

# **CBCS Syllabus for Postgraduate Course in Geography**

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EFFECTIVE FROM THE ACADEMIC SESSION 2019 –20



**West Bengal State University**

**Berunanpukuria, Malikapur**

**Barasat, North 24 Parganas**

**West Bengal – 700126**

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**Section 1: PG CBCS Structure for Geography.**

Semester	Type of Course	Course Code		Marks	Credit
I	Core	GEOPCOR01T	Geomorphology and Geotectonics	50	4
	Core	GEOPCOR02T	Soil and Plant Geography	50	4
	Core	GEOPCOR03T	Population and Welfare Geography.	50	4
	Core	GEOPCOR04T	Geography of Economic Activities	50	4
	Core	GEOPCOR05P	Statistical Techniques and Computer Application	50	4
	AECC	GEOPAEC01M	Communication Skills	50	2
II	Core	GEOPCOR06T	Hydrology and Oceanography	50	4
	Core	GEOPCOR07T	Synoptic and Applied Climatology	50	4
	Core	GEOPCOR08T	Human Culture and Society	50	4
	Core	GEOPCOR09T	India: Resource Appraisal and Management	50	4
	Core	GEOPCOR10P	Map Interpretation and Mapping Techniques.	50	4
	SEC	GEOPSEC01M	Introduction to Computer Programming	50	2
III	Core	GEOPCOR11T	Philosophies of Geography and Geopolitics	50	4
	Core	GEOPCOR12T	Multivariate Statistics in Geography	50	4
	Elective	GEOPDSE01T	A. Fluvial Processes and Management	50	4
		GEOPDSE01T	B. Rural Institutional Management and Development in India	50	4
		GEOPDSE01T	C. Natural Systems in the Anthropocene	50	4
	Core	GEOPCOR13P	Remote Sensing and Geographical Information System	50	4
	Core	GEOPCOR14P	Ground Survey and Field Methods	50	4
	GEC	GEOPGEC01M	Geospatial Analysis	50	4
IV	Core	GEOPCOR15T	Environmental Geography and Sustainable Urban Development	50	4

	Elective	GEOPDSE02T	A. Coastal Processes and Management	50	4
		GEOPDSE02T	B. Rural Resource Economics and Development in India	50	4
		GEOPDSE02T	C. Management of Physical and Human Environment	50	4
	Elective	GEOPDSE03T	A. Management of Natural and Man-Made Hazards	50	4
		GEOPDSE03T	B. Rural Culture, Heritage and Development	50	4
		GEOPDSE03T	C. Environmental Impact Assessment and Environmental Legislation in India	50	4
	Elective	GEOPDSE04P	A. Practical on Applied Geomorphology	50	4
		GEOPDSE04P	B. Practical on Regional Planning and Rural development	50	4
		GEOPDSE04P	C. Applied Environment Management	50	4
	Elective	GEOPDSE05M	A. Project based on Applied geomorphology	100	8
		GEOPDSE05M	B. Project based on Regional Planning and Rural Development	100	8
		GEOPDSE05M	C. Project based on Environment Management	100	8

Elective stream A: Applied Geomorphology

Elective stream B: Regional Planning and Rural Development.

Elective stream C: Environment Management

## **Section 2: Programme Specific Outcome (PSO)**

The postgraduate syllabus for M.Sc. course in Geography has been framed with the objective of giving the students a holistic understanding of the subject putting equal weightage on two main aspects of Geography — Physical and Human and their interactive relationships. The principal goal of the syllabus is to enable the students to secure a job at the end of the postgraduate programme. Keeping this in mind and in tune with the changing nature of Geography, adequate emphasis is rendered on the applied aspects of the subject.

### **PSO01: Physical Geography**

The courses in Physical geography focusses on geography as earth sciences and covers areas such as biogeography, climatology and meteorology, geomorphology, environment management, hydrology, oceanography, paleo-geography, and quaternary science. On completion of the programme, with a specialisation in Physical Geography the students will develop knowledge base and skills as follows:

#### Knowledge base:

- Genesis of major geomorphic features and their potential use as indicators of environmental change.
- Physical processes of tropical ecosystems with focus on soils, vegetation and changing land use.
- The relationship between environmental change and human activity including resilience, vulnerability and adaptive processes.
- The interplay between atmospheric circulation and energy balance and correlation with global climate change and hydrology.
- Methods and equipment used in the study of fluvial, estuarine and marine environments, the potential effect of sea-level and climate change.

#### Skills:

- Identify and describe key factors that control a range of biogeochemical processes and net effects in terms of the environmental impact of pollutants and greenhouse gases
- Assess how models at different scales and databases can be used to enhance our understanding of present and past climate and predict future development in climatic trends.
- Review a scientific literature and communicate results of projects orally and in writing.
- Field methods used in studies of sediment transport in the fluvial, estuarine and marine environment

### **PSO02: Human Geography**

The courses in Human geography deals more with patterns and processes that shape human society and covers areas such as culture, development, economy, health, geopolitics, demography, religion, society, transport and regional development and planning. On completion of the programme, with a specialisation in Human Geography the students will develop knowledge base and skills as follows:

#### Knowledge base:

- Conceptualisations of space and place including social, economic and development issues as well as human environment interactions.

- Globalisation processes and their geographical implications, transformation of cities, regions and landscapes, migration, urbanisation, rural-urban connections and land use change.
- The role of uneven geographical development including its implications for urban and regional development and planning.

#### Skills:

- Work at a scientific and application-oriented level with a broad range of theoretical and methodological approaches to human geography
- Work with interdisciplinary dimensions of human geographical processes and their impacts and spatial aspects at different scales.
- Work in and understand the implications of cross-cultural contexts.

#### **PSO03: Applied Geographical Aspects**

The Applied aspects in Geography include courses in Remote Sensing and GIS, advanced techniques of mapping and field-based data generation. On completion of the programme, in Geography the students will develop specific skills as follows:

#### Skills

- Student will be able to analyse the problems of physical as well as cultural environments of both rural and urban areas. They will try to find out the possible measures to solve those problems through Social Survey Project:
- Integrate RS data with other data in a GIS environment for applications in spatial planning, environmental monitoring and modelling.
- Advanced methods of field mapping and primary data collection.
- Assess data quality, in terms of uncertainty, in order to understand and describe the limitations of current RS and GIS technology.
- Develop the capability of observation through field experience so that they will be able to identify the socio-environmental problems of a locality.

#### **PSO04: Development of Communication Skill and Interaction Power**

- The students will be efficient in communication skill and social interaction.
- The students will be able to understand and write effective reports and design credentials, make effective demonstrations and give and receive clear instructions.

#### **PSO05: Understand Environmental Ethics and Sustainability**

- The students will understand the impact of their acquired knowledge in societal and environmental contexts. Articulate a global view of environmental sustainability and different approaches towards sustainable environmental management
- Demonstrate their sensitivity towards social responsibility and sustainable development.
- Understand the scientific nature of ecology and man-environment relation from different dimensions
- Develop the ethical, logical and legal knowledge to understand the need for environmental protection

### **Section 3: Course Outcome (CO)**

#### **GEOPCOR01T: GEOTECTONICS AND GEOMORPHOLOGY**

- Making the students' aware about the basic concepts of Geomorphology with background knowledge of geology and environmental sciences.
- Understanding crustal mobility and tectonics; with special emphasis on their role in landform development. Establishing the relationships between landforms, processes and underlying structure CO 4 – Overview and critical appraisal of landform development models
- Exploring how landforms and geomorphic processes vary under different climatic regimes.
- Students will be introduced to geomorphic features that are not found on Earth. As geomorphologists they will know how to use landforms on Earth to understand those on other solar system bodies.
- Develop understanding of fluvial and other geomorphic processes together with emphasis upon the applied aspect of Geomorphology and hazard management.

#### **GEOPCOR02T: SOIL AND PLANT GEOGRAPHY**

- To familiarise the students with the basic and fundamental concepts of soil geography and discuss the processes of soil formation.
- Students will know the concept, causes and controlling factors of soil erosion, soil degradation and conservation of soils
- Students should know the concept, need and methods soil of management
- To introduce the concept of Phytogeography
- Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
- To provide thorough knowledge about the conditions of plant growth
- Students will be able to understand adaptation, development and behaviour of different plant groups.
- Evaluate energy sources of ecological system

#### **GEOPCOR03T: POPULATION AND WELFARE GEOGRAPHY (4 CREDIT)**

- Objective of the course is to make the students aware about the basic concepts and theories of human population and their development.
- Provide an insight into the contemporary and emerging wellbeing issues, based on the components of welfare
- Address the geographical dimensions of inequality through the Constitutional imperatives

#### **GEOPCOR04T: GEOGRAPHY OF ECONOMIC ACTIVITIES**

- The objectives of this course are to integrate the various factors of economic development and acquaint the students about the dynamic aspects of Economic Geography
- To familiarise the students with the concept, origin, and development of agriculture
- To examine the role of agricultural determinants towards changing cropping patterns, intensity, productivity, diversification and specialisation.

- To familiarise students to understand the location of major manufacturing activities with the support of various industrial location theories and models.
- The changing industrial scenario and its impact on the Indian economy along with the economics of global trade.

### **/// GEOPCOR05P: STATISTICAL TECHNIQUES AND COMPUTER APPLICATION**

- Using statistical techniques in order to summarise, represent, analyse and interpret data.
- Introduce basic statistical procedures and train the students to apply these procedures towards analysing the geographical problems.
- The course also aims to provide training in application of computers in analysis and synthesis of a variety of quantitative data.

### **///GEOPCOR06T: HYDROLOGY AND OCEANOGRAPHY**

- Understanding the variations of global hydrological cycle and analysing the concept of Hydrology as an integral part of all living things in the world.
- Developing understanding about the significance of a systematic study on fresh water resources, their storage and utilisation, emphasising the significance of groundwater quality and its circulation.
- Introduce students to the physical and chemical properties of sea water, atmospheric and oceanic linkage.
- Students will be able to understand aquifer properties and its dynamics after the completion of the course and get an exposure towards the behavior and characteristics of the global oceans and the national and international laws for governing the coastal area and territorial sea
- Students can be involved in managing, monitoring and protecting water and water resources. They can be involved in planning, development and sustainable use of natural and domestic water resources.

### **/// GEOPCOR07T: SYNOPTIC AND APPLIED CLIMATOLOGY**

- Developing the understanding about the Earth's atmosphere and global climate.
- Understanding the major forms of weather disturbances and the dynamics of the Monsoon
- Assessing the phenomenon of climate change and its implications including the role of man in global climate change.
- Geographers can be absorbed as climate change analysts, studying and interpreting data, maps reports, photographs and charts to predict long and short scale patterns.
- Exposure of students to the various branches of Applied Climatology

### **/// GEOPCOR08T: HUMAN CULTURE AND SOCIETY:**

- An insight into the notion of Cultural Geography will help students in understanding and comprehending the prevalent social-cultural relations with changing human adaptations.
- To relate these issues through the study on the elements of Indian society and the processes of their transformations.
- The course is significant to disseminate knowledge on the Indian society with its multicultural identity as existing in this era of cultural globalization.

- It will inculcate in students the pride of universalization of Indian culture and social values

### **/// GEOPCOR09T: INDIA: RESOURCE APPRAISAL AND MANAGEMENT**

- The objective of the course is to understand India in terms of various regional divisions, their important characteristics and to analyse the natural and human resource endowments, their conservation and management.
- It also aims to sensitize the students with development issues and policies designed for regional development. The paper also gives an insight into the geography of West Bengal, to acquaint the students with the state — its problems and prospects.

### **/// GEOPCOR10P: MAP INTERPRETATION AND MAPPING TECHNIQUES**

- Acquire knowledge different types of map projection and develop a clear concept of their properties and applicability.
- Gain knowledge about topographical maps and apply this knowledge in understanding ground realities.
- Demonstrate competence in fundamental geological skills in identification; interpretation of geologic maps and cross-sections with basics of three-dimensional conceptualisation
- The course also aims to train the students in various methods of analysing socio-economic data.

### **/// GEOPCOR11T: PHILOSOPHIES OF GEOGRAPHY AND GEOPOLITICS**

- Develop an idea about evolution of geographical thinking and disciplinary trends in different parts of the world.
- Build an idea about the dichotomous nature of Geography.
- Establishing relationship of Geography with other disciplines and man-environment relationships
- Analysing modern and contemporary philosophies of Post-colonialism, Post-structuralism, Modernism and Post-modernism in Geography
- Main objective of the course on Geopolitics is to provide insight into the complex relationship between geographical factors that have a strong bearing on the political scenario at global, regional and local level.
- To sensitise the students to geopolitical understanding of conflicts and regional cooperation with respect to borders.

### **/// GEOPCOR12T: MULTIVARIATE STATISTICS IN GEOGRAPHY**

- Students should have the understanding of basic concepts associated with matrix algebra, multivariate normal distributions and their properties with special emphasis on bivariate normal distribution
- To develop the capability of analysing multivariate data using techniques like Principal Component Analysis, Factor Analysis.
- Familiarising students to Classification and Clustering methods.

### **/// GEOPDSE01T: A. FLUVIAL PROCESSES AND MANAGEMENT**

- The rivers being the major geomorphic agent of erosion, the course assumes significance as it mainly deals with an understanding of the fluvial system.

- The students are introduced to the forces resisting and driving the flow of water which has its resultant effect on the flow patterns and sediment load.
- The course also emphasises on anthropogenic disturbance of channel, floodplain and the various management options.
- The impacts of dams, river training structures are also dealt with.
- The students will be familiarised with the various Management Action Plans adopted in India for river restoration and management.
- The course also highlights the necessity of watershed management and the application of geomorphological knowledge in environmental management.

#### **GEOPDSE01T: B. RURAL INSTITUTIONAL MANAGEMENT AND DEVELOPMENT IN INDIA**

- The course intends to focus on Rural Institutional Management and Development in India at the micro-regional level.
- Evolution of decentralisation process has led to Community Development Programmes and the Institutional set-up of the Panchayati Raj Institutions.
- The students will be aware of the various facets of rural development through the various approaches to rural development, rural reconstruction and the changing rurality as a consequence.
- The conceptual background and its sound knowledge will guide them in seeking employment in several of the schemes launched by the government and implemented by it along with the NGOs. This is an added advantage as most of the students are from the rural background

#### **GEOPDSE01T: C. NATURAL SYSTEMS IN THE ANTHROPOCENE**

- Understand the scientific nature of ecology and the complex nature of man-environment relation from different dimensions
- Identify the role of human intervention in environmental disasters, hazards and assess risk
- Develop the ethical, logical and legal knowledge to understand the need for environmental protection
- Articulate a global view of environmental sustainability and different approaches towards sustainable environmental management

#### **GEOPCOR13P: REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM**

- The objective of the course is to introduce to the students the basic principles of remote sensing and the methods of digital interpretations of satellite images.
- The course provides hands-on-training on the basic elements of GIS and its areas of application.
- Geospatial analysis is a growing field of employment. The role includes analysis of data, design and use of this database.
- The work of a geospatial analyst varies greatly depending on which sector the student wants to work

#### **GEOPCOR14P: GROUND SURVEY AND FIELD METHODS**

- Main objective of field method is to provide the students the understanding of ground reality; mapping of land use and to enhance the skill of the students during field survey.

- On completion of this course students shall be able to understand the advantages of electronic surveying over conventional surveying methods.
- Students completing this course would have acquired practical knowledge on handling survey instruments like Theodolite and Total station and have adequate knowledge to carryout Triangulation surveying including general field marking for various projects.
- The course aims to give hands-on-training in preparation of maps with application of GPS.
- The students should be able to take decisions regarding what measurements to take, and which instruments to use.
- The skill to carry out surveying with Theodolites and Total Station will make the students eligible for securing jobs as surveyors in various Government and Non-government organizations.

### **/// GEOPCOR15T: ENVIRONMENTAL GEOGRAPHY AND SUSTAINABLE URBAN DEVELOPMENT**

- The importance of conserving the environment to sustain ecological balance has been emphasised in the course.
- Examples of human-induced social and ecological changes and some environmental issues in contemporary India have also been highlighted.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management
- To study the nature and facts about environment and finding and implementing scientific, technological, economic and political solutions to environmental problems.
- The course will also enlighten students on environmental issues with special emphasis on urban sustainability as the world is fast urbanizing.
- Case studies showcasing failure and success stories implemented by the governmental policies on urban development with local community participation will help in understanding critically the concept of sustainable development and its management in India.
- Students can find career opportunities in Government ministries and other public and private sector organisations concerned with policy analysis in the fields of sustainable development and environmental planning as a sustainability consultant.

### **/// GEOPDSE02T: A. COASTAL PROCESSES AND MANAGEMENT**

- This course includes interpretation of coastal environment and its management and understands coastal regions as dynamic and contested environment.
- Regional or local case studies will teach the students the techniques of geomorphic assessment of specific problems.
- This course will give students an understanding of coastal resources management and protection as a public policy problem.
- The course sensitise students about the issues of coastal vulnerability like sea level change, coastal erosion, estuarine pollution and unplanned reclamation efforts
- The students will learn to critically assess the impacts of conventional coastal management options.
- Geomorphologists can find career opportunities as Environmental Consultant in engineering consulting firms and government agencies.

### **GEOPDSE02T: B. RURAL RESOURCE ECONOMICS AND DEVELOPMENT IN INDIA**

- We are to generate livelihoods in the village itself so that people do not have to migrate to urban areas utilizing the rural resources.
- The students are introduced to the indigenous knowledge of the people in order to bring about sustainable resource management. Local experiences shape local craft and some of the industrial products are centuries old which needs to be taken care of.
- In the long run, rural tourism can make a significant contribution to arresting migration, making the villages attractive to their residents, and even result in some reverse migration.
- Establishing a rural tourism network will have a synergistic effect benefitting all players. Promotion of tourism will be ‘value addition’. Once tourists start coming, local initiative combined with governmental support can ensure further augmentation of facilities, attractions and activities, including the development of social welfare measures in the fields of health, education and employment.
- Knowledge of these issues will benefit the students as they can apply this knowledge at the grass root level. They can also carry out their own business or get jobs in these sectors instead of migrating to urban areas as most of them are from the rural background.

### **GEOPDSE02T: C. MANAGEMENT OF PHYSICAL AND HUMAN ENVIRONMENT**

- Analyse the present status of biodiversity in India and understand the need for the protection of wetlands both in view of ecology and economy.
- Develop a sound knowledge of watershed management in view of sustainable resource management.
- Understand the need of the management of human environment in lieu of global strategy
- Develop a broad understanding of the environmental problems in India from the perspective of sustainable environmental management

### **GEOPDSE03T: A. MANAGEMENT OF NATURAL AND MAN-MADE HAZARDS**

- The course elucidates the importance of disaster management, explain the causes and describe the dimensions of natural and anthropogenic disasters.
- The students will be equipped with the principles and components of disaster management, the contents of an emergency operational plan and explanation of the role of disaster mitigation and its role in sustainable development.
- The course will sensitize the students regarding the problems of groundwater and soil.
- The problems of urban geomorphology are gaining relevance in sustainable hazard management strategies. Case studies will help the students to connect with the real-world issues.
- Geographers can be engaged as Emergency Management Specialists’ who can coordinate disaster response and crisis management through planning, assessment and vulnerability analysis. With the introduction of GIS and remote sensing in Geomorphology, preparation of maps for effective management has been very effective

### **GEOPDSE03T: B. RURAL CULTURE AND HERITAGE AND DEVELOPMENT**

- Communal tolerance, mass gathering religious practices and folk music have sustained India’s peace and development. So a study on such practices will sustain our peace by the younger generation and inculcate moral value in the students.

- Heritage of rural India encompasses almost all aspects of life: monuments and historic structures, performing and visual arts, crafts and artisan skills, traditional knowledge in agriculture, water management and medicine and the heritage and history embedded in mythology, folklore, ritual, and language. Traditional crafts have survived in India because rural folk still make and use them. These are visual dialogues between the craftsmen and culture of the land.
- Case studies on these various facets as an exemplar from India in general and West Bengal in particular will set new benchmarks for rural development and promotion of local culture.
- Heritage and culture and rural tourism are tools capable to boost local economy, community mobilization and conservation and in sustainable renewal of resources.
- The course will also provide prospective job opportunities in government and NGO departments and many can act as independent entrepreneurs themselves

### **/// GEOPDSE03T: C. ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL LEGISLATION IN INDIA**

- Develop an understanding of Environmental impact assessment and its present framework in India
- Develop the knowledge of different rules related to environmental Impact Assessment
- develop the knowledge of environmental legislation and environmental governance in India
- understand the climate change adaptation strategy of India in accord of global commitment
- Develop the knowledge of ISO standardisation of environment management system and its adaptation in India

### **/// GEOPDSE04P: A. PRACTICAL ON APPLIED GEOMORPHOLOGY**

- The course aims to give hands-on-training on interpretation and quantification of fluvial and coastal processes.
- The students are trained on water and sediment analysis procedures which are indicators of the operating geomorphic processes.
- The stress on on-field data collection and monitoring will train the students to identify the problem areas and give them hand-on experience in management of fluvial or coastal problems.
- Qualitative and quantitative analysis of geomorphic data will facilitate the students to suggest the suitable management procedure.

### **/// GEOPDSE04P: B. PRACTICAL ON REGIONAL PLANNING AND RURAL DEVELOPMENT**

- Research in Geography involves thinking about the relationships between methods, techniques, analysis, and interpretation, the important role of which is filled by the research design.
- Method is a technique for gathering evidence, while methodology is a theory of how research should proceed through its various stages and phases, discussing the philosophical approach to the work.
- The course includes techniques of collection of primary and secondary data; organising, processing and analysing the socio-economic data and techniques of formulating rural planning for its holistic development. Results from qualitative research are more understandable to people who are not statistically trained and can reveal more insightful geographical thinking than purely numerical outcomes.

- The study of the same phenomenon through the use of multiple methods of data collection quantitatively and qualitatively, cross verifying it through two or more sources will help students learn of validation of the data.
- The course outcome is very promising as students can help in formulating rural plans required for Regional Planning and Rural development as little focus is on this sphere in our country.

#### **/// GEOPDSE04P: C. APPLIED ENVIRONMENTAL MANAGEMENT**

- Develop the skill to assess the air, water and soil pollution by the physical and chemical analysis of different components
- Develop the skill to prepare air quality index as per national standardisation
- Develop the skill to prepare map for spatial analysis of air ,water and soil pollution for the assessment of risk
- Develop the skill for ecological survey for the protection and conservation of environment

#### **/// GEOPDSE05M: A. PROJECT BASED ON APPLIED GEOMORPHOLOGY**

#### **/// GEOPDSE05M: B. PROJECT BASED ON REGIONAL PLANNING AND RURAL DEVELOPMENT**

#### **/// GEOPDSE05M: C. PROJECT BASED ON ENVIRONMENT MANAGEMENT**

- The project on optional paper (A or B) will be based on primary data collected from field. The topic will be based on any problem that has contemporary relevance.

#### **/// GEOPAEC01M: COMMUNICATION SKILLS**

- In an era of technology and globalization communication plays an important role. Helping students to develop their communication skills is the need of the day to motivate and help them through various strategies like to expand vocabulary, to improve fluency, to exhibit confidence to communicate better.
- The course will focus on developing communication skills as part of academic ability required by students.
- This will in turn help in improving their research skill and aptitude.
- It will also help them while presenting a paper in a seminar or facing interviews seeking a job. This course is a scientific approach towards their learning process. It is really promising as it will develop expertise of the learners

#### **/// GEOPSEC01M: INTRODUCTION TO COMPUTER PROGRAMMING**

- The course will focus on developing basic programming skills using the Python language and source programming language.
- Python helps to curtail software development cost applying those skills to solve various problems related to quantitative geography. The course will involve a brief introduction followed by computer-based tasks.
- Since Python is supported by many operating systems it is suitable for creating prototype of the software applications. At present the job market for Python developer GIS Analyst is highly promising

#### **/// GEOPGEC01M: GEOSPATIAL ANALYSIS**

- Comprehend fundamental concepts and practices of Geographic Information Systems (GIS) and advances in Geospatial Information Science and Technology.

- Apply basic graphic and data visualization concepts, demonstrate skills in file and database management.
- Give examples of interdisciplinary applications of Geospatial Analysis.
- Apply GIS analysis to address geospatial problems and/or research questions.
- Demonstrate proficiency in the use of maps, satellite images and GIS tools to create maps that effectively convey the information they are intended to.

# Semester – I

## **GEOPCOR01T: GEOMORPHOLOGY AND GEOTECTONICS (4 CREDIT)**

### **Unit1: Geotectonics**

- 1.1 Tectonic Geomorphology and structural landforms: variations in spatial and temporal scales.
- 1.2 Relative motion and absolute motion of plates: driving forces, triple junctions and their surface expressions.
- 1.3 Structure and form of orogenic belts with reference to the Himalayas: Fore deep basins, thrust belt, metamorphism and tectonics.
- 1.4 Neotectonics: geomorphic markers, rates of uplift and erosion, principles of relative and absolute dating.

### **Unit 2: Foundation and Branches of Geomorphology**

- 2.1 Principle of Uniformitarianism, Catastrophism, inheritance from the past; Systems Approach; feedbacks, equilibrium and threshold.
- 2.2 Morphogenetic regions and their importance. Significance of process studies in geomorphology
- 2.3 Applied and anthropogenic geomorphology — emergence and relevance
- 2.4 Planetary geomorphology with special reference to Mars.

### **Unit 3: Fluvial Processes and Form**

- 3.1 Significance of drainage basin as a geomorphic unit; channel initiation
- 3.2 Hydraulics of streamflow: Types of flow, stream velocity and resistance, stream energy
- 3.3 Thresholds of erosion: entrainment and bed erosion, bank erosion processes
- 3.4 Sediment transport and deposition: dissolved load, suspended load and bed load

### **Unit 4: Geomorphic Processes and Resultant Landforms**

- 4.1 Slope evolution models — King, Wood and Young.
- 4.2 Coastal morphodynamic variables and their influence on evolution of coastal forms.
- 4.3 Karst processes and landforms in Tropical Humid Environments
- 4.4 Processes of evolution of periglacial landforms

## **GEOPCOR02T: SOIL AND PLANT GEOGRAPHY (4 CREDIT)**

### **Unit1: Soil Properties and Processes**

- 1.1 Major components of soil, Weathering processes and products. Catena concept. Physical properties of soil: Texture, structure, density, soil colour, soil air and temperature.
- 1.2 Chemical properties of soil: Soil colloids, clay mineralogy, cation and anion exchange
- 1.3 Soil water: Energy state of soil water, Types of soil water movement, Solute transport.
- 1.4 .Soil organisms and soil processes: Composition and decomposition of organic matter, soil micro-organisms, biological nitrogen fixation, ammonification and nitrification, denitrification

### **Unit 2: Soil in relation to fertility and environment**

- 2.1 Soil condition and crop production: Provision of nutrients, fertilizer use, organic manures, nutrient balance, Liebig's Law of the Minimum; Soil micronutrients, soil irrigation.
- 2.2 Soil acidification: Process, pH and buffering capacity, base saturation, effect on plants and ecosystems
- 2.3 Hazardous elements in soil: Heavy metals: Pb, Zn, Cd, F, treatment of contaminated land, radionuclides in soil.
- 2.4 Soil management: Managing sandy soils, saline soils and soils disturbed by surface mining

### **Unit 3: Plant Geography**

- 3.1 Importance of Soil to plants: Plant development and root growth, water holding capacity, soil aeration and temperature.
- 3.2 Importance of water to plants: Effect on evaporation and transpiration, adaptations of Hydrophytes and Xerophytes, role of water in plant reproduction
- 3.3 Importance of temperature to plants: Temperature and transpiration, thermo-periodicity and its effect, temperature and phenology, effects of low temperature.
- 3.4 Importance of light to plants: Photosynthesis, photoperiodism and its effects, germination.

### **Unit 4: Plant and Forest Ecology**

- 4.1 Plant habitat factors; adaptation, succession and climax
- 4.2 Phytogeographical regions; Plant species, family and genera.
- 4.3 Deforestation and degradation of forest: causes and consequences; measures of conservation and afforestation.
- 4.4 Plants as resource: timber and non-timber forest products and their use.

## **/// GEOPCOR03T: POPULATION AND WELFARE GEOGRAPHY (4 CREDIT)**

### **Unit1: Population Theories and Policies**

- 1.1 Theories of population growth: biological, social and economic.
- 1.2 Fertility and mortality influencing policies; UNO's World Population Plan of Action
- 1.3 Migration theories: Ravenstein, Lee and Todaro
- 1.4 Migration influencing policies: Internal migration, Immigration and Emigration related policies

### **Unit 2: Emerging Issues in Population Geography**

- 2.1 Population and vulnerability: Identity crisis in relation to Diaspora, ageing and displacement due to development process and identity crisis. Unemployment and Dependency Ratio, food security and hunger
- 2.2 Population Explosion and Poverty: Causes, effects, and measures of control.
- 2.3 Deprivations in health care: Reproductive and Child Health Care (RCH), infant and maternal mortality, geriatric care, HIV/ AIDS.
- 2.4 Quality of population: Concepts, improved sex ratio, literacy rate, life expectancy

### **Unit 3: Welfare Significance in Development**

- 3.1 Concept of welfare, social justice and social development
- 3.2 Components of welfare: Equity, equality, justice and injustice, exclusion and inclusion, poverty reduction and inclusion.
- 3.3 Geographical dimensions of Inequality: Deprivation of the backward and minority communities; gender issues; insecurity of the child labour, unemployed youth and superannuated persons.
- 3.4 Social well-being in geography

### **Unit 4: Sustainable Development and Social Justice**

- 4.1 Goals of sustainable development.
- 4.2 Indicators of quality of life: definition and indicators of physical quality of life and standard of living.
- 4.3 Indicators of social well-being relevant to India: Housing, health and nutrition, literacy and education, social security.
- 4.4 Achieving social justice in India: Inclusive growth through Constitutional imperatives

## **/// GEOPCOR04T: GEOGRAPHY OF ECONOMIC ACTIVITIES (4 CREDIT)**

### **Unit1: Concept of Economic Resource and Economics**

- 1.1 Concept of economic resource and economic theories: Adequacy and scarcity; sustainable development, resource base and inequality.
- 1.2 Conservation and management of land, water and biotic resources.
- 1.3 Sustainable use of energy resources: renewable and non-renewable.
- 1.4 Ranking of world economic resources, global conflict on resource use.

### **Unit 2: Agricultural Geography**

- 2.1 Agricultural region: Concepts, techniques and delineation.
- 2.2 World agricultural systems and agri-business.
- 2.3 Role of technological changes in agricultural productivity in India, impact of Green, White and Blue Revolution.
- 2.4 Food security scenario in developing countries.

### **Unit 3: Industrial Geography**

- 3.1 Theories of industrial location: Traditional theories and new concepts
- 3.2 IT Revolution
- 3.3 Industrial regions of India; Industrial complexes
- 3.4 Industrial policies of India.

### **Unit 4: Geography of Trade and Transport**

- 4.1 Economics of global trade: Balance of payment. Role of World Bank, regional blocks in international trade: ASEAN
- 4.2 Significance of trade in national and international economy: G8 countries, TRIPS and MNC's
- 4.3 Contemporary structure of regional economy: Market-centres and their orders; Export Processing Zone (EPZ). Information technology and its impact on trade.
- 4.4 Transport networks and their role in national and international trade.

# **GEOPCOR05P: STATISTICAL TECHNIQUES AND COMPUTER APPLICATION**

**(4 CREDIT)**

## **Unit1: Sampling, Scales of Measurement and Population Analysis**

- 1.1 Geographical data: Discrete and continuous series, scales of measurements, frequency distribution.
- 1.2 Measures of central tendencies and dispersion: Standard deviation, variance and co-variance, coefficient of variability, skewness and kurtosis.
- 1.3 Probability: normal, poisson and binomial,; normal probability curve and its application
- 1.4 Sampling theories and methods; application of random numbers, estimation of sampling error.

## **Unit 2: Correlation and Regression**

- 2.1 Correlation and regression; bi-variate analysis and curve fitting — linear, exponential. power relationship; residuals and mapping of residuals.
- 2.2 Product moment correlation and rank correlation.
- 2.3 Hypothesis testing: formulation, rejection rule, significance level and type of errors.
- 2.4 Test of significance: Students t Test and Chi Square Test

## **Unit 3: Computer Application for Descriptive Statistics**

- 3.1 Tabulation, frequency distribution, cumulative frequency distribution, mean, median, mode, standard deviation, mean deviation.
- 3.2 Histogram, scatter diagram.
- 3.3 Correlation and regression analysis: fitting of trend line, displaying regression equation and correlation co-efficient
- 3.4 Time Series analysis.

## **Unit 4: Laboratory Note Book and Viva voce**

# Semester – II

## **GEOPCOR06T: HYDROLOGY AND OCEANOGRAPHY (4 CREDIT)**

### **Unit1: Components of Hydrology**

- 1.1 Hydrological system models and their classification; principles of hydrologic budget calculation; hydrological measurements and data sources
- 1.2 Water inputs: Water vapour; precipitation and its variability, Intensity-Duration-Frequency (IDF) relationships.
- 1.3 Water storages: Interception, throughfall and depression storage — controlling factors and estimation.
- 1.4 Water losses: Evaporation, transpiration and evapotranspiration — controlling factors and estimation.

### **Unit 2: Surface and Groundwater Hydrology and Related Applications**

- 2.1 Catchment processes: Generation of direct runoff, streamflow and baseflow.
- 2.2 Vertical distribution of water: zone of aeration and saturation. Water-bearing properties of rocks, groundwater flow — Darcy's law.
- 2.3 Water harvesting: models and feasibility
- 2.4 Water management in tropical farmlands: techniques and approaches.

### **Unit 3: Morphology of Ocean Basins**

- 3.1 Relative and absolute motion of plates; Characteristics of continental margins, ridges, guyots, trenches, canyons, fracture zones, island arcs and their tectonic settings.
- 3.2 Marine sediments: Classification, origin, composition and distribution.
- 3.3 Morphology and evolution of coral islands, conditions for coral growth, distribution of coral reefs; problem of coral bleaching.
- 3.4 Evolution and bottom topography of Indian ocean: with respect to submarine ridges, islands, continental shelf, trenches, straits and marginal seas.

### **Unit 4: Ocean Circulation and Marine Resources**

- 4.1 Atmosphere-Ocean-Climate coupling: Feedback mechanisms, ocean mixed layer dynamics, fluxes in the boundary layer, gas exchange.
- 4.2 Ocean circulation: Sea surface currents, deep ocean circulation; generation of wind-waves
- 4.3 Generation of tides: Factors controlling the nature and magnitude of tides, characteristics of tidal bore.
- 4.4 Utilisation of the oceanic resources: Nature and types, Regulatory measures like EEZ and CRZ.

# **GEOPCOR07T: SYNOPTIC AND APPLIED CLIMATOLOGY (4 CREDIT)**

## **Unit1: Atmospheric Dynamics**

- 1.1 The climate system; the concept of micro, meso and macro-climate.
- 1.2 Atmospheric temperature; equations for state of ideal gases; First and Second Laws of Thermodynamics.
- 1.3 Atmospheric moisture; process of condensation and precipitation; Carnot Cycle and Clausius-Clapeyron equation, conditions of stability and instability.
- 1.4 Concepts and equations of pressure, gravity, centripetal and Coriolis forces; geostrophic and gradient winds; divergence and vertical motion and vorticity

## **Unit 2: Synoptic Climatology of the Tropics**

- 2.1 Tropical wet and dry climates; Tropical air masses — characteristics, identification and modification, convergence and divergence.
- 2.2 Tropical circulations: Hadley and Walker cells, ENSO phenomena
- 2.3 Mechanism of Indian Monsoon and causes of its variability
- 2.4 Weather hazards: heat and cold waves, thunderstorm and cyclone — genesis and forecasting.

## **Unit-3: Climate Change**

- 3.1 Scientific evidences of climate change; reconstruction of past climates
- 3.2 Theories of climate change.
- 3.3 The climate cycle and climate trends.
- 3.4 Implications and arguments on recent trends of global climate

## **Unit 4: Applied Climatology**

- 4.1 Bioclimatology: Human comfort in relation to climate.
- 4.2 Synoptic Climatology in pollution studies, aviation and navigation
- 4.3 Urban climatology with special reference to urban heat island
- 4.4 Approaches and techniques of weather forecasting in India: short, medium and long range

## **GEOPCOR08T: HUMAN CULTURE AND SOCIETY (4 CREDIT)**

### **Unit1: Concepts in Cultural Geography**

- 1.1 Cultural Geography: Definition, Evolution and Approaches; its nature and content
- 1.2 Key Concepts of Culture : Material and Non Material Culture; Cultural Diversity and Cultural Landscape; Cultural Diffusion
- 1.3 Origin of Culture: Cultural Hearth and Cultural Realm, Cultural Region
- 1.4 Cultural Processes: Cultural Assimilation, Integration and Acculturation; Cultural Segregation and Cultural Regeneration; Detribalization and Sanskritization.

### **Unit 2: Elements of Indian Society**

- 2.1 Concept of Caste, Class, Gender and Race in India
- 2.2 Perspective of Caste System (M.N Srinibas, M.K.Gandhi and B.R. Ambedkar), Caste and Social Stratification; Caste Movement and National Integration, Castes, disadvantaged communities and social justice
- 2.3 Tribal Communities: Definitional Problems, Distinctive Features and Concentration, Tribal Problems and effects of Detribalization
- 2.4 Indian Society and its multicultural identity

### **Unit 3: Social-Cultural Relations**

- 3.1 Social groups in tribal, traditional and modern society
- 3.2 Culture and environment; technocentric and ecocentric views of development
- 3.3 Culture and technology —Industrialization, Migration, Urbanization, Modernization and Cultural Globalization
- 3.4 Impacts of technology and mobility on society

### **Unit 4: Issues of Social Change in India**

- 4.1 Social change– evolving scenario of caste-class divides and rural-urban divides ; Process of Transformation and rise of Middle Class
- 4.2 Social problems: social exclusion, poverty, migration ;crime and human trafficking
- 4.3 Digital society: evolution , global village , global city, digital divide; impact of ict on human culture and society
- 4.4 Social Planning: Constitutional provisions and its Implications, Impacts of Five Year Plans on social change

## **/// GEOPCOR09T: INDIA: RESOURCE APPRAISAL AND MANAGEMENT (4 CREDIT)**

### **Unit1: Regions of India**

- 1.1 India as a land of diversities, Historical and political integration.
- 1.2 Physico-Economic Regions of India
- 1.3 Agro-climatic regions of India: Delineation and Divisions
- 1.4 Planning regions of India: Delineation and Divisions

### **Unit 2: Natural resource appraisal and management**

- 2.1 Water resource management: Potential and uses, big dams, river linkage, utilisation of ground water.
- 2.2 Biotic resource management: Biodiversity conservation and participatory forest management, social forestry.
- 2.3 Land resource management. Land tenure and land reforms ; wastelands and wetlands
- 2.4 Mineral and energy resources: conservation and management.

### **Unit 3: Human and economic Resources**

- 3.1 Quality and composition of population: Concepts, sex ratio, literacy rate, life expectancy; constitutional directives in improving population quality; Human Development disparity.
- 3.2 Urban Population in India: problems and policies; rural-urban linkage.
- 3.3 Industrial Development in India ,Impact of new industries and globalisation on industrial sector
- 3.4 Trade and transport policies: growth and development..

### **Unit 4: Geography of Deltaic West Bengal**

- 4.1 Hydromorphological characteristics: geomorphic units and surface hydrology.
- 4.2 Problems of flood, drought and ground water contamination
- 4.3 Population dynamics : growth, migration and changing composition
- 4.4 Agricultural and industrial scenario: problems and prospects.

# **GEOPCOR10P: MAP INTERPRETATION AND MAPPING TECHNIQUES (4 CREDIT)**

## **Unit1: Map Projections and Analysis of Geological Maps**

- 1.1 Map projections: Principle, properties, limitations and uses of Polyconic and Sinusoidal Projection.
- 1.2 Map projections: Principle, properties, limitations and uses of Gall's Stereographic and Mollweide's Projection and Universal Transverse Mercator's Projection
- 1.3 Interpretation of geological maps with faults and/or intrusions.

## **Unit 2: Interpretation of Topographical Maps**

- 2.1 Morphometric analysis and interpretation of relief aspect of drainage basins: Hypsometric curve, clinographic curve/ slope determination by Raize and Henry method, Ruggedness Index, Dissection Index, Constant of Channel Maintenance
- 2.2 Morphometric analysis and interpretation of linear aspect of drainage basins: Longitudinal profile of a stream Stream ordering by Strahler and Horton, drainage density, drainage texture
- 2.3 Mapping and interpretation of cultural attributes: Nearest neighbour analysis, accessibility index and detour index.

## **Unit 3: Mapping Spatial Pattern and Inequality**

- 3.1 Location of mean centre and standard distance measure.
- 3.2 Population projection using exponential curve and Breaking point analysis
- 3.3 Location Quotient, Functional classification of urban places by Ternary diagram.
- 3.4 Lorenz Curve and Gini Coefficient for measuring inequality.

## **Unit 4: Laboratory Note Book and Viva voce**

# Semester – III

## **GEOPCOR11T: PHILOSOPHIES OF GEOGRAPHY AND GEOPOLITICS (4 CREDIT)**

### **Unit1: Paradigm Shift in Geography**

- 1.1 Cultural Landscape: Carl Sauer,
- 1.2 Colonialism and post-colonialism.
- 1.3 Structuralism and Post structuralism
- 1.4 Modernism and postmodernism

### **Unit 2: Geography as a Social Science**

- 2.1 Welfare Geography, Geography of Gender
- 2.2 Revival of Environmentalism and ecological approach, Geography as Human Ecology
- 2.3 Positivism and Critiques of Positivism, Critical theory and Habermas
- 2.4 Laws, theories and models in Geography

### **Unit 3: Political Geography and Geopolitics**

- 3.1 Political Geography as the politics of place; Functional approach; genetic functional theory of Political Geography.
- 3.2 Changing perspectives of world power: views of Mahan, Spykman and Cohen.
- 3.3 Concepts and characteristics of Nation, State and nationalism; Buffer States and Land-locked States, Electoral Geography and Federalism.
- 3.4 Politics of World Resource with special reference to oil.

### **Unit 4: Political Geography of Indian Subcontinent**

- 4.1 Changing Political Map of India since Independence; emergence of new states.
- 4.2 Political Geography of SAARC Region: boundary dispute and trade relations
- 4.3 Geopolitics of the Indian Ocean; International and interstate water dispute with reference to Ganga and Kaveri water.
- 4.4 Geo-political Problems in Border States: Enclaves, exclaves and cross-border infiltration.

# **GEOPCOR12T: MULTIVARIATE STATISTICS IN GEOGRAPHY (4 CREDIT)**

## **Unit1: Modelling and inference using the multivariate normal distribution**

- 1.1 Geographical data and multivariate analysis
- 1.2 Elementary ideas of matrix algebra
- 1.3 Non-linear bivariate relationships
- 1.4 Multivariate analysis : multiple regression and correlation

## **Unit 2: Exploratory techniques based eigenvalue and singular decomposition**

- 2.1 SVD of a data matrix; special decomposition
- 2.2 Principal Component Analysis
- 2.3 Factor Analysis
- 2.4 Canonical Correlation

## **Unit 3: Classification and Clustering**

- 3.1 Linear Discrimination
- 3.2 Classification Trees
- 3.3 Hierarchical Clustering
- 3.4 K-means Clustering

## **Unit 4: Project work**

- 4.1 A short project to be submitted which consists of analysis of a real data set using the techniques covered in class. The data set chosen should be of interest to the student. The student should be encouraged to find data by themselves for the project or use primary data from their own field experiences.

# **GEOPDSE01T: A. FLUVIAL PROCESSES AND MANAGEMENT (4 CREDIT)**

## **Unit 1: Fluvial Process: Adjustment of Channel Form**

- 1.1 Dominant controls of channel adjustment, concept of equilibrium and stable channel
- 1.2 At-a-station and downstream adjustments of cross-sectional form and longitudinal profile
- 1.3 Adjustments in planform: The continuum concept of channel pattern, conditions of meandering and braiding
- 1.4 Channel changes: causes of avulsion, capture, bank erosion, cut-offs; evidences of change

## **Unit 2: Anthropogenic interferences in channel management**

- 2.1 Human interferences and bed level variations in streams: Degradation, scour, aggradation — causes, effects and management.
- 2.2 Effects of construction of large dams and reservoirs: Disturbances in stream system, water quality in reservoirs. Large versus small dams, decommissioning of big dams,
- 2.3 River stabilization and restoration, River Action Plans
- 2.4 Management of river discharge — case study of Farakka Barrage Project

## **Unit 3: Floodplains and flood management**

- 3.1 Floodplain processes, delineation and morphology
- 3.2 Causes and characteristics of floods, fluvial responses to flood, flood hydrographs and flood routing.
- 3.3 Estimation of magnitude and frequency of extreme events. Perception of flood and flood management
- 3.4 Management of flood — case study of Kosi

## **Unit 3: Integrated Watershed Management**

- 4.1 Concept of integrated watershed management,
- 4.2 Identification of different stakeholders, and their relative importance, community participation, watershed management policies
- 4.3 Watershed resource appraisal – Physical, hydrological, land use/ land cover.
- 4.4 Techniques in watershed management: Applications of GIS and RS, role of Decision Support System and EIA.

# **GEOPDSE01T: B. RURAL INSTITUTIONAL MANAGEMENT AND DEVELOPMENT IN INDIA (4 CREDIT)**

## **Unit 1: Strategies for Rural Planning and Development**

- 1.1 Need for Rural Development in India with special reference to : poverty, illiteracy, unemployment ,migration, and land issue
- 1.2 Concept of mechanism of micro-regional planning : Bottom-up, Multi level planning, Local self governance and PRI
- 1.3 Evolution of Decentralisation process in India : Works of Balwantrao Mehta, Gadgil, Asok Mehta, G.V.K. Rao; Community Development Programme
- 1.4 Panchayati Raj Institutions: Evolution, Framework, Powers, Structure and Functioning at the Zilla Parishad, Panchayat Samiti , Gram Panchayat and Gram Sansad level through provisions of 73<sup>rd</sup> Constitutional Amendment Act and West Bengal Panchayati Raj Acts

## **Unit 2: Rural Development in India: Policies and Programmes**

- 2.1 Concept and Approaches to Rural Development: Gandhi's and Tagore's perspective; Sectoral Approach; Area Approach; Target Group Approach; Service Centre Approach and Rural Livelihood Approach
- 2.2 Role of Ministry of Rural Development, NABARD, Micro Finance Institutions, NGOs and Civil Society Organisations: in rural development
- 2.3 Rural Infrastructure Development: physical and social infrastructures, Smart village
- 2.4 Major Rural Development Programmes.: achievements and failures with case studies

## **Unit 3: Target Area and Target Population: Case Studies from West Bengal**

- 3.1 Border Area : vulnerabilities, prospects and potentialities; development policies and programmes on economy with emphasis on trade
- 3.2 Drought prone Area : vulnerabilities prospects and potentialities: development policies and programmes on sustainable livelihood practices
- 3.3 Hill Area : vulnerabilities, prospects and potentialities ; development policies and programmes on economy with emphasis on tourism
- 3.4 Tribal Area: vulnerabilities, prospects and potentialities; development policies and programmes on tribal economy with emphasis on handicraft

## **Unit 4: Rural reconstruction and Changing rural life and economy:**

- 4.1 Impact of Co-operative and Self Help Group Movement in rural India
- 4.2 Development induced displacement and its consequent rehabilitation programme
- 4.3 Impact of globalization and liberalization on rural development and measures of recovery and growth
- 4.4 Programme of rural employment generation and flagship programs.

# **GEOPDSE01T: C. NATURAL SYSTEMS IN THE ANTHROPOCENE**

## **Unit 1: Natural systems Concept**

- 1.1 Principles and components of natural systems
- 1.2 Characteristics of geosphere, biosphere, cryosphere, hydrosphere and atmosphere
- 1.3 Interlinkages between the components of natural system
- 1.4 Natural system and anthropogenic system

## **Unit 2: Anthropogenic activity and natural system**

- 1.1 Growth and distribution of human population both in spatial and temporal context
- 1.2 Exploitation of natural resources and its impact on natural systems: deforestation, agriculture, water exploitation
- 1.3 Man-Environment relationship during Anthropocene
- 1.4 Anthropogenic response to hazard, vulnerability, disaster and risk

## **Unit 3: Aspects of natural systems management**

- 1.1 Concept of earth's carrying capacity and laws of limiting factors
- 1.2 Environmental impact assessment
- 1.3 Ideas of environmental ethics, environmental protection and global responsibility
- 1.4 Green alternatives in environmental management

## **Unit 4: Sustainable development and environmental management**

- 1.1 Concept and principles of sustainable development
- 1.2 Principles of environmental management
- 1.3 Global treaties, conventions and protocols on environmental management
- 1.4 Sustainable development goals (2030) and India's initiatives

*Sumit* Gopa Samanta

Ramkrishna Maiti

Subhamita Chaudhuri

# **GEOPCOR13P: REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM (4 CREDIT)**

## **Unit1: Fundamentals of Remote Sensing**

- 1.1 Principles of remote sensing: EMR, radiation laws; energy interaction with atmosphere and earth's surface.
- 1.2 Satellite platforms, sensors and their resolutions.
- 1.3 Georeferencing and mosaicking of maps and satellite images.
- 1.4 Preparation of colour composites using different band combinations.

## **Unit 2: Digital Image Processing**

- 2.1 Extraction of spectral signature from satellite data, Contrast enhancement: Linear, non-linear, logarithmic, density slicing.
- 2.2 Unsupervised classification of satellite data:
- 2.3 Supervised classification of satellite data Training sites selection and statistical information extraction.
- 2.4 Generation of signature separability, signature statistics and classification report.

## **Unit 3: Geographical Information System**

- 3.1 Vector data formats with file extensions, Scanning, on-screen digitization, data attribution Generation of vector layers and buffers.
- 3.2 Digitization, error identification, correction. Editing and topology building, line and area measurements
- 3.3 Preparation of thematic maps and change detection using multi-dated maps and images.
- 3.4 Construction of Digital Elevation Models from SRTM data.

## **Unit 4: Laboratory note book and Viva voce**

## **GEOPCOR14P: GROUND SURVEY AND FIELD METHODS (4 CREDIT)**

### **Unit 1: Global positioning system**

- 1.1 Principles of GPS positioning, applicability of WGS-84 and Everest reference ellipsoids.
- 1.2 Different techniques of GPS survey and capability of GPS receivers.
- 1.3 Generation of on-field vectors using UTM Projection and their plotting. Calculating area and perimeter of closed and open traverse
- 1.4 Exporting GPS vectors to GIS programme.

### **Unit 2: Measuring and Surveying**

- 2.1 Measurement of slope and dip with the help of Abney Level and Clinometer.
- 2.2 Measurement of height and distance of an inaccessible object by Theodolite.
- 2.3 Land survey by Theodolite Tacheometric principle
- 2.4 Preparation of Contour map by Total Station

### **Unit 3: Laboratory Note Book and Viva Voce**

### **Unit 4: Field Report on Group project**

Guidelines for Field Work: 5 to 6 students per group. Topic based on relevant local problem.

Either a rural or an urban area of about 5 km<sup>2</sup> is to be selected for study.

The work is to be based mainly on processing of primary data collected from field with the help of appropriate schedules for physical and socio-economic survey, stressing on any suitable problem or any contemporary issue.

Duration of the field study should not exceed seven days. The area and supervisor (s) of the Report are to be determined by the Departmental Committee.

The following are to be taken as base maps, subject to availability: (a) cadastral maps, (b) 1:50,000 and/or 1:25,000 topographical sheets and (c) Satellite imageries and/or data.

Interrelations between different aspects of the study should be the focus of the Report.

Text of the Report should not exceed 6,000 words and should ideally be divided into the following sections:

- Introduction
- Statement of problem(s) and Objectives
- Materials and methods
- Discussions
- Conclusion
- References / Bibliography and Appendices (if any).

Maps, diagrams and sketches, excluding photographs, should not exceed 15 pages of A4 size paper. Handwritten Report duly endorsed by the Supervisor(s) is to be produced individually by the students. Photocopying and computer typing are not to be allowed in any form.

# Semester – IV

## **GEOPCOR15T: ENVIRONMENTAL GEOGRAPHY AND SUSTAINABLE URBAN DEVELOPMENT (4 CREDIT)**

### **Unit1: Environmental Management and Conservation**

- 1.1 Evolution of Environmental Concepts: Perception of degradation, pollution, hazard and disaster and vulnerability
- 1.2 Population Equilibrium, Biodiversity, Biotechnology and economics of biodiversity.
- 1.3 Ecosystem Management, ecosystem resilience
- 1.4 Resource conservation and management with special reference to wetlands.

### **Unit 2: Contemporary Environmental Issues, Problems and Policies**

- 2.1 Problem of groundwater pollution: Arsenic
- 2.2 Environmental Movements in India
- 2.3 Environmental refugees: Problems related to displacement, rehabilitation and compensation
- 2.4 National Environmental Policies and Management: Wastewater and Air Pollution

### **Unit 3: Unit 3: Principles of Sustainable Urban Development:**

- 3.1 Types and characteristics of Urban areas : Megalopolis, Satellite Towns, Metropolitan Areas and Urban Agglomerations
- 3.2 Concept of sustainable urban development, policies at the global level with its implications
- 3.3 Urban environment in India: Physical and social
- 3.4 Policies of urban development at the national level and its implications : National Commission on Urbanization(NCU), Integrated Development of Small and Medium Towns (IDSMT), Jawaharlal Nehru National Urban Renewal Mission (JNNURM); Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

### **Unit 4: Unit 4: Sustainable Urban Management Practices in India**

- 4.1 Water scarcity and management
- 4.2 Solid waste management and ecological consequences, MSWM Rules 2016
- 4.3 Urban transport problems and policies
- 4.4 Informal settlement and housing; Affordable Housing schemes in India

*Sumit. Gopa Samanta*

*Ramkrishna Kashi*

*Subhamita Chaudhuri*

**Unit 1 Coastal Processes and Coastal Engineering**

- 1.1 Mechanics of wind generated waves: Linear (Airy) wave theory. Waves in shallow waters — Wave refraction, shoaling and wave breaking
- 1.2 Coastal sediment transport: Dynamic beach profile; cross-shore rip currents, along shore littoral transport, coastal cells
- 1.3 Coastal protection structures: offshore breakwaters, sea walls, groins, artificial bays and beach nourishment — advantages and limitations
- 1.4 Management of coastal erosion with special reference to Digha township

**Unit 2: Deltaic-Estuarine problems and management**

- 2.1 Deltaic-Estuarine morphology and sedimentary environment. ;
- 2.2 Estuarine hydrodynamics; influence of tide and estuarine sedimentation.
- 2.3 Anthropogenic impact, estuarine problems and their management
- 2.4 Management of Reclaimed Coastal areas with special reference to Indian Sundarbans

**Unit 3: Coastal Morphological Components, Ecological Significance and Coastal vulnerability**

- 3.1 Significance of mangroves in ecological and geomorphological character of muddy coasts, process of bio-tidal accretion/: threats and management.
- 3.2 Formation, system of change and classification of coastal landforms with special reference to beach topography and coastal dunes, beach-dune interactions in sandy coasts
- 3.3 Geomorphic response to Sea level change: Quaternary sea level variations, patterns, consequences and management.
- 3.4 Tropical storms: Risk, vulnerability and management

**Unit 4 Integrated Coastal Zone Management (ICZM)**

- 4.1 Concept, objectives, administrative component — Policy and legislation, Zoning, Regulation and Enforcement. Types of management plans
- 4.2 Social component — Traditional practices, Community-based management, Capacity building, Recreation and Tourism management, Conflict management
- 4.3 Technical component — EIA, Risk and Hazard Assessment, Landscape and Visual Resource Analysis, Economic analysis
- 4.4 Plan Implementation, monitoring and evaluation.

*Sumit. Gopa Samanta*

*Ramkrishna Maiti*

*Subhamita Chaudhuri*

## **GEOPDSE02T: B. RURAL ECONOMY AND DEVELOPMENT IN INDIA (4 CREDIT)**

### **Unit1: Rural Resource and Development**

- 1.1 Sustainable development : the role of rural resources
- 1.2 Sustainable development policies on agrarian economy
- 1.3 Women and rural development policies
- 1.4 Sustainable Development in tertiary sectors: health, education and transport

### **Unit 2: Indigenous Knowledge and Sustainable Resource Management**

- 2.1 Indigenous Traditional knowledge (ITK) in agriculture, fishing, forestry and food processing
- 2.2 Community participation and resource management with respect to Common Property
- 2.3 Forest Resource management through Community participation
- 2.4 Water Resource management through Community participation

### **Unit 3: Industrial products and its marketing**

- 3.1 Earthen craft industry ,Cottage industry : Gandhian and Tagorian perspective
- 3.2 Forest based products :Honey, medicinal plants, handicraft
- 3.3 Agro based products : Food crop, cash crop, livestock and horticulture
- 3.4 Transportation, Trade and commerce :Significance of Fair, mela, hat, rural service centre

### **Unit 4: Rural development in relation to Agriculture and Irrigation**

- 4.1 Agricultural Reform and Land Reform; Land Reform Policies and their impacts in West
- 4.2 Impact of Green Revolution on Economy, Society and Environment
- 4.3 Large scale and Small scale irrigation projects; The changing pattern of irrigation in India
- 4.4 National Policies on the Improvement of Agriculture in India

*Sumit. Gopa Samanta*

*Ramkrishna Maiti*

*Subhamita Chaudhuri*

# **GEOPDSE02T: C. MANAGEMENT OF PHYSICAL AND HUMAN ENVIRONMENT**

**(4 CREDIT)**

## **Unit 1: Ecology and Environment management**

- 1.1 Ecosystem management: concept, types, components, adaptation to environment
- 1.2 Bio-diversity management: types, diversity indices-alpha ( $\alpha$ ), Beta ( $\beta$ ), Gamma ( $\gamma$ ), threats, conservation of biodiversity in India.
- 1.3 Pollution management: Air, water, soil, noise — control measures in India
- 1.4 Disaster resilience scenario in India

## **Unit 2: Watershed management in India**

- 2.1 Principles and significance of watershed management
- 2.2 Water budgeting at watershed scale
- 2.3 Water conservation and harvesting: importance and techniques
- 2.4 Ground water storage and need for artificial recharge

## **Unit 3: Wetland Management in India**

- 3.1 Types and importance of wetland
- 3.2 Functions of wetland: ecological, social, economic and cultural
- 3.3 Present status and management of East Kolkata Wetland
- 3.4 Wetland conservation and management rule, 2017 and its application

## **Unit 4: Management of human environment**

- 4.1 Components of human environment
- 4.2 Managing poverty, malnutrition and water security
- 4.3 Social impacts of forest protection policies in India
- 4.4 Need for environmental education and skill enhancement for disaster resilience

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# **GEOPDSE03T: A. MANAGEMENT OF NATURAL AND MAN-MADE HAZARDS**

**(4 CREDIT)**

## **Unit 1: Soil Erosion Problems and Management**

- 2.1 Processes of soil erosion by raindrop and runoff, factors governing soil erosivity and erodibility
- 2.2 Soil erosion and degradation: Economic and Productivity Implications, management options
- 2.3 Formation of badlands on lateritic terrain
- 2.4 Strategies for reclamation of rills and gullies

## **Unit 2: Groundwater Problems and Management**

- 2.1 Groundwater accumulation and flow mechanics.
- 2.2 Fluctuations of groundwater levels due to meteorological phenomenon, tides, urbanization and irrigation
- 2.3 Groundwater quality: Salinity, Fluoride concentration and Heavy metal pollution
- 2.4 Management of groundwater: Monitoring of quality, control of saline water intrusion, groundwater basin investigations, basin management by conjunctive use

## **Unit 3: Urban Geomorphic Problems and Management**

- 3.1 Concept of urban geomorphology, nature of urban geomorphic problems and technological applications
- 3.2 Approaches to urban hydrology; Effects of urbanisation on runoff generation
- 3.3 Urban water cycle, urban wastewater and urban nutrient dynamics
- 3.4 Sustainable management of urban wastewater – Case study of East Kolkata Wetlands

## **Unit 4: Geological Hazard Management and Planning**

- 4.1 Earthquakes - causes, characteristics, effects and damage potential, associated hazards, response; Potential Earthquake Sites in India; Case Study of any one major earthquake
- 4.2 Tsunamis - mechanism, potential areas, damaging effects, associated hazards, preparedness; Case Study of the 2004 Indian Ocean Tsunami
- 4.3 Hazard monitoring, tracking and modelling, Early warning systems, warning protocols, India Disaster Resource Network
- 4.4 Disaster mitigation: Structural and Non-structural; Disaster Management Policy in India

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*Ramkrishna Maiti*

*Subhamita Chaudhuri*

## **GEOPDSE03T: B. RURAL CULTURE AND DEVELOPMENT (4 CREDIT)**

### **Unit1: Impact of Rural Socio-cultural practices in India**

- 1.1 Association of religious practices with water bodies and forest
- 1.2 Religious customs in relation to crop calendars (Bihu, Pongal) and lunar cycle (Sankranti, Haj Yatra)
- 1.3 Socio-environmental constraints and their impact on Fusion of religious practices (Bon - Bibi and Dakshin Ray)
- 1.4 Geographical perspective of Folk culture: song and music (Baul and Bhatiali)

### **Unit 2: Indigenous products of Rural West Bengal**

- 2.1 Individual initiatives : Potters (Terracotta) and handloom weavers (Tant cotton and silk)
- 2.2 Community initiatives:: Boat making (Balagarh) and bidi (Murshidabad).
- 2.3 Harnessing local resource: Tiger prawn seed collection (Meen culture in Sundarbans)
- 2.4 Social welfare measures towards the artisans: Government initiatives and SHG's.

### **Unit 3: Rural Tourism**

- 3.1 Tourism Planning and Policies: Incredible India Campaign, Biswa Bangla Campaign, Tourism Policy of 2008 & 2016; Role of WBTDCL
- 3.2 Role of Central Government and State Government Departments in Rural Tourism: Panchayati Raj, Tribal welfare and Transport
- 3.3 Tourism Infrastructure and Community participation: Beach Tourism and adventure tourism
- 3.4 Ecotourism and its impact on local economy

### **Unit 3: Rural regeneration through Tourism in West Bengal**

- 3.1 Scope and Nature of Rural Tourism in West Bengal; Religious tourism and Heritage Tourism; Tourism and Gender
- 3.2 Craft and Handicraft based tourism : Problems, Potentialities and Planning
- 3.3 Nature based tourism : Problems, Potentialities and Planning
- 3.4 Tourism and Disaster: Economic and Social Implications in vulnerable areas

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*Ramkrishna Maiti*

*Subhamita Chaudhuri*

## **GEOPDSE03T: C. ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL LEGISLATION IN INDIA (4 CREDIT)**

### **Unit 1: Environmental Impact Assessment**

- 1.1 Concept, components, principles, of Environmental Impact Assessment, Environmental Impact Management, Environmental auditing
- 1.2 India-EIA notification 2006 and draft notification 2020
- 1.3 Environmental compliance requirements; Water Act,1974, the Environment Act,1986, biological diversity act 2002 and , noise pollution rule 2000
- 1.4 EIA methodologies: contingent evaluation techniques, checklist and matrices

### **Unit 2: Environmental Governance in India**

- 2.1 42<sup>nd</sup> amendment Act, article 51A, Supreme Court expanded article 21,
- 2.2 Roles and responsibilities of Ministry of environment and Forest, 1985, Central Pollution Control Board, State Pollution Control Board
- 2.3 Indian Forest Act of 1927 and 1980, Atomic Energy Act of 1962, Wildlife Protection Act of 1972
- 2.4 Importance of Public Interest Litigation and Green Bench

### **Unit 3: Climate change adaptation challenges in India**

- 3.1 National Action Plan on Climate Change (NAPCC), 2008
- 3.2 National Solar Mission (2010)
- 3.3 National Water Mission, National Mission for Sustaining the Himalayan Ecosystem (2014)
- 3.4 National Mission for a Green India (2014), National Mission for Sustainable Agriculture (2010)

### **Unit 4: Environmental management System based on ISO standard**

- 4.1 ISO14001: 2015
- 4.2 ISO14004: 2016
- 4.3 ISO14005:2019
- 4.4 India's present adaptation to ISO standard in Environmental management

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*Subhamita Chaudhuri*

## **GEOPDSE04P: A. APPLIED GEOMORPHOLOGY PRACTICAL (4 CREDIT)**

### **Unit 1: Quantification and interpretation of fluvial processes and forms**

- 1.1 Measurement of channel planform: Braiding index, Sinuosity index, Meander wavelength and Radius of curvature.
- 1.2 Calculation of hydraulic geometry equations from field data
- 1.3 Calculation of velocity and discharge using Manning's equation, Stage-discharge rating curves, measurement of velocity by using current meter.
- 1.4 Analysis and interpretation of Thiessen polygon of drainage basins, Flow Duration Curves and Stage-discharge rating curves.

### **Unit 2: Quantification and interpretation of coastal processes and forms**

- 2.1 Preparation of wave refraction diagram and interpretation
- 2.2 Monitoring tide in field and its interpretation
- 2.3 Determination of breaker types and computation of breaking wave energy by empirical equations. Mapping of coastal vulnerability.
- 2.4 Study of beach morphology, identification of sedimentary structures and biogenic forms in beach environment.

### **Unit 3: Sediment and water analysis**

- 3.1 Measurement of suspended sediment concentration
- 3.2 Analyses of Pebbles: Shape Indices,
- 3.3 Textural analysis by sieving and pipette method.
- 3.4 Measurement of salinity

### **Unit 4: Practical Note Book and viva voce:**

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# **GEOPDSE04P: B. REGIONAL PLANNING AND RURAL DEVELOPMENT PRACTICAL (4 CREDIT)**

## **Unit 1: Rural Research Method and Methodology**

- 1.1 Pre-field Issues on rural research: Contemporary research trends, literature search on research problem stated, framing research question and hypothesis, selecting study area and target population, identifying and collecting relevant secondary data , preparing survey schedule and questionnaire.
- 1.2 Issues on Field research: Pilot study based on questionnaire, Ethnographic Field diary ; Longitudinal study and case study research; Ethical Issues in collection of primary data
- 1.3 Field Techniques: Participatory Rural Appraisal (PRA) and Focus Group Discussion (FGD)
- 1.4 Post Field Techniques :Methods of report writing: Transcription from ethnographic field notes, audio-video recordings, participant observation , PRA and FGD

## **Unit2: Students' perception study through field-based visual observations**

- 2.1 Rural communities and Natural resource management: land/ water/ biotic resources
- 2.2 Rural communities and disaster resilience: floods/ river bank erosion/ cyclones /droughts/ landslide
- 2.3 Rural marketing and farm management: hat, mela or fair
- 2.4 Rural entrepreneurship development : Tourism/ Handicraft industry

## **Unit 3: Techniques and formulation of Rural Planning through Data Analysis:**

- 3.1 Application of qualitative research techniques: Stakeholder Analysis and identification of problems and priorities; SWOT Analysis of a rural development scheme or any sector
- 3.2 Application of statistical techniques in Demographic Data Analysis: Population Composition, Occupational Structure, Dependency Ratio and Measurement of Migration based on Census
- 3.3 Application of GIS and RS: preparation of land use map using open soft ware, mapping of human habitation and detection of change from multi-dated maps and/ or images
- 3.4 Spatial plan formulation and layout for a Gram Panchayat/ Gram Sabha/ village level planning based on the above techniques and on available information from PRI

## **Unit 4: Practical Note Book and viva voce**

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## **GEOPDSE04P: C. APPLIED ENVIRONMENTAL MANAGEMENT (4 CREDIT)**

### **Unit 1: Measurement and mapping of water and soil Quality**

- 1.1 Water sampling: concept, conditions and technique
- 1.2 Estimation of pH, acidity and alkalinity of water samples
- 1.3 Estimation of TSS, TDS, Turbidity, conductivity, DO, BOD, COD, Total hardness of water samples
- 1.4 Soil sampling technique and determination of soil pH, NPK, Organic Carbon

### **Unit 2: Measurement and mapping of air and noise pollution**

- 2.1 Urban Dust fall measurement
- 2.2 Suspended particulate matter measurement: PM 2.5, PM 10
- 2.3 Estimation of air quality index on the basis of station data (CPCB/ SPCB)
- 2.4 Measurement of noise pollution by digital sound meter

### **Unit 3: Ecological survey methods**

- 3.1 Counts, quadrats, transects
- 3.2 Calculate estimated biodiversity using the Simpson's Index of Diversity
- 3.3 Estimate percentage cover and frequency using quadrat data
- 3.4 Estimate abundance using quadrat data

### **Unit 4: Laboratory notebook and viva voce**

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*Subhamita Chaudhuri*

**// GEOPDSE05M: A. PROJECT WORK ON APPLIED GEOMORPHOLOGY OR**

**// GEOPDSE05M: B. PROJECT WORK ON REGIONAL PLANNING AND RURAL DEVELOPMENT**

**// GEOPDSE05M: C. PROJECT WORK ON ENVIRONMENT MANAGEMENT**

**(8CREDIT)**

**Unit 1: Dissertation based on optional paper and viva**

Each Examinee shall prepare a Dissertation Paper under the supervision of a Departmental Faculty on his / her own chosen Theme.

The Report must be documented in duplicate (1 for examinee, 1 for seminar library) under the following Heads:

• Introduction and Conceptual Background; • Statement of the Problem; • Objectives of Study; • Literature Review; • Methodology including data / information / map collection; • Location of the Study Area; • Analysis, Display and Interpretation of Data (relating to each objective separately); and • Conclusion.

The Dissertation Paper should contain • Acknowledgement, • Preface, • Table of Content, • List of Tables, • List of Figures, • List of Plates, • References and • Appendix.

Pages containing Illustrations (maps, diagrams, graphs and photographs) = 40 (maximum).

Word Limit = 10000 (maximum) excluding tables and appendix (Computer typed,

Line Spacing = 1.5;

Font = Arial font size 11/ Times New Roman font size = 12 / 11).

Each Examinee shall submit a copy of the Report before the actual day of Examination.

Each Examinee shall present his / her Paper before an audience comprising Internal / External Examiners and others on the day of Examination using LCD Projector (maximum 25 slides about - concept / idea / theme; major objectives; methodology; study area; observations and analysis; conclusion).

Time allotted for each presentation = 20 minutes (maximum) Marks on performance of individual students (= 6) during preparation of the Dissertation Report and its content (= 6) shall be awarded by the Internal Examiner(s) and on the Research and Academic Quality of the Report (= 12) followed by the Presentation and Viva Voce (= 16) by the External Examiner(s).

## **Section 5: Aptitude Enhancement Course**

### **GEOPAEC01M: COMMUNICATION SKILLS (2 CREDIT)**

#### **Unit1 Non-verbal and Oral Communication**

- 1.1 Importance and purpose of communication, process of communication, types and techniques communication, barriers to communication
- 1.2 Non-verbal communication: body language, tips for improving non-verbal communication
- 1.3 Academic listening: listening to lectures and presentations, tips for taking down points
- 1.4 Reading skills: purpose, process, methodologies, academic reading tips
- 1.5 Speaking skills: pronunciation, communication protocols, expressing opinions and command over language, self confidence

#### **Unit 2: Writing Capability and Communication Skill for Career Building**

- 2.1 Elements of effective writing, the sentence, phrases and clauses, types of sentences
- 2.2 Main forms of written communication: Summarising and elaboration, as per requirement
- 2.3 Remedial English grammar and usage: Articles, tenses, prepositions, correction of errors in a given sentence, errors in the use of words, errors in punctuation, preparing a CV
- 2.4 Presentation skills: Preparing a PowerPoint presentation, presenting a paper, group discussions, preparing for and facing a job interview
- 2.5 Time and stress management: Identifying time wasting elements, time management tips, identifying factors responsible for stress, stress management tips.

## **Section 6: Skill Enhancement Course for Geography**

### **GEOPSEC01M: INTRODUCTION TO COMPUTER PROGRAMMING (2 CREDITS)**

#### **Unit1: Concepts of hardware, Software and Programming**

- 1.1 Introduction to computer system: hardware and software
- 1.2 Introduction to programming methodology, logic of computer program: algorithmic approach
- 1.3 Algorithm: definition, characteristics, advantages and limitations
- 1.4 Flowcharts: definition, symbols of flow chart Pseudocode: definition and basic logic structures (sequence logic, selection logic and iteration logic), advantages and limitations)
- 1.5 Elements of computer programming, programming language and its types

#### **Unit 2: Working with Python Programming Language**

- 2.1 Rationale for using Python language.
- 2.2 Data types and lists; writing simple programs
- 2.3 Programming with loops; Conditional statements
- 2.4 Using Spyder; Functions and Modules.
- 2.5 Reading and writing data files
- 2.6 Dealing with numerical data using NumPy
- 2.7 Plotting data with Python using Matplotlib and Plotly

**GEOPGEC01M: GEOSPATIAL ANALYSIS (4 CREDIT)**

**Unit 1: Cartography and Map Interpretation**

- 1.1 Concept of Map scale, enlargement, reduction, vertical exaggeration.
- 1.2 Introduction to Survey of India topographical maps, numbering, scales, grid reference, signs and symbols.
- 1.3 Relief representation techniques: Profiles, identification and representation of landforms from topographical sheets
- 1.4 Map projections Concept, Classification, types and uses

**Unit 2: Satellite Remote Sensing**

- 2.1 Concept of Remote Sensing: remote sensing process, sources of energy, advantages and limitations of remote sensing.
- 2.2 Remote sensing platforms and sensors: Active and Passive Remote Sensing; PAN / Multispectral / Hyperspectral Imaging; Thermal / Microwave / Radar data
- 2.3 Digital image formats, radiometric correction, geometric correction, image enhancement, filtering; image transformation
- 2.4 Digital image classification methods and algorithms: supervised and unsupervised; accuracy assessment; interpretation of error matrix

**Unit 3: Introduction to GIS**

- 3.1 GIS: evolution and components; concept of datum and spheroid, mean sea level, geoid models; Formats of storing GIS Data Georeferencing a raster layer with GPS Points and an existing georeferenced layer, defining projection
- 3.2 Creating attribute tables: data definition, data input, data updating, queries on tables
- 3.3 Vector based spatial analysis: Vector data formats with file extensions, digitization, editing, topology creation, line and area measurements.
- 3.4 Raster data manipulation: Resampling, Mathematical operations using raster layers

**Unit 4: Global Navigation Satellite System**

- 4.1 1.1 Principles of GNSS positioning with special reference to GPS, different GNSS Systems in Operation; how a GNSS system works; sources of error in a GNSS system
- 4.2 Collection and retrieval of GNSS positions, preparation of maps from GNSS data. .
- 4.3 Length and area measurements from GNSS data
- 4.4 Mapping exercise with hand-held GPS, data downloading and visualization, import GPS data in Google Earth

## **Section 8: Reference List**

### **GEOPCOR01T: Geomorphology and Geotectonics**

- Ballantyne, C.K. (2008): *Periglacial Geomorphology and Sedimentology*, Blackwell Publishing Inc., London.
- Brown, A.G. (1997): *Alluvial Geoarchaeology: Floodplain Archaeology and Environment Change*, Cambridge University Press, Cambridge.
- Chorley, R., Schumm, S. and Sugden, D.E. (1994): *Geomorphology*, Methuen, London.
- Clark, J.R. (1996): *Coastal Zone Management Handbook*, CRC Press / Lewes Publishers, New York.
- Coch, N.K. (1994): *Geohazards: Natural and Human*, Prentice-Hall, Englewood Cliffs.
- Cook, R.U. and Doorncamp, J. C. (1990) *Geomorphology in Environment Management: A New Introduction*, 2nd edition, Clarendon Press-Oxford, Oxford.
- Cooke, R.U., Warren, A. and Goudie. A.S. (1993): *Desert Geomorphology*, CRC Press, London.
- Cox, A. and Hart, R.B. (1986) : *Plate Tectonics: How it Works*, Blackwell Scientific Publications, Oxford.
- Goudie, A (editor) (2004): *Encyclopaedia of Geomorphology*, Volumes 1 & 2, Routledge, London.
- Goudie, A. (editor) (1990): *Geomorphological Techniques*, 2nd edition, Allen Unwin, Crows Nest (Australia).
- Huggett, R. (2006): *Fundamentals of Geomorphology*, Routledge, London.
- Kale, V.S. and Gupta, A. (2001): *Introduction to Geomorphology*, Orient Longman Ltd., Hyderabad.
- Kay, R. and Alder, J. (1999) : *Coastal Planning and Management*, E & FN Spon / Routledge, London
- Keary, P. and Vine, F.J. (1996) : *Global Tectonics*, 2nd edition, Blackwell Scientific Publications, Oxford.
- Knighton, D. (1998): *Fluvial Forms and Processes: A New Perspective*, Arnold, London.
- Kondolf, G.M. and Piégay, H. (editors) (2003): *Tools in Fluvial Geomorphology*, Wiley, Chichester.
- McCullagh, P. (1978) : *Modern Concepts in Geomorphology*, Clarendon Press-Oxford, Oxford.
- Morisawa, M. (editor) (1994): *Geomorphology and Natural Hazards*, Elsevier, Amsterdam.
- Morisawa, M. (1985): *Rivers*, Longman, London.
- Ritter, D.F., Kochel, R.C. and Miller, J.R. (2006): *Process Geomorphology*, 4th edition, Waveland Press, New York.
- Selby, M.J. 1985. *An Introduction to Geomorphology*, Clarendon, Oxford.
- Smith, K. (2004): *Environmental Hazards, Assessing Risk and Reducing Disaster*, 4th edition, Routledge, London.
- Summerfield, M.A. (Editor) (1991): *Global Geomorphology : An Introduction to the Study of Landforms*, John Wiley and Sons Ltd., New York.
- Thomas, D.S.G. (editor) (2008): *Arid Zone Geomorphology: Process, Form and Change in Drylands*, 2nd Edition, Wiley, Chichester.
- Woodroffe, C.D. (2003): *Coasts: Form, Process and Evolution*, Cambridge University Press, Cambridge.

### **GEOPCOR02T: Soil and Plant Geography**

- A.G. Pimente, J. D. (editor) 1993 : *World Soil Erosion and Conservation*, Cambridge University Press, Cambridge: 349p.
- Biswas, T.D. and Mukherjee, S.K. 1987 : *Textbook of Soil Science*, Tata-McGraw-Hill, 314p.
- Brady, N..C. and Weil, R.R. 1996 : *The Nature and Properties of Soil*, 11th edition, Longman, London: 740p.
- Chapman J.L. and Reiss, M.J. 1993: *Ecology: Principles and Applications*, Cambridge University Press, Cambridge.
- Coleman, D.C. and Crosby, J. 1996 : *Fundamentals of Soil Ecology*, Academic Press, San Diego: 203p.

- Cruickshank, J.G., (1972) : Soil Geography, David & Charles, Newton Abbor.
- Ellis, S. and Mellor, R. 1995 : Soils and Environment, Routledge, London: 364p.
- Floth, H.D. 1990 : Fundamentals of Soil Science, 8th edition, John Wiley and Sons, New York: 360p.
- Jacks, G.V. (1963) : Soil, Nelson, London.
- Marsh and Grossa (----) : Introduction to Biogeography
- Mitchell, C. W. 1991 : Terrain Evaluation: An Introductory Handbook to the History, Principles and Methods of Practical Terrain Analysis, 2nd edition, Longman Science & Technical, London: 441 p.
- Morgan, R.P.C. 1995 : Soil Erosion and Conservation, 2nd edition, Longman, London: 198p.
- Myers, A.A. and Giller, P.S. (editors) 1988: Analytical Biogeography: An Integrated Approach to the Study of Animal and Plant Distributions, Chapman and Hall, London.
- Odum, E P (1966): Ecology, Holt Reinhart & Winston, New York.
- Ricklets, R.E. 1993 : The Economy of Nature: A Textbook in Basic Ecology, 3rd edition, W.H. Freeman and Co. New York.
- Schwab, G.O., Fangmeir, D.D. and Elliot, W.J. 1996 : Soil and Water Management Systems, 4th edition, John Wiley and Sons Inc., New York: 371p. I
- Seddon, B. (1971) : Introduction to Biogeography , Duckworth, London.
- Sharma. P.D. 1996 : Ecology and Environment, 71h edition, Rastogi Publications, Mirat.
- Singer, M.J. and MuMs, D.N. 1996 : Soils: An Introduction, Prentice Hall, London: 480p.
- Tivy, J. (1971) : Biogeography : A Study of Plant in the Ecosphere, Oliver & Boyd.
- Viles, H. (editor) (1988): Biogeomorphology, Blackwell, New York.
- Watts, D. (1971) : Principles of Biogeography, McGraw Hill, London.
- West, R G (1968) : Pleistocene Geology & Biology, Longmans, London.
- Wild, A. 1993 : Soils and the Environment: An Introduction, Cambridge University Press, Cambridge: 287p.

#### **GEOPCOR03T: Population and Welfare Geography.**

- Beaujeu Garnier, J., (1966) : Geography of population, Longman, London.
- Chandna, R.C. (1998) : Geography of Population, Rawat, New Delhi.
- Clarke, J.I., (1973) : Population Geography, Pergamon Press, Oxford
- Mitra, A. (1978) : India's Population (Vol.1 & 2), Abhinav, New Delhi.
- Aggarwal, S. M. (1974): India's Population Problems, McGraw Hill Publishing Co. Ltd., New Delhi
- Berelson, B. (1974): Population Policy in Developed Countries, MacMillan, London
- Bhende, A. A. and Kanitkar, T. (2011): Principles of Population Studies, Himalaya Publishing House, Mumbai
- Chandana, R. C. (2013): Population Geography, Kalyani Publications, Delhi
- Coale, A. J. and Hoover, E. M. (1958): Population Growth and Economic Development in Low Income Countries, Amit Publishers, New Delhi
- Desoza, A. A. (1983): Indian Population Problem in Perspective and Social Action, Concept Publications, New Delhi
- Hazel, B. R. (1994): Population Geography, Singapore Publishers Pvt. Ltd., Singapore
- Rao, V. K. R. V. (1966): Education and Human Resource Development, Allied Publishers, Bombay
- Stockwell, E. G. (1968): Population and People, Quadrangle Books, Chicago
- UN (1962): Demographic Aspects of Manpower, Report 1, Sex and Age Patterns of Participation in Economic Activities, Population Studies No. 33, New York

#### **GEOPCOR04T: Geography of Economic Activities**

- Alexander and Hartshorn: Economic Geography, Englewood cliffs, Prentice Hall, 1963
- Behrman Jack, N : Industry ties with Science & Technology Policy.
- Cox K.R. (1972) : Man, Location and Behavior. John Wiley & Sons. N.Y.
- Gregor, H.F. (1970) : Geography of Agriculture – Themes in Research. Prentice Hall, N.Y.
- Hurst, Michael, and E.E.(1974) : Geography of transport, McGraw Hill, New York.
- Raja M & Aggarwal, Y(1986) : Transport Geography of India, Concept, New Delhi.
- Robinson: Geography of Transport.
- Simmons: Agricultural Geography.
- Taafe and Gauthier (1973): Geography of Transportation, Prentice Hall, Englewood Cliffs.
- Thoman & Corbin (1980) : Geography of Economic Activity, McGraw Hill, New York.
- Unwin, T. (editor) 1994: Atlas of World Development, John Wiley and Sons Ltd., Chichester: 364p.
- World Bank 1996: From Plan to Market: World Development Report 1996, Oxford University Press, Oxford: 241p

### **GEOPCOR05P: Statistical Techniques and Computer Application**

- Alvi, Z. 1995 : Statistical Geography: Methods and Applications, Rawat Pub. New Delhi:
- Cochram, W.G. (1953) : Samling Techniques, Asia Publishing House, New Delhi.
- Hammond, R. and Macullagh, P.S. (1974) : Quantitative Methods in Geography, Clarendon Press, Oxford.
- Kendall, M.G.(1945) : The Advanced Theory of Statistics, Charles Griffin & Co., London.
- Mehmood, Aslam (1977) : Statistical Methods in Geographical Studies, Rajesh Publication, New Delhi.
- Pal, S.K. 1999 : Statistics for Geoscientists, Concept publishing Company, New Delhi: 423p.
- Silk, J. 1979 : Statistical techniques in Geography, George Allen and Unwin, London: 276p:
- Walford, P., 1995: Geographical Data Analysis, John Wiley and Sons Inc., New York: 446p.

### **GEOPCOR06T: Hydrology and Oceanography**

- Brooks, K.N., Ffolliott, P.F., Gregersen, H.M and DeBano, F.B. (2003): Hydrology and the Management of Watersheds, 3rd edition, Wiley-Blackwell, Chichester.
- Brutsaert, W. (2005): Hydrology: An Introduction, Cambridge University Press, Cambridge.
- Carter, R.W.G. (1988): Coastal Environments: An Introduction to the Physical, Ecological and Cultural Systems of Coastlines, Academic Press, London.
- Chow, V.T. (1988): Applied Hydrology, McGraw-Hill Education, New York.
- Dingman, S.L. (2002): Physical Hydrology, 2nd edition, Prentice Hall, Englewood Cliffs.
- Ganeri, A. (1994): The Ocean Atlas, Dorling Kindersley, London.
- Garrison, T.S. (2007): Oceanography: An Invitation to Marine Science, 6th edition, Brooks Cole, Chicago.
- Keary, P. and Vine, F.J. (1996): Global Tectonics, 2nd edition, Blackwell Scientific Publications, Oxford.
- Keith, D. and Mays, L.W. (2004): Groundwater Hydrology, 3rd edition, Wiley, Chichester.
- Kinkade-Levario, H. (2007): Design for Water: Rainwater Harvesting, Stormwater Catchment, and Alternate Water Reuse, New Society Publishers, Gabriola Island (Canada).
- Leier, M. (2001): World Atlas of the Oceans: More than 300 Maps and Charts of the Ocean Floor, Firefly Books, London.
- Pinet, P.R.(2006) Invitation to Oceanography, 4th edition, Jones & Bartlett Pub. New York.
- Pirazzoli, P.A. (1996): Sea Level Changes: The Last 20000 Years. Wiley, New York.
- Pugh, D. (2004): Changing Sea Levels. Effects of Tides, Weather and Climate, Cambridge University Press, Cambridge.

- Thruman, H.V. and Trujillo, A.P. (2003): Introductory Oceanography, 10th edition, Prentice Hall, Englewood Cliffs.
- Todd, D.K. (2004): Groundwater Hydrology, 3rd edition, Wiley, Chichester.
- Trujillo, A.P and Thurman, H.V. (2007): Essentials of Oceanography, 9th edition, Prentice Hall, Englewood Cliffs.
- Woodroffe, C.D. (2003): Coasts: Form, Process and Evolution, Cambridge University Press, Cambridge.

#### **GEOPCOR07T: Synoptic and Applied Climatology**

- Ayoade, J.O. (1983): Introduction to Climatology for the Tropics, John Wiley, NYork
- Barry R.G., & Chorley R.J. (1970) : Atmosphere, Weather & Climate, Methuen.
- Critchfield H : General Climatology (1979) : Prentice Hall of India, New Delhi
- Crowe P.R.: Concepts in Climatology.
- Oliver and Hidor (2005): Climatology, Pearson.
- Peterson, S., (1956): Weather Analysis and Forecasting, Methuen, New York.
- Peterson S. (1969): Introduction to Meteorology, McGraw Hill, New York.
- Trewartha G.T. (1968): An Introduction to Climate, (4th ed.) McGraw Hill, New York.
- Thomson, R.D. (1990): Atmospheric Processes and Systems, Routledge, London
- Barry, R. G. and Perry, A. H. (1973): Synoptic Climatology: Methods and Applications, Methuen and Co. Ltd., London
- Navarra, J. G. (1979): Atmosphere, Weather and Climate, W. B. Saunders Company, Philadelphia
- Petterson, S. (1969): Introduction to Meteorology, McGraw Hill, New York
- Rama Sastry, A. A. (1984): Weather and Weather Forecasting, Publications Division, Ministry of Information and Broadcasting, Government of India, New Delhi
- Stringer, E. T. (1972): Foundations of Climatology, W. H. Freeman and Company, New York

#### **GEOPCOR08T: Human Culture and Society**

- Ley D & Samuels M (ed.)(1978) : Humanistic Geography : prospects and problems, Croom Helm, Chicago.
- Morgan L H, (1877) : Ancient Society, Mac Millan & Co. London.
- Robinson H (1976) : Human Geography, Mac Donald & Evans, London.
- Shurmer-Smith, P. (2002) Doing Cultural Geography, Sage, London.
- Smith D M(1977) : Human Geography : A welfare approach, Edward Arnold, London.
- Tuan Yi-Fu (1976) : Humanistic Geography, Annals of Association of American Geographers, vol.66.

#### **GEOPCOR09T: India: Resource Appraisal and Management**

- Ahuja R. 2001: Social problem in India Rawat Publication
- Claval P.2002: An Introduction to regional geography, Blackwell Publishers
- Dežere & Sen 1999 :Indian Development OUP
- Swami Nathan M.S. 2007: Agriculture cannot wait
- Sen P.K. & Prasad N. 2002 An introduction to Geomorphology of India, Allied publishers Pvt. Ltd.
- Singh R.L. (ed) 1971 India: a regional geography NGSI
- Spate O.H.K. & Learmonth A.T.A.1967 :India & Pakistan Munsiram Monoharlal pub.Pvt. Ltd

#### **GEOPCOR10P: Map Interpretation and Mapping Techniques.**

- Hallert, B. (1960) : Photogrammetry, McGrawHill Book Company, London.
- Lillesand T.M. and Kiefer R.W.(1979) : Remote Sensing and Image Interpretation, John Wiley & Sons.,

N. Y.

- Reddy, A. : Geoinformatics.
- Sabins, F.F., 1997 : Remote Sensing: Principles and Applications, 3rd edition, W.H. Freeman & Company, New York: 494p.
- Kellaway, G.P. 1979. Map Projections, 1st Indian edition, B.I. Publication, Delhi.
- Sarkar, A.. Practical Geography: A Systematic Approach, Orient Longman Ltd., Hyderabad: p.
- Roy, P. 1988. An Analytical Study of Map Projections, Volume 1, Pub?, Kolkata.
- Ramamurthy, K. (19 82): Map Interpretation, Rex Printer, Madras
- Vaidyanadhan, R. (1968): Index to a set of sixty topographic maps illustrating specified physiographic feature.
- Gupta, K. K. and Tyagi, V. C. (1992): Working with maps. Survey of India Publication.
- Tamaskar, B. G. and Deshnnikh, V. M. (1974): Geographical Interpretation of Indian Topographical maps. Orient Longman.

### **GEOPCOR11T Philosophies of Geography and Geopolitics**

- Adhikary, S.(1999) : Fundamentals of Geographical Thought, Chaitanya Publishing House, Allahabad.
- Banerjee-Guha, S. (2004) : Space, Society and Geography, Rawat, New Delhi.
- Dickinson, R.E. and OJR Howarth (1933) : The Making of Modern Geography, Clarendon, London.
- Dikshit, R.D.(1997) : Geographical Thought, a Contextual History of Ideas, Prentice Hall, New Delhi.
- Gregory, D (1978) : Ideology, Science & Human Geography, Hutchinson, London.
- Hartshorne, R. (1994): The Nature of Geography, Rawat, New Delhi.
- Johnston, R.J. (1997) : Geography & Geographers, Arnold, London.
- James, P.E. and Jones, C.F.(1954) : American Geography: Inventory & Prospects, Association of American Geographers.
- Lefebvre, H. (1991) : The Production of Space, Blackwell, Oxford.
- Peet, R. (2003) : Radical Geography, Rawat, New Delhi.
- Peet , R. (2001) : Modern Geographical Thought, Rawat, New Delhi.
- Shurmer-Smith, P. (2002) Doing Cultural Geography, Sage, London.
- Stoddart, R. (1981) : Geography, Ideology & Social Concern, Blackwell, Oxford.
- Stoddart, D.R. (1986) : On Geography and its History, Basil Blackwell, Oxford.
- Taylor,G.(ed.) (1951) : Geography in the Twentieth century, New York.
- Wooldridge, S.W. (1956) : The Geographers as Scientists, London.
- Wooldridge, S.W. and East, W.G. (1965) : The Spirit and Purpose of Geography.

### **GEOPCOR12T: Multivariate Statistics in Geography**

- Johnson, R.A. and Wichern, D.W. (2002). Applied Multivariate Statistical Analysis, 5th ed. Prentice Hall. (Required). • Everitt, B. (2005). An R and S-plus companion to multivariate analysis. Springer. (Recommended).
- Anderson, T.W. (2003). An Introduction to Multivariate Statistical Analysis, 3rd ed. Wiley.
- Hastie, T., Tibshirani, R. and Freedman, J. (2001). The Elements of Statistical Learning: Data Mining, Inference, and Perdition. Springer.
- H"ardle, W. and Simar, L. (2003). Applied Multivariate Statistical Analysis. Springer.
- Mardia, K.V., Kent, J.T. and Bibby, J.M. (1979). Multivariate Analysis. Academic Press.
- Acevedo, M. F. (2012): Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press, London
- Johnston, R. J. (1978): Multivariate Statistics in Geography, Longman, London

- Rogerson, P. A. (2010): *Statistical Methods for Geography*, Sage Publications, London
- Summer, G. (1978): *Mathematics for Physical Geographers*, John Wiley, New York
- Yeats, M. H. (1974): *An Introduction to Quantitative Analysis in Human Geography*, McGraw-Hill, New York

### **GEOPDSE01T A: Fluvial Processes and Management**

- Baker, V., Craig-Kochel, R. and Patton, P.C. (1988): *Flood Geomorphology*, Wiley, Chichester.
- Bandyopadhyay, S. 1997 : Natural environmental hazards and their management : a case study of Sagar Island, India, *Singapore Journal of Tropical Geography*, 18(1): 20–45.
- Basu, S.R. (2004): *Man and Environment*, ACB Publishers, Kolkata.
- Basu, S.R. and Sarkar, S. (1996): Development of alluvial fans in the foothills of the Darjiling Himalaya and their geomorphological characteristics. In: Rachocki, A.H. editor): *Alluvial Fans: A Field Approach*, Wiley, Chichester: 321–333.
- Brooks, K.N., Ffolliott, P.F., Gregersen, H.M and DeBano, F.B. (2003): *Hydrology and the Management of Watersheds*, 3rd edition, Wiley-Blackwell, Chichester.
- Brown, A.G. (1997): *Alluvial Geoarchaeology: Floodplain Archaeology and Environment Change*, Cambridge University Press, Cambridge.
- Carter, R.W.G. (1988) : *Coastal Environments: An Introduction to the Physical, Ecological and Cultural Systems of Coastlines*, Academic Press, London.
- Clark, J.R. (1998) : *Coastal Seas: The Conservation Challenge*, Blackwell, London.
- Das, K. and Bandyopadhyay, S. (1996): Badland development in a lateritic terrain at Santiniketan, West Bengal'. *National Geographer*, 31(1&2): 87–103.
- Faniran, A. and Jeje, L.K. 1983. *Humid Tropical Geomorphology*, Longman, London.
- Ford, D.C. and Williams, P. (2007) *Karst Hydrogeology & Geomorphology*, Revised edition, Wiley, Chichester.
- Ghosh, A.K. & Sanyal, P. (editors) (1996): *Integrated Coastal Zone Management: A Manual*, Department of Environment, Govt. of West Bengal / Department of Ocean Development, Govt. of India, Kolkata.
- Ghosh, D. (2005) *Ecology and Traditional Wetland Practice: Lessons from Wastewater Utilisation in the East Calcutta Wetlands*, Worldview, Kolkata.
- Giardino, J.R., Marston, R.A. and Morisawa, M. (Editors) (2000): *Changing the Face of Earth: Engineering Geomorphology*, Elsevier Science, Amsterdam.
- Goudie, A (editor) (2004): *Encyclopaedia of Geomorphology*, Volumes 1 & 2, Routledge, London.
- Goudie, A. (editor) (1990): *Geomorphological Techniques*, 2nd edition, Allen Unwin, Crows Nest (Australia).
- Gregersen, H., Ffolliott , P. and Brookes, K. (2008): *Integrated Watershed Management: Connecting People to their Land and Water*, Cabi Publishing, Nosworthy Way (UK).
- Gupta, A. (editor) (2008): *Large Rivers: Geomorphology and Management*, Wiley, Chichester.
- Harvey, M.A., Mather, A.E. and Stokes, M. (editors) (2005): *Alluvial Fans: Geomorphology, Sedimentology, Dynamics*, Geological Society of London, London.
- Heathcote, I.W. (1998): *Integrated Watershed Management: Principles and Practice*, Wiley, Chichester.
- Huggett, R. (2006): *Fundamentals of Geomorphology*, Routledge, London.
- Kay, R. and Alder, J. 1999 : *Coastal Planning and Management*, E & FN Spon / Routledge, London
- Kennedy, B.A. (2007): *Inventing the Earth: Ideas on Landscape Development since 1740*, Wiley, Chichester.
- Kinkade-Levario, H. (2007): *Design for Water: Rainwater Harvesting, Stormwater Catchment, and Alternate Water Reuse*, New Society Publishers, Gabriola Island (Canada).
- Knighton, D.1998 : *Fluvial Forms and Processes: A New Perspective*, Arnold, London.
- Kondolf, G.M. and Piégay, H. (editors) (2003): *Tools in Fluvial Geomorphology*, Wiley, Chichester.

- Lancaster, B. (2006): Rainwater Harvesting for Drylands, Chelsea Green Publishing Company, Chelsea.
- Masselink, G. and Hughes, M (2003): An Introduction to Coastal Processes and Geomorphology, Hodder Arnold, London.
- Ministry of Environment and Forests, Govt. of India (2005); Report on the Committee chaired by Prof. M.S. Swaminathan to Review the Coastal Regulation Zone Notification 1991, New Delhi.
- Mitchell, C.W 1991. Terrain Evaluation, 2nd edition, Longman Scientific & Technical, Harlow.
- Morgan, R.P.C. (2005): Soil Erosion and Conservation, 3rd edition, Wiley-Blackwell, London.
- Morisawa, M. (editor) 1994. Geomorphology and Natural Hazards, Elsevier, Amsterdam.
- Morisawa, M. 1985. Rivers, Longman, London.
- Nag, P. and Saha, G.N. (1996): Geomorphic Mapping: Perspectives and Dimensions, National atlas and Thematic Mapping Organisation, Kolkata.
- Niyogi, D. 1970 : Geological background of beach erosion at Digha, West Bengal, Bulletin of the Geological Mining and Metallurgical Society of India, 43: 1–36.
- Paul, A.K. (2002): Coastal Geomorphology and Environment: Sundarban Coastal Plain, Kanthi Coastal Plain, Subarnarekha Delta Plain, ACB Publishers, Kolkata.
- Pirazzoli, P.A. 1996. Sea Level Changes: The Last 20000 Years. Wiley, New York.
- Post, J.C. and Lundin, C.G. (editors) (1996): Guidelines for Integrated Coastal Zone Management, The World bank, Washington.
- Pugh, D. 2004. Changing Sea Levels. Effects of Tides, Weather and Climate, Cambridge University Press, Cambridge.
- Rachocki, A.H. ( (1990): Alluvial Fans: A Field Approach, Wiley, Chichester.
- Randhir, T.O. (2006): Watershed Management - Issues and Approaches, IWA Publishing, London.
- Rao, K.L. (1979): India's Water Wealth: Its Assessment, Uses and Projections, Revised edition, Orient Longman, New Delhi.
- Reading H.G. and Collinson, J.D. 1996 : 'Clastic coasts.' In Reading H.G. (editor): Sedimentary Environments: Processes, Facies and Stratigraphy, 3rd edition, Blackwell Science Ltd. Oxford
- Ro, C. (2007): Fundamentals of Fluvial Geomorphology, Routledge, London.
- Rudra, K. (2006): Shifting of the Ganga and Land Erosion in West Benga: A Socio-Ecological Viewpoint, Indian Institute of Management, Kolkata.
- Sen, P.K. (1995): Geomorphological Analysis of Drainage Basin : An Introduction to Morphometric and Hydrological Parameters, University of Burdwan, Bardhaman.
- Smith, K. Environmental Hazards, Assessing Risk and Reducing Disaster, 4th edition, Routledge, London.
- Starkel, L. and Basu, S. 2000 Rains, Landslides and Floods in the Darjeeling Himalaya, Indian National Science academy, New Delhi.
- Summerfield, M.A. (Editor) 1991. Global Geomorphology : An Introduction to the Study of Landforms, John Wiley and Sons Ltd., New York.
- Tinkler, 1985. A Short History of Geomorphology, Croom Helm., Beckenham.
- Vaidyanadhan, R. (editor) (1991): Quaternary Deltas of India, Memoir 22, Geological Society of India, Bangalore.
- White, W.B. (1988): Geomorphology and Hydrology of Karst Terrains, Oxford University Press, Oxford.
- Wilson, J.P. and Gallant, J.C. (editors) 2000. Terrain Analysis : Principles and Applications, John Wiley and Sons Ltd. New York.
- Wirthmann, A. 2001. Geomorphology of the Tropics, Translated by Busche, D. Springer-Verlag, Berlin.
- Woodroffe, C.D. (2003): Coasts: Form, Process and Evolution, Cambridge University
- Bridge, J. (2003): Rivers and Floodplains, Blackwell, London.
- Bridge, J. S. (2003), Rivers and Floodplains: Forms, Processes, and Sedimentary Record, 491 pp., Blackwell, Oxford.

- Dingman, S. L. (2009), *Fluvial Hydraulics*, 559 pp., Oxford University Press, Oxford.
- Lancaster, S. T., and R. L. Bras (2002), A simple model of river meandering and its comparison to natural channels, *Hydrological Processes*, 16 (1), 1{26.
- Parker, G. (2004), *1D Sediment Transport Morphodynamics with Applications to Rivers and Turbidity Currents*, University of Illinois, [http://hydrolab.illinois.edu/people/parkerg/morphodynamics\\_e-book.htm](http://hydrolab.illinois.edu/people/parkerg/morphodynamics_e-book.htm), visited April, 2012.
- Robert, A. (2003), *River Processes: An Introduction to Fluvial Dynamics*, 214 pp., Arnold, London.

### **GEOPDSE01T B: Rural Institutional Management and Development in India**

- Agarwal,A.N.(1995):*Indian Economy ,Problems of Development and Planning*,Vishwa Prakasan ,New Delhi
- Boudeville,J.R.(1966): *Problems of Regional Economic Planning*,Edinburgh University Press, Edinburgh
- Chand.M,Puri.V.K, (1983):*Regional Planning in India*,Allied Publishers,New Delhi
- Chandra,Bipin(1992): “The Colonial Legacy”, in *The Indian Economy Problems and Prospects*,Ed:Bimal,J,Penguin Books,New Delhi
- Chandrasekhara,C.S.and Sundaram.K.V(1968):*Planning Regions in India*,Town and Country Planning Organisation(mimeo)
- Chandrasekhara,C.S.and Sundaram.K.V(1968):*Metropolitan Centres and Regions in India*,21st International Geographical Congress, Metropolitan Growth and Planning
- Dickinson.R.E,(1964):*City and Region: A geographical interpretation*,Routledge and Kegan Paul Ltd., London
- Dickinson.R.E,(1964): *City , Region and Regionalism*,A geographical Contribution to Human ecology Kegan Paul Ltd., London
- Dreze.J and Sen A.(1996):*Economic Development and Social Oppurtunity*,Oxford University Press,New Delhi
- Dutta,R. & K.P.M,Sundaram,(1997): *Indian Economy*,S.Chand and Cc.Ltd, New Delhi
- De Blij, H.J. and Muller, P.O. 1997: *Geography: Realms Regions and Concepts*, 8th edition, John Wiley and Sons Ltd., New York
- Misra,R.P(1969): *Regional Planning:Concepts,Techniques,Policies and Case Studies*,Concept, New Delhi
- Misra.R.P,Sundaram.K.V& VLS Prakash Rao((1974):*Regional Development Planning In India*,A New Strategy,Vikas Publishing House Pvt.Ltd., New Delhi
- Misra,S.K,and Puri,V.K.(1997): *Indian Economy*,Himalaya Publishing House, Mumbai
- Mitra,A(1965):*Levels of Regional Development in India*,Government of India
- Gill,R.(1975):*Economic Development :Past and Present*, Prentice-Hall of India,New Delhi
- Glasson,J.(1975): *An Introduction to Regional Planning*, Hutchinson and Co.,London
- Walter,Issard(1975):*Introduction to Regional Science* ,Prentice-Hall,NewYork
- Ray Chaudhuri,Jayasri(2001): *An Introduction to Development and Regional Planning*, Orient Longman,Kolkata
- Chitambar, J.B. 1993: *Introductory Rural Sociology*, Wiley Eastern, New Delhi
- De, N. K. (1984): *Measuring Land Potentials in Developing Countries*, The University of Burdwan, Burdwan, West Bengal
- De, N. K. and Jana, N. C. (1997): *The Land: Multifaceted Appraisal and Management*, Sribhumi Publishing Co., Calcutta: 412 pages
- Goomen, M.A. and Datta, A. 1995: *Panchayats and their Finance*, Rawat Pub. Co., New Delhi.
- Hooja Rakesh, 1987: *Administrative interventions in Rural Development*, Rawat Publications, Jaipur
- Institute of Social Sciences 1994: *Decentralised Planning and Panchayati Raj*, Rawat Pub. Co., New Delhi.

- Mandal, R.B. 1988: Systems of Rural Settlements in Developing Counties, Concept Pub. Co., New Delhi
- Matthews a. 1994: Panchayati Raj: From Legislation to Movements, Rawat Pub. Co., New Delhi
- Matthews G. (editor) 1995: Status of Panchayati Raj: 1994, Institute of Social Sciences / Rawat Pub. Co.,
- Misra, H.M. (ed.) 1987: Contributions to Indian Geography, Volume 9: Rural Geography, Heritage Pub., New Delhi.

### **GEOPDSE01T C. Natural Systems in the Anthropocene**

- Chapman, D. (1994): Natural Hazards, Oxford University Press, Melbourne: 174p.
- Eckart Ehlers, Thomas Krafft, Earth System Science In The Anthropocene; Emerging issues and Problems, Springer
- Timothy Lenton, Earth System Science: A very short introduction, Oxford University press, 2016
- David P. Turner, The Green Marble: Earth System Science And Global Sustainability, Columbia University Press, 2018
- Dominick Dellasala Michael Goldstein (Ed.), Encyclopedia Of The Anthropocene (1st Edition), Elsevier, 2017
- Rachel Carson Silent Spring, 40th anniversary edition,
- Ethics and Biodiversity, UNESCO Office Bangkok and Regional Bureau for Education in Asia and the Pacific, 2011
- Clini, Corrado, Musu, Ignazio, Gullino, Maria Lodovica (Eds.), Sustainable Development and Environmental Management; Experiences and Case Studies, Springer, 2008
- Bala Krishnamoorthy, Environmental Management: Text and Cases (2nd Edn.), PHI Learning Private Ltd, 2013
- Dresner, S. (2002): The Principles Of Sustainability, Earthscan, London
- Park, C. (1998): The Environment: Principles and Applications, Routledge, London:
- UNDP (2002): Sustainable Development Strategies, Earthscan, London
- Wright, R.T. and Boorse, D.F. (2011): Environmental Science: Toward A Sustainable Future, PHI Learning Private Limited, New Delhi

### **GEOPCOR13P: Remote Sensing and Geographical Information System**

- Campbell, J. B. 1996: Introduction to Remote Sensing, 2nd edition, Taylor & Francis, London.
- Lillesand, T.M. and Kiefer R.W. (1979) : Remote Sensing and Image Interpretation, John Wiley & Sons., N. Y.
- Robinson, A.H., Sale, R.D., Morrison, J. 1984: Elements of Cartography, Wiley, New York.
- Sabins, F.F., 1997: Remote Sensing: Principles and Applications, 3rd edition, W.H. Freeman & Company, New York.

### **GEOPCOR14P Ground Survey and Field Methods**

- Chang, K. (2002) Geographic Information Systems, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
- Chorley, R.J. and Haggett, P. (1969) Network Analysis, Arnold, London
- Cole, J.P. and King, C.A.M. (1968) Quantitative Geography, Wiley.
- Curran, P.J. (1985) Principles of Remote Sensing, Longman.
- Dent, B.D. (1985) Principles of Thematic Map Design, Addison Wesley Publishing Company, Inc. U.S.A.
- Haggett, P. (1965) Locational Analysis in Human Geography, Arnold.
- Hammond, R. and Mc Cullagh, P. (1977) Quantitative Techniques in Geography : An Introduction, Clarendon Press, Oxford
- Kanetkar, T.P. and Kulkarni, S.V. (1977) Surveying and Levelling (Part I and II) Pune Vidyarthi Griha Prakashan, Pune.

- Kraak, M.J. and Ormeling, F. (2004) *Cartography: Visualization of Geospatial Data*, Pearson Education, Singapore, Delhi.
- Mahmood, A. (1977) *Statistical Methods in Geographical Studies*, Rajesh Publications, New Delhi.
- Misra, R.P. and Ramesh, A. (1969) *Fundamentals of Cartography*, Prasaranga, University of Mysore.
- Natarajan, V. (1976) *Advanced Surveying*, B.I. Publications, New Delhi. Raisz, E. (1962) *Principles of Cartography*, Mc Graw-Hill Book Co., N.Y.
- Pugh, J. C. (1975): *Surveying for Field Scientists*, Methuen & Co. Ltd., London.
- Yeates, M.H. (1968) *An Introduction to Quantitative Analysis in Economic Geography*, Mc Graw-Hill Book Company, New York.

### **GEOPCOR15T Environmental Geography and Sustainable Urban Development**

- Adams, W.M. 1995: *Green Development: Environmental Sustainability in the Third World*, Routledge, London: pp 1-8,87-139.
- Alexander, D. 1993: *Natural Disasters*, Research Press, New Delhi: 619p.
- Allaby, M. 1996: *Basics of Environmental Science*, Routledge, London: 297p.
- Allaby, M. 2006 : *The Encyclopaedia of Natural Calamities*, Viva, Kolkata.
- Bardhan, P. 2003 : *Poverty, Agrarian Structure & Political Economy in India*, OUP, New Delhi.
- Bhattacharra, R.N. (Ed.Re print 2007) *Environmental Economics – An Indian Perspective*, Oxford University Press, New Delhi.
- Blaikie, P., Cannon, To Davis, I. and Wisener, 1994: *At Risk: Natural Hazards, People's Vulnerability and Disasters*, Routledge, London: 320p.
- Brown, J.H. & Lomolino, M.V. 1998 : *Biogeography*, Sinauer Associates, USA.
- Buchholz, R.A. 1993 : *Principles of Environmental Management, the Greening of Biosphere*, Prentice Hall Inc., New Jersey
- Canter, L. W. 1996: *Environmental Impact Assessment*, 2nd edition, McGraw Hill, New York: 660p.
- Carter, N.(2001) *The Politics of the Environmental Ideas, Activism, Policy*, Cambridge University Press, Cambridge U.K.
- Chapman, D. 1.994: *Natural Hazards*, Oxford University Press, Melbourne: 174p.
- Cox, C.B & Moore, P.D. (2000) *Biogeography - An Ecological & Evolutionary Approach*, Blackwell Science Ltd, Oxford, Lond
- Dasgupta, P. and Mller, K.G. 1997 : *The Environment and Emerging Development Issues, Volumes I and 2*, Clarendon Press, Oxford: 593p.
- Das, M.C. 1993 : *Fundamentals of Ecology*, Tata MacGraw Hill, New Delhi.
- Echlom, E.P. 1991 : *Down To Earth*, EWP, New Delhi.
- Elsom, D.M. 1992 : *Atmospheric Pollution: A Global Problem*, 2nd edition, Blackwell Pub. Co., London: 422p.
- Falconer, R.A. and Goodwin, P. (editor) 1994 : *Wetland Management*, Thomas Telford, London: 289p.
- Gadgal, M. & Guha, R. 1993 ; *This Fissured Land- An Ecological History of India*, O U P, New Delhi.
- Gadgil, M. & Guha, R. 2000 : *The Use and Abuse of Nature*, OUP, New Delhi.
- Guha R.2005 : *The Ramchandra Guha Omnibus*, O U P, New Delhi
- Goudie, A. 1986: *The Human Impact on the Natural Environment*, 2nd edition, Blackwell Pub. Co., London: 337p. Hardoy, J .E Mittin, D. & Satterthwaite, D. 1992 : *Environment Problems in the World Cities*, Earthscan Pub. Ltd. London:
- Goudie, A. (20001) *The Nature of the Environment*, Blackwell Publishers, Oxford, U.K.
- Hughes, A. D. 2001 : *An Environmental History of the World* , Routledge, London.
- Hugget, R. & Cheesman, I.(2002) *Topography & The Environment*, Prentice Hill, New York, London.
- Huggett, R.J (Reprint 2002) *Fundamentals of Biogeography*, Routledge, London & New York.

- Kormondy, E.J. 1996 : Concepts of Ecology, Prentice Hall Inc., New Jersey
- I.G. Simmons – Ecology of Natural Resources, New York.
- Marsh, W.M. and Grossa, J.M. 1996: Environmental Geography: Science, Landuse and Earth
- MacDonald, G. 2003 : Biogeography Introduction to Space, Time and Life, John Wiley.
- Mathur, M.H. & Marsden, D. 1998 : Development Projects and Impoverishment Risk, OUP, New Delhi.
- Marsh, W.M. & Grossa(Ir). I.(1996) Environmental Geography- Science, Land use & Earth Systems, John Willey & Sons, New York
- Middleton, N & Keefe, P.O (2001) Redefining Sustainable Development, Pluto Press, London, Sterling & Virginia.
- Odum, E.P. 1971 : Fundamentals of Ecology, WB Saunders, USA
- Pickering, K. and Owen, L.A. 1997 : An Introduction to Global Environmental Issues, 2nd edition, Routledge, London:
- R.Guha(Ed) 1994 : Social Ecology, OUP, New Delhi.
- Echlom, E.P. 1991 : Down To Earth, EWP, New Delhi.
- Singh, R.B. and Misra, S. 1996 : Environmental Laws in .India: .Issues and Responses, Rawat Pub., New Delhi:
- Sharma, P.D. 1975 : Ecology and Environment, Rastogi Publication, Meerut
- Shiva, V. & Moser, I. (Ed) 1995 : Biopolitics, Zed Books, London.
- Turk, I. & Turk. A.(1988) Environmental Science, Saunders College Publishing, New York.
- Valancy, F. and Bronstein, D.A. 1995 : Environmental and Social Impact Assessment, John Wiley and Sons inc., New York: 325p.
- Wathern, P. (editor) 1988 : Environmental Impact Assessment: Theory and Practice, Routledge, London: 332p.
- Whyte, I.L.. 1995 : Climate Change and Human Society, Arnold, London: 217p.
- Chatterjee, S.P. (1947): Partition of Bengal, Calcutta Geographical Society: Publication no.8.
- Dixit, R. D.(1996) : Developments in Political Geography, Sage, New Delhi.
- Dixit, R. D.(2000) : Political Geography: The Spatiality of Politics, New Delhi, Tata McGraw Hill Publishing Co. Ltd.
- Dutt, R.P: India Today,
- Johnston, R.J., Taylor, P.J. and Watts, M.J. (eds) (2000) : Dictionary of Human Geography, Blackwell.
- Johnston, R.J., Taylor, P.J. and Watts, M.J. (eds) (1995): Geographies of Global Change: Re-mapping the World in the Late Twentieth Century, Blackwell, Oxford.
- Pounds, N.J.G (1963): Political Geography, McGraw Hill Book Co. Inc., New York, San Francisco, Toronto, London, Kogakusha Co. Ltd.
- Shastri, S.M. (1927): Mc Crindles Ancient India as Described by Ptolemy, Chakravarty Chatterjee, Kolkata.
- Bhat L.S. (1973): Regional Planning in India.
- Carbs H. (1981): The study of urban Geography.
- Chand M. and Puri, V. K. (1988) : Regional Planning in India
- Harvey D. (1973): Social justice and the city, Edward Arnold, London.
- Hill Horst, D. (1971) : Issues in Regional Planning, Rotterdam University.
- Glasson John, (1974) : An Introduction to Regional Planning, Hutchinson, London
- Hall Peter, (1974) : Urban and Regional Planning, Penguin, London.
- Kukhinski A.R. ed. (1972) : Growth poles and Growth centers in Regional Planning
- Mouton, Paris, The Hague.

- Misra R.P. (1969) : Regional Planning, Concept, Techniques, Policies, The University of Mysore Press, Mysore.
- Misra R.P. Sundaram and Rao, (1974) : Regional Planning in India, Viking, Delhi
- Mitra Ashok (1971) : Levels of Regional Development in India, Census of India.

### **GEOPDSE02T A. Coastal Processes and Management**

### **GEOPDSE02T B. Rural Resource Economics and Development in India**

### **GEOPDSE02T C. Management of Physical and Human Environment**

- Botkin, Daniel B. 2011. Environmental Science: Earth as a Living Planet, John Wiley and Sons, New Delhi.
- Chapman, J.L. and Reiss, M.J. 2005. Ecology Principles and Applications, Cambridge University Press, London.
- Dash, M.C. 1994. Fundamentals of Ecology, Tata McGraw Hill, New Delhi
- Gunther, O. 1998 Environmental Information Systems. Berlin, New York, Springer.
- Miller G. Taylor and Scott Spoolman. 2011. Essentials of Ecology, Brooks/Cole Learning, USA.
- Odum, E.P. 1971. Fundamentals of Ecology, W.B. Saunders Company, Philadelphia.
- Environmental Science by S. C. Santra. New Central Book Agency (P) Ltd.,
- Ecology & Environment by P.D. Sharma. 10th edition – Rastogi Publications; Meerut
- Environment Problems & Solutions by D.K. Asthana and Meera Asthana; S.Chand & Company Ltd.
- Introduction to Environmental Science by Y. Anjaneyulu. BS Publications. 3rd Edition reprint
- Elsom, D.M. (1992): Atmospheric Pollution: A Global Problem, 2nd edn, Blackwell Pub. Co., London
- Farmer, A. (1997): Managing Environmental Pollution, Routledge, London
- Reddy S.R., Reddy G. Prabhakaran, Rainfed Agriculture & Watershed Management, Kalyani publisher, 2018
- Jos T. A. Verhoeven, Boudewijn Beltman, Roland Bobbink, Dennis F. Whigham, Wetlands and Natural Resource Management, Springer
- Dhruvajyoti Ghosh, Ecosystem Management; Towards theory and practice
- Ecology and traditional wetland practice, lessons from wastewater utilisation in the East Calcutta Wetlands,
- Utpal Kumar De, Prof. Manoranjan Pal, Dr. Premananda Bharati, Inequality, Poverty and Development in India, Focus on the North Eastern Region, Springer

### **GEOPDSE03T A. Management of Natural and Man Made Hazards**

### **GEOPDSE03T B. Rural Culture, Heritage and Development**

### **GEOPDSE03T C. Environmental Impact Assessment and Environmental Legislation in India**

- Environmental Impact Analysis by Jain R.K. & Others
- Pollution Management in Industries by Trivedi R. K.
- ISO14001 by Schoffman A. & Tordini A.
- Environmental Impact Assessment by Canter Larry W.
- Environmental Auditing by A.K. Srivastava
- Handbook Of Environmental Laws, Acts Guidelines, Compliances & Standards Vol-I & VII by R.K. Trivedi

### **GEOPAEC01M Communication Skills**

## **GEOPSEC01M: Introduction to Computer Programming**

- Zelle, J. M. (2010). Python programming: an introduction to computer science (2nd ed.). Franklin, Beedle & Associates, Inc.

## **GEOPGEC01M Geospatial Analysis**