with OGR: Attribute filters, Spatial filters, Using SQL to create temporary layers. [Reading: Chapter 5 from [2]].

3.3 Manipulating geometries with OGR: Working with points, lines, and polygons. [Reading: Chapter 6 from [2]].

3.4 Using spatial reference systems: OSR and pyproj. [Reading: Chapter 8 from [2]].

Unit 4. Raster Data Processing with Python (15 hours)

4.1 Reading and writing raster data with GDAL: Introduction to GDAL, Reading writing and Resampling raster data with GDAL. [Reading: Chapter 9 from [2]].

4.2 Working with raster data: Ground control points, Converting pixel coordinates, Histograms, Attribute tables, Virtual raster format. [Reading: Chapter 10 from [2]].

4.3 Map algebra with NumPy and SciPy [Reading: Chapter 11 from [2]].

4.4 Visualizing data with Matplotlib: Introduction to Matplotlib, Plotting vector data, Plotting raster data, Plotting 3D data. [Reading: Chapter 13 from [2]].

4.5 Geodata processing with Rasterio.

Suggested Reading Materials:

1. Allen Downey. (2012). *Think Python- How to Think Like a Computer Scientist* (Version 2.0.17). Green Tea Press .
2. Christine Garrard. (2016). *Geoprocessing with Python*. Manning.
3. Erik Westra. (2013). *Python Geospatial Development, Second Edition* (Second). Packt Publishing.
4. Fabrizio Romano. (2015). *Learning Python Learn to Code Like a Professional with Python - an Open Source, Versatile, and Powerful Programming Language*. Packt Publishing.
5. Göktürk Üçoluk, S. K. (2012). *Introduction to Programming Concepts with Case Studies in Python* (First). Springer.
6. Joel Lawhead. (2017). *QGIS Python Programming Cookbook* (Second Edition). Packt Publishing.
7. John Guttag. (2016). *Introduction to Computation and Programming Using Python* (Second). MIT Press.
8. Scott Shell. (2014). *An introduction to Numpy and Scipy*.

Web References:

1. Introduction to Computer Programming
http://cims.nyu.edu/~kapp/courses/cs0002fall2014/syllabus.php
3. Introduction to Computer Programming Spring 2017
https://www.cs.uky.edu/~keen/115/syllabus/root.html
5. For Errors: https://docs.python.org/release/3.0/contents.html
6. AUTOMATE THE BORING STUFF WITH PYTHON :
https://automatetheboringstuff.com/
7. "Python Programming", http://en.wikibooks.org/wiki/Python_Programming,
https://docs.python.org/release/3.0/tutorial/index.html
9. Building a Basic GUI in Python with Tkinter and wxPython
http://sebsauvage.net/python/gui/
10. Tkinter Python Interface to Tcl/Tk
https://docs.python.org/2/library/tkinter.html
11. Python Scripting (PyQGIS)
http://www.qgistutorials.com/en/index.html
12. PYQGIS DEVELOPER COOKBOOK
http://docs.qgis.org/testing/en/docs/pyqgis_developer_cookbook/

Title of the Course – Principles of Databases								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
DSE - 4	GEOG 61116	**Theory**	**Practical**	04	60	**CIE**	**ESE**	**Total**
		04	00			50	50	100

Course Objectives:

1. To introduce basics of databases as well as querying with SQL.

Course Outcomes:

CO 1. Understand the principle of databases.
CO 2. Explain the principles and vocabulary of databases.
CO 3. Explain the fundamentals of the relational data model.
CO 4. Learn to formulate queries.

Unit:1 **(15 hours)**

1.1 Introduction to Database Technology:
New terminology, The purpose of database technology, Data, databases & database systems, The world that embeds a database, Operating a database system, Geospatial data and databases

1.2 Database Management Systems:
Basic characteristics of a database management system (DBMS), Components of a DBMS, Functions of a DBMS, Interaction with a DBMS.

1.3 Relational data model:
New terminology, Relations – basics, Constraints, Keys

Unit: 2 **(15 hours)**

2.1 Logic and Set theory:
Purpose of using mathematics, example database, Logic and how it can be used in database context, Sets and how they can be used in database context

2.2 Principles of data extraction from databases:
New terminology, Before we query the database; Querying the database- i. Tuple selection, ii. Attribute projection, iii. Combination of tuple selection & attribute projection; Closer look at tuple declaration; Closer look at selection condition; Working with Sets & Bag; Simple method of query definition

2.3 Operations on a database using mathematics in queries:
Concepts of relational algebra, A method for query formulation, Formulation of queries on a single relation, Formulation of queries involving multiple relations

Unit: 3 **(15 hours)**

3.1 JSP Queries:
New terminology; JSP Queries: i. simple join queries, ii. inner/outer join queries, iii. multiple join queries, iv. other join queries

3.2 Parametric Queries and Nested Queries:
Parametric queries, Nested queries, Nested parametric queries

3.3 Summary Queries:
Summary queries, Ordering, Mathematics summary

Unit: 4 **(15 hours)**

4.1 Updating a relational database:

New terminology; Database updating- i. insertion, ii. removal, iii. modifying, iv. cascading updates, v. integrity

4.2 Database Design:

The database design method in steps, Classes to describe object populations, Attributes to characterize objects, Associations to describe links between objects, The role of constraints, The resulting database

Suggested Reading Materials:

1. Chris J. Date. (2000). *An Introduction to Database Systems* (Second Edition). Addison-Wesley Publishing Company.
2. Jeffrey D. Ullman. (1988). *Principles of Database and Knowledge-base Systems: Vol. Volume I.* Computer Science Press.
3. Raghu Ramakrishnan. (1997). *Database Management Systems* (McGraw-Hill).
4. Ramez A. Elmasri, & Shamkant B. Navathe. (1994). *Fundamentals of Database Systems* (Second Edition). Benjamin/Cummings Publishing Company.
5. Rolf A. de By. (1999). *Data Extraction and Data Analysis from Relational Databases* (First). ITC, UT, the Netherlands.
6. Ryan K. Stephens, & Ronald R. Plew. (2001). *Database Design*. Sams Publishing.

Title of the Course – Remote Sensing and Machine Learning								
Year - 2				**Semester - IV**				
Course Type	**Course code**	**Credit Distribution**		**Credits**	**Allotted Hours**	**Allotted Marks**		
		Theory	**Practical**			**CIE**	**ESE**	**Total**
DSE - 4	GEOG 61117	04	00	04	60	50	50	100

Learning Objectives:

1. To obtain proficiency in preprocessing and analyzing remote sensing imagery using machine learning algorithms
2. To Apply remote sensing and machine learning methods to solve real-world environmental and geospatial problems
3. To Critically evaluate the strengths and limitations of remote sensing and machine learning
4. To obtain the knowledge of integration of Remote sensing and Machine learning.

Course Outcomes (Cos):

CO 1. Clear understanding of the basic concepts of Machine learning.
CO 2. Understanding the types Machine learning.
CO 3. Understand the preprocess of Remote sensing data for Machine learning Model.
CO 4. Understanding of how to use Machine learning model to solve real world hydrological problems.
CO 5. Students will integrate and use Remote Sensing and Machine learning knowledge to solve Geographical problems.

UNIT 1: Remote Sensing Data Preprocessing (15 hours)

1.1 Data acquisition and preprocessing
1.2 Image enhancement techniques
1.3 Image registration and georeferencing
1.4 Data fusion and integration

UNIT 2: Introduction to Machine Learning (15 hours)

2.1 Overview of machine learning concepts and algorithms
2.2 Supervised vs unsupervised learning
2.3 Training and testing datasets
2.4 Evaluation metrics for machine learning

UNIT 3: Image classification (15 hours)

3.1 Supervised classification techniques: Support vector machine (SVM)
3.2 Random forest
3.3 Unsupervised classification techniques: K means clustering
3.4 Hierarchical clustering

UNIT 4: Applications of Machine learning in Geographical Studies (15 hours)

4.1 Flood mapping
4.2 Landslide susceptibility mapping
4.3 Groundwater potential zone mapping

4.4 Land use Land cover change mapping

Suggested reading materials:

1. Jensen, J. R. (2005). Introductory digital image processing: A remote sensing perspective (3rd ed.). Pearson Education.
2. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2014). Remote sensing and image interpretation (7th ed.). Wiley.
3. Richards, J. A., & Jia, X. (2006). Remote sensing digital image analysis: An introduction (4th ed.). Springer.
4. Hastie, T., Tibshirani, R., & Friedman, J. (2009). The elements of statistical learning: Data mining, inference, and prediction (2nd ed.). Springer.
5. Bishop, C. M. (2006). Pattern recognition and machine learning. Springer.
6. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). Data mining: Practical machine learning tools and techniques (4th ed.). Morgan Kaufmann.
7. Ghosh, P., & Melendez, J. (Eds.). (2020). Machine Learning for Remote Sensing Applications. CRC Press.
8. Camps-Valls, G., Tuia, D., Benediktsson, J. A., & Zhu, X. X. (Eds.). (2021). Deep Learning for Remote Sensing Data. Springer.
9. Chen, C. (Ed.). (2018). Deep Learning in Remote Sensing (1st ed.). CRC Press.
10. Belgiu, M., & Dragut, L. (2016). Random Forests in Remote Sensing: A Review of Applications and Future Directions. ISPRS Journal of Photogrammetry and Remote Sensing, 114, 24-31.
11. Mountrakis, G., Im, J., & Ogole, C. (2011). Support Vector Machines in Remote Sensing: A Review. ISPRS Journal of Photogrammetry and Remote Sensing, 66(3), 247-259.

Annexure I
University of Mumbai
Two Year Degree Course of M.A. / M.Sc. (Geography)
As per Choice Based Credit System (CBCS)
(With effect from the academic year 2023-2024)
Examination pattern for Semester III and IV

Semester III:
a) Theory Paper: 100 marks for each paper (Total theory papers 3)
i) Internal examination: Total marks 50 (in each theory paper)
ii) External examination: Total marks 50 (in each theory paper) Duration: 2 Hours
1) Total number of questions to be framed for theory paper in external examination is 7 of 10 marks each.
2) Out of total 7 questions, students are required to attempt **any Five** questions.

b) Practical Paper: 100 marks for one paper with four credits
50 marks for one paper with two credits
c) Dissertation: 100 marks for four credits.
The dissertation assessment will be as follows – The dissertation assessment will be by internal and external examiner as per the heads like thesis, presentation, viva voce, supervisor's evaluation, class performance.
1) Out of total 100 marks in four credits practical, 80 marks for practical examination, 10 marks for journal writing and 10 marks for viva.

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

3) Number of questions would correspond with number of major modules in the respective practical Course syllabus.
c) Marking system:
i) Total marks for theory: 4 Credits *3 theory papers =12 credits
ii) Total marks for practical: 6 credits for two practical papers
iii) Total marks for Dissertation: 4 credits
iii) Grand Total for Semester III is 22 credits

Semester IV
a) Theory Paper: 100 marks for each paper (Total theory papers 3)
i) Internal examination: Total marks 50 (in each theory paper)
ii) External examination: Total marks 50 (in each theory paper) Duration: 2 Hours
1) Total number of questions to be framed for theory paper in external examination is 7 of 10 marks each.
2) Out of total 7 questions, students are required to attempt **any Five** questions.

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

1) Out of total 100 marks in four credits practical, 80 marks for practical examination, 10 marks for journal writing and 10 marks for viva.
c) Dissertation: 150 marks for six credits. The dissertation assessment will be by internal and external examiner as per the heads like thesis, presentation, viva voce, supervisor's evaluation, class performance.

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

c) Marking system:
i) Total marks for theory: 4 Credits *3 theory papers =12 credits
ii) Total marks for practical: 4 credits for one practical
iii) 6 credits for dissertation

Note- Theory and practical components for core and elective papers will be examined by Internal and / or external examiners from other Institutions.

iv) Grand Total for Semester IV = 22 credits

Total credits earned at the end M.A. / M.Sc. Second year (Semester III and Semester IV) would be 44.

Annexure II
Letter Grades and Grade Points

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