ADAMAS UNIVERSITY

SCHOOL OF SCIENCE

Course Structure

COURSE NAME: 5 Years Integrated M.Sc. in Geography and Geoinformatics

COURSE CODE:							
SEMESTER: I							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Geo-tectonics and Geomorphology	6	5	1	0	6
		Scale, Area Measurement, Geological Map Interpretation and Identification of Rocks and Minerals (Lab)	9	0	0	9	6
Foundation-I		English Language & Literature	2	2	0	0	2
Generic Elective I	Theory-	Elective Chemistry I/ Elective Zoology I/ Elective Botany I	4	3	1	0	4
	Lab-	Elective Chemistry I/ Elective Zoology I/ Elective Botany I	3	0	0	3	2
Generic Elective I(Non lab based)	Theory-	Elective Mathematics 1/ Elective Economics I-Introductory Microeconomics, Psychology I	6	5	1	0	6
Total			**24**				**20**

SEMESTER: II							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Climatology	6	5	1	0	6
		Thematic Cartography (Lab)	9	0	0	9	6
Foundation-II		Environmental Science and Energy Resources	2	2	0	0	2
Generic Elective II (Lab based)	**Theory-**	Elective Chemistry II/ Elective Zoology II/ Elective Botany II	4	3	1	0	4
	Lab-	Elective Chemistry II/ Elective Zoology II/ Elective Botany II	3	0	0	3	2
Generic Elective II(Non lab based)	Theory-	Elective Mathematics II/ Elective Economics II- Introductory Macroeconomics, Psychology II	6	5	1	0	6
Total			**24**				**20**

SEMESTER: III							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Human Geography	6	5	1	0	6
		Regional Planning and Development	6	5	1	0	6
		Statistical Methods in Geography (Lab)	9	0	0	9	6
Skill Enhancement Course I (Subject Specific) (Practical)		Statistical Techniques and Computer Application Lab	3	0	0	3	2
		Basics of Remote Sensing	3	0	0	3	2
Generic Elective III (Lab based)	Theory-	Elective Physics I/ Elective Computer Science I/ Elective Chemistry I	4	3	1	0	4
	Lab-	Elective Physics I/ Elective Computer Science I/ Elective Chemistry I	3	0	0	3	2
Generic Elective III (Non lab based)	Theory-	Elective Statistics I, Sociology I, Political Science I, History I	6	5	1	0	6
Total			**31**				**26**

SEMESTER: IV							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Economic Geography	6	5	1	0	6
		Geography of India	6	5	1	0	6
		Map Interpretation (Topographical Sheet and Climatic Data Analysis) Lab	9	0	0	9	6
Skill Enhancement Course II (Practical)		Basic GIS and Cartography Lab	3	0	0	3	2
		Research Methods Lab	3	0	0	3	2
Generic Elective IV (Lab based)	Theory-	Elective Physics II/ Elective Computer Science II/ Elective Chemistry II	4	3	1	0	4
	Lab-	Elective Physics II/ Elective Computer Science II/ Elective Chemistry II	3	0	0	3	2
Generic Elective IV (Non lab based)	Theory-	Elective Statistics II, Sociology II, Political Science II, History II	6	5	1	0	6
Total			**31**				**26**

SEMESTER: V							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Evaluation of Geographical Thought	6	5	1	0	6
		Advance Remote Sensing and GIS (Lab)	9	0	0	9	6
Discipline Specific Elective I		Population and Settlement Geography	6	5	1	0	6
		Resource Geography	6	5	1	0	6
Discipline Specific Elective II		Agricultural Geography	6	5	1	0	6
		Urban Geography	6	5	1	0	6
Foundation		Industry Internship-I					**2**
Total			**27**				**26**

SEMESTER: VI							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core		Environmental Geography	6	5	1	0	6
		Soil Geography					3
		Field Work					4
Discipline Specific Elective III		Political Geography	6	5	1	0	6
		Geography of Health and Wellbeing	6	5	1	0	6
Discipline Specific Elective IV		Hydrology and Oceanography	6	5	1	0	6
		Geography of Tourism and Transport	6	5	1	0	6
Foundation		Seminar on Contemporary Research in Applied Geography and Geoinformatics	2	2	0	0	2
Total			**27**				**27**

SEMESTER: VII							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Week**	**L**	**T**	**P**	**Credit**
Core Theory		Advanced Geomorphology and Geo-tectonics	3	2	1	0	3
		Advanced Climatology	3	2	1	0	3
		Demography and settlement Geography	3	2	1	0	3
		Regional Geography	3	2	1	0	3
		Geopolitics, history and International relation	3	2	1	0	3
Core Practical		Geo-statistics	6	0	0	6	4
		Advanced Quantitative Techniques	6	0	0	6	4
Total							**23**

SEMESTER: VIII							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Semester**	**L**	**T**	**P**	**Credit**
Core Theory		Advanced hydrology and ocean science	3	2	1	0	3
		Energy, environmental technology and development	3	2	1	0	3
		Regional entity of India and West Bengal	3	2	1	0	3
		Ecological dynamics and pedology	3	2	1	0	3
Core Practical		Culture and Society	3	2	1	0	3
		Advanced Cartography and Surveying	6	0	0	6	4
		Geo-spatial Analysis and its Applications	6	0	0	6	4
		Geo Computation	3	0	0	3	2
Total							**25**

SEMESTER: IX							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Semester**	**L**	**T**	**P**	**Credit**
Core Theory		Geography of Economic Behavior	3	2	1	0	3
		Philosophy of Geography	3	2	1	0	3
		Advanced Elective I	3	2	1	0	3
Core Practical		Advanced Geo-imaging and GIS	6	0	0	6	4
		Term Paper Leading to Field Project		0	0		2
		Advanced Elective Practical-I	6	0	0	6	4
		Term Paper Leading to Dissertation	6	0	0	6	4
Foundation		Industry Internship-II					2
Total							**25**

SEMESTER: X							
Type of paper	**Paper Code**	**Title of the paper**	**Contact hours per Semester**	**L**	**T**	**P**	**Credit**
Core		Advanced Elective II	3	2	1	0	3
		Advanced Elective Practical II	6	0	0	6	4
		Field Project and comprehensive viva	8	0	0	8	6
Foundation		Seminar on Contemporary Research in advanced Geography & Geoinformatics	2	2	0	0	2
Core		**Project** : I. Literature review II. Seminar presentation III. Dissertation	30	0	0	30	12
Total							**27**

Total Credit: 245

1. Generic elective (either lab based or non lab based):
   Semester I to IV (one in each semester)

2. Subject specific skill enhancement course :
   Semester III and IV (one in each semester)

3. Discipline specific electives:
   Semester V and VI (two in each semester)

4. Advanced Elective Papers:
   Semester IX and X (One chosen in semester IX, same will be continued in semester X)
   Options are:
   1. **Urban Ecology, Environment and conservation**
   2. **Applied Geomorphology and Hazard**
   3. **Urban landscape, infrastructure and management**
   4. **Hydro-meteorology**
   5. **Remote sensing and GIS**

Semester IX			
	Paper	**Code**	**Credit**
Advanced Elective I (Theory)	Urban Ecology, Environment and conservation-I		3
	Geomorphology and Hazard-I		3
	Urban landscape, infrastructure and management-I		3
	Hydro-meteorology-I		3
	Remote sensing and GIS-I		3
Advanced Elective Practical I	Urban Ecology, Environment and conservation-I		4
	Geomorphology and Hazard-I		4
	Urban landscape, infrastructure and management-I		4
	Hydro-meteorology-I		4
	Remote sensing and GIS –I		4
Semester X			
	Paper	**Code**	**Credit**
Advanced Elective II (Theory)	Urban Ecology, Environment and conservation-II		3
	Geomorphology and Hazard-II		3

	Urban landscape, infrastructure and management-II		3
	Hydro-meteorology-II		3
	Remote sensing and GIS -II		3
Advanced Elective Practical II	Urban Ecology, Environment and conservation-II		4
	Geomorphology and Hazard-II		4
	Urban landscape, infrastructure and management-II		4
	Hydro-meteorology-II		4
	Remote sensing and GIS –II		4

ADAMAS UNIVERSITY

SCHOOL OF SCIENCE
SYLLABUS
COURSE NAME: 5 Years Integrated M.Sc. in Geography and Geoinformatics

SEMESTER: I
(July to December)

Title of the Paper: Geotectonics and Geomorphology
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: This course will introduce to the large dynamics of the earth's surface: e.g. how the oceans grow and shrink, how the continents are shuffled around, how mountain belts evolve, why volcanism and earthquake occur, where they do and much more. This in turn tells us about the inner working of the earth. It will make the student acquaintance with the study of earth surface processes and resulting landforms.

Unit 1: Origin of the Earth and its interior:
1.1. Theories about the Origin of the Earth
1.2. Structure Of The Earth-Interior, Discontinuity and Seismic Waves
1.3. Rocks: Igneous, Sedimentary and Metamorphic

Unit II: Deformation and Tectonics:
2.1. Endogenic and Exogenic Processes Folds and Faults —Origin and Types
2.2. Concept Of Isostasy and Isostatic Compensation
2.3. Continental Drift, Sea Floor Spreading, Plate Tectonic theory,Mountain Building: Orogenic Types and Classification - relation with Tectonics

Unit III: Fundamentals of Geomorphology
3.1. Definition and scope of Geomorphology, Uniformitarianism and Neo catastrophic Approaches, Fundamental concepts of Geomorphology
3.2. Geological Time scale and Geomorphic Processes, System Approach- Classification
3.3. Landforms on Granite and Basalt; Landforms on Limestone; Development of River Network on Folded and Faulted Structure

Unit IV: Geomorphological Processes
4.1. General Degradational Processes: Processes of Rock Weathering and Their Effects on Landform
4.2. Fluvial and Aeolian Processes and Landforms; Glacial Processes and Landforms; Fluvio-Glacial Landforms ; Aeolian Processes and Landforms; Fluvio-Aeolian Processes
4.3. Landscape Evolution Models- Davis, Penck and king

Recommended Readings:

1. Husain Majid (2002), Fundamenatls of Physical Geography, Second Edition, Rawat Publications, Jaipur and New Delhi.

2. Siddartha K. (1994), Earth Dynamic Surface (Transworld Media & Communications – Publication – Patna ,
3. Strahler, A.N. and Strahler, A.H. (1984), Elements of Physical Geography, John Wiley, New York.
4. Selby, M.J., (2005), Earth's Changing Surface, Indian Edition, OUP
5. Singh Savindra(1993), Physical Geography, PrayagPustakBhawan, Allahabad.
6. Bloom, A.L. (1992), Geomorphology- Systematic Analysis of Late Cenozoic Landforms, Prentice Hall India, New Delhi.
7. Singh Savindra (1993), Geomorphology, PrayagPustakBhawan, Allahabad
8. Strahler, A .N. (1988), Earth Sciences, Harper and Row Publishers, N.D.
9. Thornbury, W.D. 1954: Principles of Geomorphology, John Wiley, New York.
10. Chorley, R.J. 1969: Introduction to Fluvial Processes, Methuen, London
11. Chorley, R.J., Schumm, S. A. and Sugden, D.E. 1984: Geomorphology, Methuen, London
12. Dayal, P. 1996: Textbook of Geomorphology, Shukla Book Depot ,Patna.
13. Kale, V. and Gupta, A. 2001: Introduction to Geomorphology, Orient Longman, Kolkata
14. McCullagh, P. 1978: Modern Concepts in Geomorphology, Oxford University Press, Oxford.
15. Morisowa, M. 1968: Streams, their Dynamics and Morphology, McGraw Hill, New York.
16. Ollier, C.D. 1975: Weathering, Longman, London
17. Selby, M. J. 1991: Earth's Changing Surface, Clarendon Press, London
18. Small, R.J. 1978: The Study of Landforms, Cambridge University Press, Cambridge
19. Sparks, B.W. 1960: Geomorphology, Longman, London.

Wooldridge, S.W. and Morgan, R.S. 1959: The Physical basis of Geography- An Outline of Geomorphology, Longman, London

Title of the Paper: Scale, Area Measurement, Geological Map Interpretation and Identification of Rocks and Minerals

Core Practical

Credits- 6, Contact hours per week – 9

Objective of the Study: This paper is organized into two parts: one is the study of map scale which is concerned with reducing geographical features of interest to manageable proportions. This unit will also provide students with the opportunity to learn the area measurement, enlargement and reduction methods. And the second part will help the students to classify several mineral and rock samples using the identification keys. Interpretation of Geological maps will help to understand the formation of different rock layers, structural formation and their impact on landform. The laboratory instruments will be introduced to the students during the lab activities.

Unit I: Map Scale Representation; Enlargement – Reduction; Area Measurement and Instrument Identification:

1.1. Linear, Diagonal and Vernier scale drawing
1.2. Enlargement and reduction – Mathematical calculations
1.3. Area measurement by Graphical Method
1.4. Lab instruments: Clinometer, Abney Level, Slide Caliber

Unit II: Geological Map:

2.1. Study of Horizontal, Vertical and tilted beds along with alignment of contours: Study of strike, dip and bedding plane

2.2. Drawing of sections on uniclinal and simple folded structures depicting unconformity, succession of beds and their thickness
2.3. Interpretation of the section covering geological history and relation between topography and structure

Unit III: Megascopic Identification of Rocks & Minerals:

3.1. Rocks: granite, basalt, dolerite, shale, sandstone, limestone, conglomerate, laterite, slate, phyllite, schist, marble, quartzite, gneiss
3.2. Minerals: talc, gypsum, calcite, mica, feldsper, quartz, chalcopyrite, hematite, magnetite, bauxite, galena

Unit IV: Laboratory Note Book and Viva-voce

A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
2. Ishtiaque, M. 1989: Practical Geography, Heritage Publishers, New Delhi.
3. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
4. Sarkar, Ashis, Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata.2000
5. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.
6. BasuPatha. Practical Geography.

Plat: Basics and Advanced Geological Maps (Selected Exercise)

SEMESTER: II
(January – June)

Title of the Paper: Climatology
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: This course is designed to give an understanding of Earth's climates and the factors that influence and control them. This course will serve as an introduction to the study of the atmosphere. In this course students will be exposed to the structure, composition and interaction of atmosphere within itself and with the hydrosphere and exosphere, global energy balance and transfer, atmospheric circulation, precipitation processes, weather systems and classification of climate types (Köppen and Thornthwaite)

Unit I: Atmospheric Layers and Thermal Variation
1.1. Nature, Composition and Layered Structure of the Atmosphere
1.2. Factors Controlling Insolation; Heat Budget of the Atmosphere
1.3. Horizontal and Vertical Distribution of Temperature; Inversion of Temperature; Green House Effect and Importance of Ozone Layer

Unit II: Global Wind Circulation System
2.1. Global Atmospheric Pressure Belts and Their Oscillation
2.2. General Wind Circulation – Primary, Secondary and Tertiary Systems
2.3. Jet Stream and Index Cycle; Monsoon Mechanism With Reference To Jet Stream, Monsoon Variability

Unit III: PrecipitationandAir Mass
3.1. Processes and Forms of Condensation
3.2. Mechanism and Forms of Precipitation- Ice Crystal Theory, Collision-Coalescence Theory
3.3. Airmass: Typology, Origin and Characteristics; Warm and Cold Fronts; Frontogenesis and Frontolysis

Unit IV: Weather Disturbance and Climatic Classification:
4.1. Tropical Cyclone and Weather Disturbances
4.2. Mid-Latitude Cyclone and Anti-Cyclone
4.3. Climatic Classification after Koppen and after Thornthwaite: 1931 And 1948

Recommended Readings:
1. Aggarwal, S.K. (1972), Fundaments of Ecology, Ashish Publishers, New Delhi.
2. Barry, R.G. and Chorely, R.J.,Atmosphere, Weather and Climate, ELBS, Methuen & Co. Ltd. London.
3. Critchfield, H.J. (1987) Climatology, Prentice Hall of India, New Delhi.
4. Lal, D.S. 1986: Climatology, Chaitanya Publishing House, Allahabad.
5. Savindra Singh (2005): Climatology , PrayagPustakBhawan, Allahabad
6. Trewartha, G.T. (Latest edition) Introduction to Climate McGraw Hill, New York.

Title of the Paper: Thematic Cartography
Core Practical
Credits- 6, Contact hours per week – 9

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Objective of the Study: The objective of the paper is to make the student learn the art of measuring the distances and angles on ground in such a way that it becomes reproducible on a map which is drawn to scale later on with the help of proper referencing system. This course will make the student understand the methods and procedures that is used to transform the spherical three-dimensional earth into two-dimensional planar surfaces considering various map projections.

Unit I: Surveying and Levelling

1.1. Surveying and Levelling - Concept and Classification
1.2. Closed and Open traverse survey by Prismatic Compass
1.3. Longitudinal /profile levelling by Dumpy Level; Contouring by levelling along radial line by a Dumpy Level: at least three radial lines to be set out from a common centre and their relative position to be obtained by measurement of magnetic bearing and/or included angle by Prismatic Compass
1.4. Micro slope analysis using Abney level

Unit II: Map Projections - Planer Case

2.1. Concept, classification and suitability of map projections
2.2. Construction and properties of Planer (azimuthal) Projection –
   i. Polar Zenithal Gnomonic Projection
   ii. Polar Zenithal Stereographic Projection
   iii. Polar Zenithal Orthographic Projection
   iv. Polar Zenithal Equidistant Projection
   v. Polar Zenithal Equal Area Projections

Unit III: Map Projection – Conical and Cylindrical Cases

3.1. Construction and properties of Conical Projection –
   i. Simple Conical Projection with one standard parallel
   ii. Bonne's Projection
   iii. Sinusoidal Projection
   iv. Polyconic Projection
3.2. Construction and properties of –
   i. Cylindrical Equal Area
   ii. Mercator's Projection

Unit IV: Laboratory notebook and viva voce

A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. Gopal Singh (1996) – Map Work and Practical Geography, Vikas Publications, New Delhi.
Kanetkar, T.P. and Kulkarni, S.V. 1972: Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan, Pune

3. Kanetkar, T.P. and Kulkarni, S.V. 1972: Surveying and Levelling, Part II, Pune VidyarthiGrihaPrakashan, Pune
4. Mishra, R.P.and Ramesh (1989) – Fundamentals of Cartography, Concept, New Delhi.
5. Monk house, F.J and Wilkinson, M.R.(1968) _ Maps and Diagrams, Methuen, London
6. Negi, B.S. (1998) –Practical Geography, Kedarnath and Ramnath, Meerut.
7. Robinson, A.H. (1995) – Elements of Cartography, John Willey, New York.
8. Kellaway, G.P., 1979: Map Projections, B.I. Publications, New Delhi
9. Sarkar, Ashis, Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata.2000
10. Steers, J.A.1954: An Introduction to the Study of Map Projections, University of London Press, London
11. Misra, R.P. and Ramesh, A. 1986: Fundamentals of Cartography, McMillan, New Delhi

SEMESTER: III
(July - December)

Title of the Paper: Human Geography
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: This course provides a broad introduction to the conceptual and empirical concerns of two of the major sub-disciplines of contemporary human geography. It is organized into two parts. First part explores social geography, focusing on opening up students' perspectives to the different social issues that affect people's lives, different social processes and the components of social geography. Second part introduces with the cultural geography focusing on the Indian culture, cultural landscape and groups.

Unit I: Concept in Social Geography
1.1. Definition, Scope and Content of Social Geography
1.2. Social Structure and Social Processes: Macro and Micro; Social Patterns
1.3. Concept of Space: Social Space, Material Space; Social Wellbeing

Unit II: Components of Social Geography
2.1. Region as a Social Unit
2.2. Social Elements; Class, Caste, Tribe and Ethnicity with Special Reference to India
2.3. Social Issues in Urban Areas: Social Area Analysis; Social Ecology

Unit III: Cultural Geography
3.1. Concept of Culture in Geography; Definition, Scope and Content of Cultural Geography
3.2. Cultural Groups With Reference To India: Ethnic, Linguistic and Religious
3.3. Cultural Regions, Cultural Areas and Cultural Landscape; Cultural Assimilation, Integration and Diffusion

Unit IV: Human Adaptation to the environment:
4.1. (i) cold region—Eskimo; (ii) hot region Bushman, Beduin; (iii) lateau—Gonds, Masai, (iv)Mountain — Gujjars, nomads, (v) regions of recurrent floods, droughts and other natural hazards; Adaptation in modern society-agricultural, urban and metropolitan
4.2. Fundamental Principles – of terrestrial unity, of activity / change, and of adaptation
4.3. Human Occupance of the Earth – nature, ecology, adaptation, dynamism, conflicts and issues

Recommended Readings:
1. Admed, A (2004) : Social Geography, Rawat Publication, New Delhi
2. Chapman, K. (1979): People, Pattern and Process – An Introduction to Human
3. Guha, R. C: Social Geography.
4. Jones, E. and Eyles, J. (1977): An Introduction to Social Geography, Oxford University Press, Oxford.
5. Rubenstain, J. M. and Becon, J. M. (1990): Cultural Geography, John Wiley and Sons Inc., New York.
Spencer, J. E. and Thomas, W. L. (1969): Cultural Geography, John Wiley and Sons Inc., New York.

Title of the Paper: Regional Planning and Development
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: This course will give an introduction to basic concepts and theories within the field of regional planning and the history and experiences of regional planning in India over the years concentrating on political and practical challenges faced by planning systems. Issues concerning management of different aspects of sustainability in planning are explored with the help of a case study.

Unit I: Regions and Development

1.1. Concept of regions - nature and types of regions, Formal and Functional Regions
1.2. Regions and Regionalization – approaches, scale and dimension; bases of regional division - physical and socio – economic
1.3. Concept Growth, Development and Underdevelopment; Efficiency-Equity Debate, measuring development (Economic, Social and Environmental); Human development, history and heritage of regional development

Unit II: Planning Regions:

2.1. Concept of planning regions – need for regional planning, types of regional planning and planning regions
2.2. Theories and Models for Regional Planning: Growth Pole Model of Perroux; Growth Centre Model in Indian Context; Myrdal, Hirschman, Rostow and Friedmann; Village Cluster
2.3. Regional Planning and regional disparities with special reference to India

Unit III: Regional planning in India

3.1. Regional Approach to Planning in India's Five Year Plans,
3.2. Regionalization and experience of Regional Planning in Indian multi level planning (State, District and Block level Planning)
3.3. State and development – A case study of Gujarat

Unit IV:Regional Planning and Prospects

4.1. DamodarValley as Planning Region
4.2. Kolkata Metropolitan Development Authority (KMDA) as a Planning Region
4.3. Jungle Mahal as a backward region

Recommended Readings:

1. Chatterjee, S. P. (1973): Physiography of India, Gazetteer of India, Vol. I, Chopra, P. N. (Ed.), Govt. of India, New Delhi.
2. Singh, R. L. (1989): India – A Regional Geography, National Geographical Society of India, Varanasi.
3. Spate, O. H. K. and Learmonth, J. A. (1972): India and Pakistan, Methuen Co. Ltd., London.
4. Ganguly, D. S., Damodar Valley Corporation.
5. Mamoria. C.B. 1996, *Economic and Commercial Geography of India.* Revised edition. ShivlalAggarwalaan Co. Agral.
6. Bhat L S. – Regional Planning in India, Statistical Publishing Society, Calcutta, 1973.
7. Bhat L. S. et. at. : Micro-Level Planning: A Case Study of Karnal Area, Haryana, K.B. Publishing, New Delhi, 1976.
8. Chand M. &Puri V.K.– Regional Planning in India, Allied Publishers Pvt. Ltd., N.Delhi, 1983.

9. Friedman J. & Alonso W. – Regional Development and Planning – A Reader, M.I.T. Press, Cambridge, Mass, 1967.
10. Friedmann, J. and Alonso, W. : Regional Development Policy – A Case Study of Venezuela, M.I.T. Press, Cambridge, Mass, 1966.
11. Glasson J. - An Introduction to Regional planning : Concept, Theory & Practice, Hutchinson & Co.(Publishers) Ltd., London, 1983.
12. Glikson, Arthur : Regional Planning and Development, Netherlands Universities foundation for International Co-operation, London, 1955.
13. Gosal, G. S. and Krishan, G. : Regional Disparities in Levels of Socio-Economic Development in Punjab, Vishal Publications, Kurukshetra, 1984.
14. Inamdar, N. R. &Kshire, V.K., - District Planning in India : A Case study of Maharastra, Oxford & IBH Publishing Co., Delhi, 1986.
15. Kundu A. &Raza M. – Indian Economy : The Regional dimension – Spectrum Publishers, N. Delhi, 1982.
16. Misra R. P. – Regional Planning:Concepts,Techniques and Policies, University of Mysore, Mysore, 1969.
17. Misra R. P., et. al – Multi-level planning & Integrated Rural Development in India - Heritage Publishers, Delhi, 1980.
18. Misra R. P., et. at. – Regional development planning in India: A Strategy, Vikas Publishing House Pvt. Ltd., Delhi, 1974.
19. Rao Hemlata – Regional disparities and Development in India, Ashish Publishing House, N. Delhi, 1984.
20. Richardson, H. W., - Regional economics, Weidenfeld and Nicolson, London, 1969.
21. Sundaram K. V. – Urban and Regional Planning, Vikas Publishing House Pvt. Ltd., New Delhi, 1977.
22. Sundaram, K. V. (Ed.) – Geography and Planning, Essays in Honour of V.L.S. Prakasa Rao, Concept Publishing Co., New Delhi, 1985.

Title of the Paper: Statistical Methods in Geography
Core Practical
Credits- 6, Contact hours per week – 9

Objective of the Study: Statistical Methods for Geography is a systematic introduction to the essential techniques in statistical analysis. It provides tools to have an integrated overview of spatial data and spatial data analysis. Students will learn the measures and techniques and central tendency, dispersion and bi-variate analysis and regression.

Unit I: Basic Concepts

1.1. Significance of statistical techniques in Geography, Descriptive and Inferential Statistics, nature of statistical data: discrete, continuous, parametric and non-parametric
1.2. Geographical Data Matrix – construction of a data matrix
1.3. Tabulation and Descriptive Statistics: Frequency distribution – Histogram, Frequency Polygon, Ogive, normal and skewed distribution
1.4. Sampling techniques: random, systematic and stratified

Unit II: Measures of Central Tendency and Dispersion

2.1. Measures of central tendency: mean, median, mode, Centro-graphic techniques of central tendency
2.2. Partition values –quartile, deciles and percentile

2.3. Measures of dispersion: mean deviation, quartile deviation, variance, standard deviation and Co-efficient of variation.
2.4. Probability of distribution/occurrences - Normal Distribution

Unit III: Bivariate Analysis – Correlation and Regression

3.1. Association and Correlation – Rank correlation and Product Moment Correlation (Karl Pearson)
3.2. Bivariate scatter diagram and regression trend line - Simple Regression
3.3. Residuals from regression – residual mapping
3.4. Time Series Analysis - Moving average, semi average and least square method

Unit IV: Laboratory Note book and viva voce

A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. Alvi, Z. 1995: Statistical Geography-Methods & Application, Rawat Publications, Jaipur.
2. Berry B. J. L. and Marble D. F. (eds.): Spatial Analysis – A Reader in Geography.
3. Clark, W.A.V. and Hosking, P.L. 1986: Geographical Methods for Geographers, John Wiley and Sons, New York
4. Croxton, F.E., Cowden, D.J. & Klein, S 1969: Applied General Statistics, Prentice Hall of India Pvt. Ltd., New Delhi
5. Dickinson, G.C. (1973): Statistical Mapping and Presentation of Statistics
6. Ebdon D., 1977: Statistics in Geography: A Practical Approach.
7. Goon, A.M., Gupta, M.K. &Dasgupta, B. 1992: Basic Statistics, Volume 1, The World Press Pvt. Ltd., Kolkata
8. Goon, A.M., Gupta, M.K. &Dasgupta, B. 1992: Fundamentals of Statistics, Volume 1, The World Press Pvt. Ltd., Kolkata
9. Gregory, S. 1985: Statistical Methods and the Geographer, Longman, London
10. Hammond P. and McCullagh P. S., 1978: Quantitative Techniques in Geography: An Introduction, Oxford University Press.
11. King L. S., 1969: Statistical Analysis in Geography, Prentice-Hall
12. Mahmood A., 1977: Statistical Methods in Geographical Studies, Concept.
13. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi
14. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction, Hutchinson and Co., London
15. Pal S. K., 1998: Statistics for Geoscientists, Tata McGraw Hill, New Delhi.
16. Pal, S.K. 1998: Statistics for Geo-Scientists- Techniques and Application, concept Publishing Company, New Delhi.
17. Sarkar, A. (2013) Quantitative geography: techniques and presentations. Orient Black Swan Private Ltd., New Delhi
18. Shinha, Indira (2007) Sankhyikibhugol. Discovery Publishing House, New Delhi
19. Silk J., 1979: Statistical Concepts in Geography, Allen and Unwin, London.
20. Spiegel M. R.: Statistics, Schaum's Outline Series
21. Yeates M., 1974: An Introduction to Quantitative Analysis in Human Geography, McGraw Hill, New York.

Title of the Paper: Statistical Techniques and Computer Application
Skill Enhancement Course – I
(Subject Specific Practical: Option I)
Credits- 2, Contact hours per week – 3

Objective of the Study: This course will enable students to apply the essential techniques of statistical analysis by using various statistical data analysis tools/packages. The course will enable students to understand the basics of statistical functions and its applicability and provide them a basic platform to face real world spatial problems.

Unit I: Basics of Statistical techniques

1.1. Data entry and moving around the workbook and worksheet – Tabulation, constructionof GDM
1.2. Data representation and visualization – construct and interpret Histogram, Frequency Polygon and Curve.

Unit II: Statistical Functions

2.1. Descriptive Statistics and interpretations – Mean, Median, Mode, Variance, Standard deviation and Co-efficient of variation.
2.2. Inferential statistics and interpretation – Probability of distribution, Correlation, Regression

Unit III: Laboratory Notebook

A project file consisting of 5 exercises on using any method on above mentioned themes.

Recommended Readings:

1. Mahmood A., 1977: Statistical Methods in Geographical Studies, Concept.
2. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi
3. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction, Hutchinson and Co., London
4. Pal S. K., 1998: Statistics for Geoscientists, Tata McGraw Hill, New Delhi.
5. Pal, S.K. 1998: Statistics for Geo-Scientists- Techniques and Application, concept Publishing Company, New Delhi.
6. Sarkar, A. (2013) Quantitative geography: techniques and presentations. Orient Black Swan Private Ltd., New Delhi
7. Winston (2013), Microsoft Excel 2013: Data Analysis and Business Modeling
8. Rajan E. (2015), Excel VBA: A Beginners' Guide
9. Webpage: https://office.live.com/start/Excel.aspx

Title of the Paper: Basics of remote Sensing
Skill Enhancement Course I
(Subject Specific Practical: Option II)
Credits- 2, Contact hours per week – 3

Objective of the Study: This course will enable students to learn the basics of remote sensing including concepts of phtogrammetry its methods and techniques. The course will expose students to environ of remote sensing and its applicability.

Unit- I: Basics of Remote Sensing

1.1. Remote Sensing: Definition and Development; Platforms and Types; Photogrammetry.
1.2. Concept of aerial photography; different types of aerial photography.
1.3. Satellite Remote Sensing: Principles, EMR Interaction with Atmosphere and Earth Surface; types of Satellites, Sensors ; resolution

Unit II: Basics of Image Processing

2.1. Image Processing (Manual): Selection of band combination, Mosaicing to FCC image.
2.2. Categorisation Land Use Land Cover - Satellite Image Interpretation.

Unit III: Laboratory Notebook

A project file consisting of 5 exercises on using any method on above mentioned themes.

Reading List

1. Bhatta , B. (2008) Remote Sensing and GIS, Oxford University Press, New Delhi.
2. Campbell J. B., 2007: *Introduction to Remote Sensing*, Guildford Press
3. Jensen, J. R. (2005) Introductory Digital Image Processing: A Remote Sensing Perspective, Pearson Prentice-Hall.
4. Joseph, G. 2005: *Fundamentals of Remote Sensing*, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: *Remote Sensing and Image Interpretation*, Wiley. (Wiley Student Edition).
6. Li, Z., Chen, J. and Batsavias, E. (2008) Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences CRC Press, Taylor and Francis, London
7. Mukherjee, S. (2004) Textbook of Environmental Remote Sensing, Macmillan, Delhi.
8. Nag P. and Kudra, M., 1998: *Digital Remote Sensing*, Concept, New Delhi.
   Singh R. B. and Murai S., 1998: *Space-informatics for Sustainable Development*, Oxford and IBH Pub.

SEMESTER: IV
(January - June)

Title of the Paper: Economic Geography
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study : This paper will highlight the importance of economic geography in analyzing contemporary societies and economies, will provide a comprehensive introduction to basic concepts and key theoretical approaches in economic geography, and will introduce with the Earth's Resources and the patterns in economic activities including primary (The Earth as a Resource), secondary (Building Resources into Products) and tertiary (Facilitating Our Use of Resources) both in National and Global levels.

Unit I: Resources and Economy

1.1. Concept and Classification of Resources: Economic and Environmental Approaches to Resource Utilization.
1.2. Resource Depletion and Resource Conservation; Forrester-Meadows Model on Limits to Growth; Sustainable Use of Resources
1.3. Economic Activity: Concept and Classification

Unit II: Primary Activities

2.1. World View of Primary Activities-- With Reference To Forestry, Fishing and Mining
2.2. Critical Appreciation Of Agricultural Systems: Intensive Agriculture (Rice), Extensive Agriculture (Wheat), Plantation Farming (Tea) and Mixed Farming (NW Europe);
2.3. Fishing: Inland and Ocean (in-shore/off shore), methods, types of fish, storage and marketing, importance, problems and solutions.

Unit III: Secondary Activities

3.1. Factors of Industrial Location; Industrial Location and Economic Growth Models: Weber, Losch
3.2. Industries-- Their Resource Base, Distribution, Potentials Of Growth And Problems With Reference To Iron And Steel (India, Japan), Cotton Textile (India), Petrochemicals (India and USA) And Food Processing (India)
3.3. Manufacturing regions; Industrial Association, Integration, Infrastructure and Problems With Reference To Kanto Plains, and Kolkata-Haldia.

Unit IV: Tertiary Activities

4.1. Tertiary activities and service: concept, classification and importance
4.2. Trade: as an engine and hindrance to growth, determinants, trade strategies – import substitution and export promotion and impact of information technology on trade in India, SEZ and Technology Park
4.3. International trade: Ricardian theory, international trade with reference to GATT and WTO.

Recommended Readings:

1. Alexander J.W. (1976): Economic Geography, Prentice Hall of India. New Delhi.
2. Alexanderson G. (1988): Geography of manufacturing, Prentice Hall of India. New Delhi.
3. Berry, Conkling & Ray (1988): Economic Geography Prentice Hall of India, New Jersey.
4. Guha, J.L. and Chattaraj, P.R. 1989: A New Approach to Economic Geography: A Study of Resources, World Press, Kolkata 8.

5. Hartshorne, T. A. and Alexander, J. W. (1988): Economic Geography, Prentice Hall
6. Hurst Elliott (1986): Geography of Economic Behaviour, Unwin, London.
7. Johnson R.J. & Taylor D.J. (1989): A world in crisis, Basil-Blackwell, Oxford.
8. Leong. G.C. and Morgan, G.C. 1975: Human and Economic Geography, Oxford University Press, Hong Kong
9. Lloyd, P. and B. Dicken (1972): Location in space - A theoretical approach to economic geography Harper and Row, New York.
10. Losch (1954): Economics of Location, Yale University Press New York.
11. Redcliff, M. (1987): Development & the environmental crisis. Methuen. London. 8. Sinha B.N.(1971): Industrial geography of India
12. Siddhartha, K. (2000): Economic Geography - Theories, process and patterns, K-isalaya Publications Pvt. Ltd., New Delhi
13. World Development Report, Oxford University Press, New York, (Published annually).
14. Zimmermann, E.W. 1956: World Resources and Industries, Harper Brothers, New York.

Title of the Paper: Geography of India
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: The paper is designed to give general acquaintance about physical environment of our country in terms of its physiographic, climatic characteristics and their combined impact on soil and natural vegetation and to acquaint the learner with the variety of natural resource available in our country and their utilization for the economic development. This paper will also introduce with some specific geographical problems of India.

Unit I: Physical Settings of India

1.1 Structure and Physiography; Physiographic regions of India (R.L. Singh)
1.2 Drainage System (Peninsular and Extra Peninsular); characteristics and classifications
1.3 Climatic, Soil and Vegetation Region of India

Unit II: Demography and Economy

2.1. Population size and growth; age and sex structure; rural-urban distribution; Distribution of population by race, caste, religion, language and tribes; Socio – cultural regions of India (Sopher)
2.2. Resource distribution: Forest resources – distribution and utilisation; Mineral and power resources distribution and utilisation of Iron Ore, Coal, Petroleum, Natural Gas, Bauxite and Hydroelectricity.
2.3. Economy: Agricultural production and distribution of Paddy, Wheat and Tea; Industrial development and distribution of Iron & Steel, Cotton Textiles, Oil –Refineries, Automobile and Information technology and Industrial Regions

Unit III: Studies of Geographical Problems and Planning

3.1. Variability of Monsoon and its impact on society and economy;Soil salinity and desertification
3.2. Regional and social conflicts: interstate water disputes; anti-regime and inter-ethnic and communal/inter religious disputes
3.3. Need and objectives of regional planning in India; Planning regions after Sengupta and Sdasyuk; Liberalization, Privatization and Globalization; PURA; BharataNirman; Five year plans and Indian economy - a review.

Unit IV: Geography of West Bengal

4.1. Physical settings – Physiography, drainage, climate, soils and natural vegetation

4.2. Population distribution – Post independent spatio – temporal distribution of population; Fertility, Mortality and Migration

3.4. Economy and development – Distribution of Paddy and Tea Cultivation; Distribution of Power and Mineral resources- coal and iron ore; Industrial development and industrial belts of West Bengal – problems and consequences; Problems of development of SEZ in West Bengal

Recommended Readings:

1. Bose, A. et. al. eds, 2001: Population in India's Development, 1947-2000, Vikas, New Delhi.
2. Chatterjee, S. P. (1973): Physiography of India, Gazetteer of India, Vol. I, Chopra, P. N. (Ed.), Govt. of India, New Delhi.
3. Deshpande C. D., 1992: India: A Regional Interpretation, ICSSR, New Delhi.
4. Govt. of India, Reference Annual, 2001, Pub., Div., New Delhi, 2001.
5. Govt. of India, The Gazetteer of India. Vol. I & II, part I-A (i) and (ii) New Delhi, 1966.
6. Johnson, B. L. C., ed. 2001. Geographical Dictionary of India. Vision Books, New Delhi.
7. Khullar, D. R. (2006): India. A Comprehensive Geography. Kalyani Publishers., New Delhi.
8. Mandal R. B. (ed.), 1990: Patterns of Regional Geography – An Intenational Perspective. Vol. 3 – Indian Perspective.
9. Mita, A. Levels of regional Development India Census of India, Vol. Part I-A (i) and (ii) New Delhi, 1967.
10. Mitra, A.: Regional Geography of India.
11. Pathak, C. R. 2003: Spatial Structure and Processes of Development in India. Regional Science Assoc., Kolkata
12. Routray, J.K. Geography of Regional Disparity Asian Institute of Technology, Bankok, 1993.
13. Roy Chaudhuri, S. P. et. al. (1963): Soils of India, Council of Agricultural Research, New Delhi.
14. Sdyasuk Galina and P Sengupta (1967): Economic Regionalisation of India, Census of India
15. Sharma, T. C. 2003: India - Economic and Commercial Geography. Vikas Publ., New Delhi.
16. Singh R. L., 1971: India: A Regional Geography, National Geographical Society of India.
17. Singh, Jagdish 2003: India - A Comprehensive & Systematic Geography, GyanodayaPrakashan, Gorakhpur.
18. Spate O. H. K. and Learmonth A. T. A., 1967: India and Pakistan: A General and Regional Geography, Methuen.
19. Tirtha, Ranjit 2002: Geography of India, RawatPubls., Jaipur & New Delhi.
20. Tiwari, R. C. (2007): Geography of India, PrayagPustakBhawan, Allahabad
21. Valdiya, K.s. Dyanamic Himalaya, University Press, Hyderabad, 1998.
22. Wadia, D.N: Geogrphy of India, McMillan & Co., London, 1967.

Title of the Paper: Map Interpretation (Topographical Sheet and Climatic Data Analysis)
Core Practical
Credits- 6, Contact hours per week – 9

Objective of the Study: This paper is organized into two parts*:* the first part will deal with the Topographical sheets. In this part the students will learn to extract information from maps, recognize symbols, read heights at (and between) contours, identify simple geographical relationships. Relate maps to photographs and other sources of information. The second part introduces the concept of synoptic charts and weather map which reflects the state of theatmosphere over a given spatio-temporal scale. Students will learn to interpret the atmospheric condition of a given place considering distinct map assets. The second part will introduce the students with the

Unit I: Nomenclature of Indian Topographical Sheets and Identification of Physical Features

1.1. Principles of toposheet numbering as followed by Survey of India (SOI); Principles of modern toposheet numbering as followed by SoI.
1.2. Thorough study of toposheet of 1:50,000 scale: Identification of macro and micro geomorphic features
1.3. Interpretation of a Mountain Area and Plateau Area: Cross and Longitudinal Profiles; Interpretation using Morphometric techniques in 10 x 12 cm area (Relative Relief Map after Smith; Average Slop Analysis after Wentworth; Drainage Density Map)

Unit II: Identification and Interpretation of Cultural features of Toposheet

2.1. Grid-wise (10 x 12 cm area) Road density and Settlement Frequency Map with interpretation
2.2. Drawing and analysis of profiles and transect chart with interpretation
2.3. Analysis of landforms and correlation between physical and cultural elements under the heads of: relief, drainage, natural vegetation, settlements and transport

Unit III: Interpretation of Climatic Data

3.1. Mapping and interpretation of – Ombrothermic charts; Rainfall dispersion diagram; Rating curves, Hydrographs and Unit hydrographs
3.2. Interpretation of Weather Maps (Indian Sub-continent) – Pre monsoon, Monsoon and Post Monsoon season
3.3. Preparation of Station models for different meteorological stations of India with the help of synoptic chart

Unit IV: Laboratory Note book and viva voce

A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. A Sarkar; Practical Geography, Orient Blackswan Private Limited - New Delhi; Third edition (2015)
2. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
3. Gupta K.K. and Tyagi, V. C., 1992: Working with Map, Survey of India, DST, New Delhi.
4. Ishtiaque, M. 1989: Practical Geography, Heritage Publishers, New Delhi.
5. Mishra R.P. and Ramesh, A., 1989: Fundamentals of Cartography, Concept, New Delhi.
6. Monkhouse F. J. and Wilkinson H. R., 1973: Maps and Diagrams, Methuen, London.
7. P Saha and P Basu; Advanced Practical Geography, Books & Allied Ltd. Publisher (3rd Revised edition).
8. Platt, J.I., 1956 : Selected Exercises upon Geological Maps, Part I, Unwin, London

9. Rhind D. W. and Taylor D. R. F., (eds.), 1989: Cartography: Past, Present and Future, Elsevier, International Cartographic Association.
10. Robinson A. H., 2009: Elements of Cartography, John Wiley and Sons, New York.
11. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C. 1995: Elements of Cartography, John Wiley and Sons, New York.
12. Sarkar, A. (2015) Practical geography: A systematic approach. Orient Black Swan Private Ltd., New Delhi
13. Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers.

Title of the Paper:Basic GIS and Cartography
Paper Code:
Skill Enhancement Course II
(Subject Specific Practical: Option I)
Credits- 2, Contact hours per week – 3

L - 0 T - 0 P – 3

Objective of the Study: This paper introduces concept of digital cartography to students. It enables students to learn techniques of map preparation in GIS environment while identifying map scale and error and resultant deformations.

Unit- I: Basics of Digital Cartography

1.1. GIS and Digital Cartography: Concept of Digital Cartography, Advantages andDisadvantages of Digital Cartography
1.2. GIS Datastructure and conversions

Unit II: Digital mapping

2.1. Input of Raster Image, Georeferencing, Digitisation, Assigning map scales, Preparation of Map Layout and Printing Setup.
2.2. Map Projection Systems of the World - Errors and deformations

Unit III: Laboratory Notebook

A project file consisting of 5 exercises on using any method on above mentioned themes.

Recommended Readings:

1. Bhatta, B. (2010) Analysis of Urban Growth and Sprawl from Remote Sensing,Springer, Berlin Heidelberg
2. Burrough, P.A., and McDonnell, R.A. (2000) Principles of Geographical Information System-Spatial Information System and Geo-statistics. Oxford University Press
3. Chauniyal, D.D. (2010) SudurSamvedanevamBhogolikSuchanaPranali, Sharda PustakBhawan, Allahabad
4. Heywoods, I., Cornelius, S and Carver, S. (2006) An Introduction to Geographical Infromation system. Prentice Hall.
5. Jensen J. R., 2004: *Introductory Digital Image Processing: A Remote Sensing Perspective*, Prentice Hall.
6. Jha, M.M. and Singh, R.B. (2008) Land Use: Reflection on Spatial Informatics Agriculture and Development, New Delhi: Concept.
7. Joseph, G. 2005: *Fundamentals of Remote Sensing*, United Press India.

8. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: *Remote Sensing and Image Interpretation*, Wiley. (Wiley Student Edition).
9. Nag P. and Kudra, M., 1998: *Digital Remote Sensing*, Concept, New Delhi.
10. Nag, P. (2008) Introduction to GIS, Concept India, New Delhi.
11. Rees W. G., 2001: *Physical Principles of Remote Sensing*, Cambridge University Press.
12. Sarkar, A. (2015) Practical geography: A systematic approach. Orient Black Swan Private Ltd., New Delhi
13. Singh, R.B. and Murai, S. (1998) Space Informatics for Sustainable Development, Oxford and IBH, New Delhi.

Title of the Paper: Research Methods
Skill Enhancement Course II
(Subject Specific Practical: Option II)
Credits- 2, Contact hours per week – 3

Objective of the Course: This paper will provide a basic direction of initiation of research. In this paper student will learn methods of data framing, questionnaire, Literature review, data collection and data analysis. This course will also guide the students to prepare a basic research report.

Unit I: Introduction to Research Methodology

1.1. Geographic Research: Definition, Motivation and Significance
1.2. Framing Research Questions, Objectives and Hypothesis
1.3. Literature Review; Preparing Sample Questionnaire

Unit II: Data Processing and Report Writing

2.1. Data Collection: Type and Sources of Data; Methods of Collection; Input and Editing
2.2. Data Analysis: Qualitative Data Analysis; Quantitative Data Analysis; Data Representation Techniques
2.3. Preparation of Research Report: Structure ; Preliminaries; Text; References, Bibliography and Citations; Abstract

Unit III: Laboratory Notebook

A research report on a specific problem following mentioned framework must be submitted by each individual students.

Recommended Readings:

1 Creswell J., 1994: Research Design: Qualitative and Quantitative Approaches Sage Publications.
2 Dikshit, R. D. 2003. The Art and Science of Geography: Integrated Readings. Prentice-Hall of India, New Delhi.
3 Evans M., 1988: "Participant Observation: The Researcher as Research Tool" in Qualitative Methods in Human Geography, eds. J. Eyles and D. Smith, Polity.
4 Misra, R.P. (2002) Research Methodology, Concept Publications, New Delhi.
5 Mukherjee, Neela 1993. Participatory Rural Appraisal: Methodology and Application. Concept Publs. Co., New Delhi.
6 Mukherjee, Neela 2002. Participatory Learning and Action: with 100 Field Methods. Concept Publs. Co., New Delhi
7 Robinson A., 1998: "Thinking Straight and Writing That Way", in Writing Empirical Research Reports: A Basic Guide for Students of the Social and Behavioural Sciences, eds. by F. Pryczak and R. Bruce Pryczak, Publishing: Los Angeles.

8 Special Issue on "Doing Fieldwork" The Geographical Review 91:1-2 (2001).
9 Stoddard R. H., 1982: Field Techniques and Research Methods in Geography, Kendall/Hunt. Wolcott, H. 1995. The Art of Fieldwork. Alta Mira Press, Walnut Creek, CA.

SEMESTER: V
(July - December)

Title of the Paper: Evolution of Geographical Thought

Core Theory

Credits- 6, Contact hours per week - 6

Objective of the Study: This course will explain the philosophical thought about the evolution of geography and its changing definition over time and space uniquely among the physical sciences, the social sciences and the humanities. This paper emphasise on the changing viewpoint in geography since the ancient time up to the modern era. This could be useful from the perspective of contemporary issues and other approaches in geography.

Unit I: Nature and Concepts in Geography

1.1. Nature of Geography and its relation with other disciplines ; Human – EnvironmentRelationship
1.2. Concepts in Geography: Encyclopaedism; Location, Time and Space
1.3. Approaches in Geography: Ideographic and Nomothetic; Areal differentiation and Spatial organization; Systems Approach

Unit II: Paradigms in Geography

2.1. Early Origins of Geographical Thinking with reference to the Classical periods: Greek, Roman
2.2. Evolution of Geographical Thinking during Medieval and Dark age: Indian and Chinese Philosophies; Arabian School of thoughts,
2.3. Modern Trends in Germany, France, Britain, United States of America.

Unit III: Modern Debates and Thoughts

3.1. Environmental Determinism andPossibilism; Empiricism and Positivism
3.2. Systematic and Regional approaches in Geography
3.3. Probabilism and Structuralism

Unit IV: Contemporary Thoughts

4.1. Quantitative Revolution and its Impact; Radicalism
4.2. Humanistic and Behavioural Approaches; Feminism
4.3. Trends towards Post Modernism – Changing Concept of Space in Geography, Future of Geography.

Recommended Readings:

1. Adhikari, S. (1992): Fundamentals of Geographical Thought, ChaitanyaPublishing. House, Allahabad.
2. Harvey, D. (1969): Explanations in Geography, London.
3. Hartshorne, R. (1939): The Nature of Geography: Association of American Geographers, USA.
4. Harvey, Milton E. and Brian, P. Holly (Ed.) (1981): Themes in Geographical Thought, Rawat Publication, Delhi.
5. Hossain, M. (1988): Evolution of Geographical Thought, Rawat Publications, Jaipur.
6. Johston, R. J. et al (Ed.) (1981) The Dictionary of Human Geography, Blackwell, England

7. Peet, R. (Ed.) (1977): Radical Geography, Methuen, London.
8. Haggett.: Geography – A Modern Synthesis.
9. Arentsen M., Stam R. and Thuijis R. (2000): Post-modern Approaches to Space, ebook.
10. Bhat, L.S. (2009) Geography in India (Selected Themes), Pearson.
11. Bonnett, A. (2008): What is Geography? Sage.
12. Dikshit, R. D. (1997): Geographical Thought: A Contextual History of Ideas, Prentice– Hall India.
13. Hartshone, R. (1959): Perspectives of Nature of Geography, Rand MacNally and Co.
14. Holt-Jensen, A. (2011): Geography: History and Its Concepts: A Students Guide, SAGE.
15. Johnston, R. J. (1997): Geography and Geographers, Anglo-American Human Geography since 1945, Arnold, London.
16. Kapur, A. (2001): Indian Geography Voice of Concern, Concept Publications.
17. Martin Geoffrey, J. (2005): All Possible Worlds: A History of Geographical Ideas, Oxford.
18. Soja, E. (1989): Post-modern Geographies, Verso, London. Reprinted 1997, Rawat Publ., Jaipur and New Delhi.

Title of the Paper: Advance Remote Sensing and GIS
Core Practical
Credits- 6, Contact hours per week – 9

Objective of the Course: This paper provides students with a critical understanding of the theory and practice of Geographical Information Systems (GIS) and allied remote sensing and image processing techniques within the field of applications in geography.

Unit I: Pre-Image Processing and Geo-referencing
1.1. Importing raw image in Remote Sensing Platform; Georeferencing: GCP to map and map to map
1.2. Rectification- Radiometric and Geometric Correction, rectification of contrast and Brightness
1.3. Image enhancement: Linear enhancement and Filtering

Unit II: Image Processing and classification (Digital)
2.1. Concept of band combination and selection of bank combinations for identifying differential objects; Interpretation of DN values
2.2. Image classification: Supervised and Un-supervised
2.3. Editing and Output; Overlays

Unit III: GIS Data Structure and Application of RS-GIS
3.1. GIS data Type: spatial and Non-spatial, Raster and Vector Data Structure; digitisation
3.2. Addition of data attribute; Scale design; Preparation of thematic map
3.3. Interpretation and Application of Remote Sensing and GIS: Land use/ Land Cover, Urban Sprawl Analysis; Forests Monitoring

Unit IV: Laboratory Note Book and Viva Voce
A project file consisting of two exercises will be done from aerial photos and satellite images (scale, orientation and interpretation) and 3 exercises on using any GIS Software on above mentioned themes.

Recommended Readings:
1. Bhatta , B. (2008) Remote Sensing and GIS, Oxford University Press, New Delhi.
2. Campbell, J. B. (2007): Introduction to Remote Sensing, Guildford Press.

3. Chauniyal, D.D. (2010): SudurSamvedanevamBhogolikSuchanaPranali, Sharda PustakBhawan, Allahabad
4. Jensen, J. R. (2004): Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
5. Joseph, G. 2005: *Fundamentals of Remote Sensing*, United Press India.
6. Li, Z., Chen, J. and Batsavias, E. (2008) Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences CRC Press, Taylor and Francis, London
7. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: *Remote Sensing and Image Interpretation*, Wiley. (Wiley Student Edition).
8. Lo, C.P. and Yeung, A.K.W. (2002): Concepts and Techniques in Geographic Information Systems. Upper Saddle River, New Jersey: Prentice Hall.
9. Mukherjee, S. (2004) Textbook of Environmental Remote Sensing, Macmillan, Delhi.
10. Nag P. and Kudra, M., 1998: *Digital Remote Sensing*, Concept, New Delhi.
11. Narayan, L.R.A. (1999): Remote Sensing and Its Application, Universities Press (India) Ltd., Hyderabad.
12. Rees, W.G. (2001): Physical Principles of Remote Sensing, Cambridge University Press.
13. Sarkar, A. (2015) Practical geography: A systematic approach. Orient Black Swan Private Ltd., New Delhi
14. Singh R. B. and Murai S., 1998: *Space-informatics for Sustainable Development*, Oxford and IBH Pub.
15. Singh, R.B. and Murai, S. (1998): Space-informatics for Sustainable Development, Oxford and IBH Pub.
16. Tomlinson, R. (2011): Thinking About GIS: Geographic Information System Planning for Managers.
17. Wade, T. and Sommer, S. (ed.) (2006): A to **Z GIS.**ESRI Press.
18. Wolf, P.R. and Dewitt, B.A. (2000): Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.

Title of the Paper: Population and Settlement Geography
Discipline Specific Elective Theory - I (Option I) Credits- 6,
Contact hours per week - 6

Objective of the Study: This course is designed in two parts. The first part will introduce the students with the growth of the world's population and associated problems and show an understanding of the causes and consequences of over-population and under- population. It will define the main components influencing population growth; will also describe the relationship between population growth and resources; will try to identify and suggest reasons for different types of population structure as shown by age/sex pyramids as well as will describe the factors influencing the density and distribution of population and population migration. The second part will describe and explain the factors influencing the size, development and function of urban and rural settlements and their spheres of influence; Describe and give reasons for the characteristics of land-use zones of urban; Describe some of the problems of urban areas, their causes and possible solutions.

Unit I: Population Dynamics

1.1. Population Geography: Nature, scope and trends, Sources of Data with special reference to India (Census, Vital Statistics and NSS).
1.2. The concept of population density and its types: Factors influencing spatial distribution and density of population; World distribution of population, Population - Resource Region
1.3. Population Dynamics: Fertility, Mortality and Migration – Measures, Determinants and Implications.

Unit II: Demographic Attributes and Concerns

2.1. Population structure and composition: Age and Sex specific, Rural and Urban Composition, Literacy.
2.2. Theories of Population Growth: Malthus and Marx, Demographic Transition; Population policy with

reference to Indiaand China; Theories of Migration: Ravenstein, Lee and Todaro

2.3. Emerging issues and concerns - Ageing of Population; Declining Sex Ratio; HIV/AIDS; nutrition and morbidity with special reference to India

Unit III: Introduction to Rural and Urban Settlements

3.1. Definition, nature, types and characteristics of settlements; Morphology of rural settlements: site and situation, Social segregation rural landuse morphology; Types and Patterns of Rural Settlements; Rural house types and forms with reference to India

3.2. Urban settlements: Characteristics and definition, Census definition and categories in India; Concept of Metropolitan, Conurbation, Megacity, Megalopolis, Ecumenopolis and Necropolis

3.3. Morphology and Functions of Settlements: Classical models of Burgess, Homer Hoyt, Harris and Ullman, Central Place theory of Christaller; City Region, Umland and Rural urban Fringe and Continuum

Unit IV: Rural – Urban Infrastructure: Issues and Concerns

4.1. Problems of Rural settlements: Housing, Drinking water, Power, Education and Finance

4.2. Urban Housing problem: study of outgrowth and urban sprawl with reference to India; Urban Re-development, Renewal and New Town – case studies with reference to India.

4.3. Urban basic infrastructure and issues: Water supply and sanitation; solid waste management; role of National policies and JNNURM

Recommended Reading:

1. Carter, H.1975: The Study of Urban Geography, Edward Arnold, London
2. Daniel, P. 2002: Geography of Settlement, RawatPubls., Jaipur & New Delhi.
3. G. Dickinson, R. E. (1964) : City and Region.
4. Ghosh, S. 1998 : Settlement Geography, Orient Longman Ltd. , Kolkata.
5. Hudson, F. S. (1976) : Geography of Settlement.
6. Johnson, J.H. 1977 Urban Geography- An Introductory Analysis, Pergamon press, Oxford
7. Mandal, R.B. 2001: Introduction to Rural Settlements, Concept Publishing Company, New Delhi
8. Misra, H.N. (1987) Rural Georaphy, Vol. IX, Contributions to Indian Geography, Heritage Publishers, New Delhi.
9. Ramachandran R., 1989: Urbanisation and Urban Systems of India, Oxford University
10. Singh R.L. & K.N. Singh : Readings in Rural Settlement Geography, NGSI Varanasi, 1975
11. Agarwala, S.N. 1985: India's Population Problems, Tata McGraw hill, New Delhi
12. Chandna, R.C. 1986: A Geography of Population, Kalyani Publishers, New Delhi
13. Clarke, J. I. 1971: Population Geography and the Developing Countries, Pergamon Press, Oxford
14. Clarke, J. I. 1972 Population Geography, Pergamon Press, Oxford
15. Hassan, M.H. 2005: Population Geography, Rawat Publications, New Delhi
16. Mamoria, C.B. India's Population Problem, KitabMahal New Delhi, 1981.
17. Mitra, Ashok India's Population: Aspects of Quality and Control Vol I & II. Abhiman Publications, New Delhi, 1978.
18. Trewartha, G.T. 1969: A Geography of Population- World Patterns, John Wiley, New York.
19. Zacharia, E. and Sinha, V.C., 1986 : Elements of Demography, Allied publishers Pvt Ltd, New Delhi
20. Zelinsky, W. 1966: A Prologue to Population Geography, Prentice Hall India, New Delhi
21. Carter, H.1975: The Study of Urban Geography, Edward Arnold, London
22. Daniel, P. 2002: Geography of Settlement, RawatPubls., Jaipur & New Delhi.
23. G. Dickinson, R. E. (1964) : City and Region.
24. Ghosh, S. 1998 : Settlement Geography, Orient Longman Ltd. , Kolkata.
25. Hudson, F. S. (1976) : Geography of Settlement.
26. Johnson, J.H. 1977 Urban Geography- An Introductory Analysis, Pergamon press, Oxford
27. Mandal, R.B. 2001: Introduction to Rural Settlements, Concept Publishing Company, New Delhi

28. Misra, H.N. (1987) Rural Georaphy, Vol. IX, Contributions to Indian Geography, Heritage Publishers, New Delhi.
29. Ramachandran R., 1989: Urbanisation and Urban Systems of India, Oxford University
30. Singh R.L. & K.N. Singh : Readings in Rural Settlement Geography, NGSI Varanasi, 1975

Title of the Paper: Resource Geography
Discipline Specific Elective Theory - I (Option II)
Credits- 6, Contact hours per week - 6

Objective of the Study: This course is designed to provide basic concepts of resource distribution and its management. Students will learn utilization and availability of world resources considering the distribution of land, water, forest, mineral and power resources. They will also learn the resource management techniques and concept of resource conservation and sustainability which will enable them to understand and evaluate the policies of resource conservation and sustainability.

Unit I: Concept and Nature of Resources

1.1. Concept, Scope, Nature and Classification of resources
1.2. Economic and Environmental approaches to resource utilization; Process of resources: Zimmerman model
1.3. Principals of resource adequacy and resource scarcity: Pressure on resources

UnitII: Distribution and management of Natural Resources

2.1. Distribution, Classification, Management and Utilization of resources : Land Resources and Water Resources; problem of land acquisition in developing countries; Extensive Economic Zones (EEZ) of the world
2.2. Global scenario of utilisation, problems and trend of management of resources: Forests and Energy Resources,
2.3. Distribution, depletion and management of resource: Mineral and Soil Resources

Unit III: Environmental Crisis and Management

3.1. Environment as a resource system; Technology, Market, Culture and resources
3.2. Environmental crisis-nature and management of deforestation
3.3. Flood and droughts, Land degradation, Depletion of fresh water resources and their management

Unit IV: Concept of resource conservation and sustainability

4.1 Conservation of natural resources in the context of environment, population and development.
4.2 Sustainable Resource Development' eco-friendly technology and sustainable development.
4.3 National policies, plans, programmes, processes and patterns of resource development

Recommended Readings:

1. Adams, W.M.1995: Green development: Environmental sustainability in the Third World, London: Rout ledge.
2. Burton, I. and Kates, R.W. 1978: Readings in Resources Management and Conservation, McGraw Hill, New York.
3. Canter,L. W. 1996: Environmental Impact Assessment, 2nd edition, New Yprk: McGraw hill.
4. Chapman J.L. and Reiss, M.J. 1993: Ecology: Principles and applications, Cambridge: Cambridge university Press.
5. Clark, G.L; Feldman, M.P. and Gertler, M.S.(eds.) 2000: The Oxford handbook of Economic Geography, Oxford University Press, Oxford and New York.
6. Cutter S. N., Renwich H. L. and Renwick W., 1991: Exploitation, Conservation,Preservation: A Geographical Perspective on Natural Resources Use, John Wiley and Sons, New York.

7. David W. Pearce and Kerry R. Turner 1999: Economics of Natural Resources and the Environment, The Johns Hopkins University press, Baltimore.
8. Gadgil M. and Guha R., 2005: The Use and Abuse of Nature: Incorporating This Fissured Land: An Ecological History of India and Ecology and Equity, Oxford University Press. USA.
9. Holechek J. L. C., Richard A., Fisher J. T. and Valdez R., 2003: Natural Resources: Ecology, Economics and Policy, Prentice Hall, New Jersey.
10. Hoyt,J.B. (1973) Man and the earth,Prentice Hall, New Jersy.
11. Husain, M. (2010) Human Geography, Rawat Publication, Jaipur.
12. John Bowers (1997), Sustainaility and Environmental Economics, Addison Weley Longman Ltd, Singapore.
13. Jones G. and Hollier G., 1997: Resources, Society and Environmental Management, Paul Chapman, London.
14. Klee G., 1991: Conservation of Natural Resources, Prentice Hall, Englewood.
15. Mather A. S. and Chapman K., 1995: Environmental Resources, John Wiley and Sons, New York. 7. Mitchell B., 1997: Resource and Environmental Management, Longman Harlow, England.
16. Owen S. and Owen P. L., 1991: Environment, Resources and Conservation, Cambridge University Press, New York.
17. Rees J., 1990: Natural Resources: Allocation, Economics and Policy, Routledge.London.
18. Roger Perman, Yue Ma and James Mc Gilvray (1997) Natural Resources and Environmental Economics, II Edition, Addison weley Longman Ltd, Singapore.

Title of the Paper: Agricultural Geography
Discipline Specific Elective Theory - II (Option I)
Credits- 6, Contact hours per week - 6

Objective of the Study: In this course the students will learn land use classification, determinants of agriculture, agricultural regions, and techniques of delineation. This course will cover the aspects of nature and scope of agricultural geography, Origin and evolution of agriculture, a broadened theoretical base to include the agricultural system of the world, models of Agricultural Location and their relevance in Indian context and will encompass the interaction of agriculture with globalization.

Unit I: Introduction to Agricultural Geography

1.1. Introduction to Agricultural Geography; Origin of agriculture: Major Gene centers and Diffusion of agriculture – Agriculture and human civilization.
1.2. Agricultural Region, Concept and techniques of delineation of agricultural regions
1.3. Determinants of agriculture (tropical) – Physical, economic, social and technological factors

Unit II: Agricultural Systems:

2.1. Major agricultural types in the world: Shifting cultivation, Subsistence agriculture, Commercial agriculture, Plantation agriculture
2.2. Measurement of agricultural productivity and efficiency; Crop combination and Diversification
2.3. Model Agricultural Systems of the world: Von Thunen and Whittlesey; Land use model: L.D.Stamp

Unit III: Agriculture in India

3.1. Characteristics and challenges of Indian agriculture; Agro-climatic, Agro-ecological & Crop Combination Regions of India

3.2. Role of Technological Changes in Agricultural Productivity and Efficiency, Green ,White, Blue and

Pink Revolution-success and failures in India

3.3. Problem associated with Indian agriculture – National Agricultural Policy; Impact of Globalization, Food Security and Corporate Farming

Unit IV: Applied Agricultural Geography

4.1. Problems and Prospects of Tropical Agriculture – droughts, over irrigation, land fragmentation and marketing

4.2. Allied areas in agriculture and Agricultural Development - Dairy farming, Poultry, Sheep and Goat farming, Agro –Tourism, Bee keeping, Poly houses

4.3. Sustainable Agricultural Practices in Tropical Region - Ecological conservation, organic farming, Crop rotation and group plantation, pest and weed management

Recommended Readings:

1. Basu, D.N., and Guha, G.S., 1996: Agro-Climatic Regional Planning in India, Vol.I& II, Concept Publication, New Delhi.
2. Bryant, C.R., Johnston, T.R, 1992: Agriculture in the City Countryside, Belhaven Press, London.
3. Burger, A., 1994: Agriculture of the World, Aldershot, Avebury.
4. Dhillon, J.S. Agricultural Geography
5. Gregory H. P. (1970), "Geography of Agricultural ", Prentice Hall New York
6. Grigg, D.B., 1984: Introduction to Agricultural Geography, Hutchinson, London.
7. Husain, Majid. (1999), "Agricultural Geography", Rawat Pub. New Delhi
8. Ilbery B. W., 1985: Agricultural Geography: A Social and Economic Analysis, Oxford University Press.
9. Mohammad, N., 1992: New Dimension in Agriculture Geography, Vol. I to VIII, Concept Pub., New Delhi.
10. Mohammad, N., 1992: New Dimension in Agriculture Geography, Vol. I to VIII, Concept Pub., New Delhi.
11. Roling, N.G., and Wageruters, M.A.E.,(ed.) 1998: Facilitating Sustainable Agriculture, Cambridge University Press, Cambridge.
12. Shafi, M., 2006: Agricultural Geography, Doring Kindersley India Pvt. Ltd., New Delhi
13. Singh, J. and Dhillon, S.S. (1984), "Agricultural Geography", 2nd edition, Tata McGraw-Hill, New Delhi.
14. Singh, J., 1974: An Agricultural Atlas of India: A Geographical Analysis, Vishal Publications, Kurukshetra.
15. Singh, J., and Dhillon, S.S., 1984: Agricultural Geography, Tata McGraw Hill, New Delhi.
16. Tarrant J. R., 1973: Agricultural Geography, David and Charles, Devon.
17. Wigley, G. (1981), Tropical Agriculture: The Development of Production, 4th edition, Arnold, London.

Title of the Paper: Urban Geography
Discipline Specific Elective Theory - II (Option II)
Credits- 6, Contact hours per week - 6

Objective of the Course: The main objective of this course is to introduce the concepts and basics of urban spaces and urban geography. It deals with critical issues of urban geography including patterns of growth and development of urbanisation in developed and developing countries while highlighting the key concepts and concerns of urban problems and implications.

Unit I: Introduction to Urban Geography

1.1. Definition of Urban Geography: Nature and scope; Approaches: Positivist approaches, Behavioural and humanistic approaches, Structuralist approaches
1.2. Urbanisation: Definition and measurements; process of urbanisation during ancient, medieval, modern and postmodern period; Globalisation and political economy of Urbanisation
1.3. Key concepts in Urban Geography: Urban Image, Centrality, Mobility, Transnational Urbanism; La Corbusier's Model of Sustainable city

Unit II: Patterns of Urbanisation in Developed and Developing Countries

2.1. Process of urbanization in developed and developing countries; Characteristics of urban aces: developed vs. developing countries.
2.2. Pattern of world cities: Global cities, Represented city, Hybrid City, Intransitive City and the Creative City
2.3. Suburbanization, Segregation and Gentrification; Urban Aesthetics and changing urban spaces: working in the skyline, mobile and wireless in urban place

Unit III: Classification of Urban Places

3.1. Demographic characteristics of urban populations; Gradients of Population Density within Cities, Occupational structure of urban populations,
3.2. Functional classification of towns in medieval period with reference to India: administrative towns, military towns, commercial towns, industrial towns, port towns, religious towns
3.3. Recent Developments in Urban Classification with reference to India: Aurousseau's; Harris's and Howard Nelson's Classification

Unit IV: Urban Problems and Issues

4.1. City Employment issues, Displacement issues, Subsidy issues
4.2. Housing issues, Cultural issues, Urban green spaces, Urban transport, sustainability issue
4.3. Case studies of Delhi, Kolkata, Mumbai, Chennai, Bangalore and Chandigarh with reference to Land use, Urban and Environmental Issues and planning

Recommended Readings:

1. Bala, Raj (1986), Urbanisation in India, Rawat,Publication Jaipur.
2. Cadwallader, Martin (1986), Urban Geography, Prentice Hall, New Jersey.
3. Carter, Harold (1995) The Study of Urban Geography, Arnold London
4. Dickinson, E. (1949): City, Region and Regionalism" (Book Review). Town Planning Review.
5. Dickinson, R.E. (1964) City and Region Routledge London.
6. Fyfe, N.R. and Kenny, J.T. (2005): The Urban Geography Reader, Rutledge.
7. Gibbs, J.P. (1961) Urban Research Methods D. van Nostrand Co. Inc. Princeton, New Jersey.

8. Graham, S. and Marvin, S. (2001): Splintering Urbanism: Networked Infrastructures, Technological Motilities and the Urban Condition, Rutledge
9. Hall T. (2006): Urban Geography, Taylor and Francis.
10. Harvey, David (1989) The Conditions of Post modernity, Blackwell Oxford.
11. Kaplan, D.H., Wheeler, J.O. and Holloway, S.R. (2008): Urban Geography, John Wiley.
12. Knox, P.L. and McCarthy, L. (2005): Urbanization: An Introduction to Urban Geography, Pearson Prentice Hall New York.
13. Knox, P.L. and Pinch, S. (2006): Urban Social Geography: An Introduction, Prentice-Hall.
14. Kundu, A (1992) Urban Development and Urban Research in India, Khanna Publication, New Delhi.
15. Mayer H.M. and Kohn, C.F. (eds.)(1958), Reading Urban Geography. University of Chicago Press, Chicago.
16. Pacione, Michael (2001), Urban Geography - A Global Perspective, Routedge, London.
17. Ramachandran, R. (1992): The Study of Urbanisation, Oxford University Press, Delhi.
18. Ramachandran, R. (1989): Urbanisation and Urban Systems of India, Oxford University Press, New Delhi.
19. Sassen, S. (2001): The Global City: New York, London and Tokyo, Princeton University Press.
20. Short, J.R. (1996) The Urban Order,Oxford : Blackwell
21. Singh, K. and Steinberg, F. (eds.) (1987) Urban India in Crisis, New Age International, New Delhi.
22. Singh, R.B. (Ed.) (2015): Urban development, challenges, risks and resilience in Asian megacities. Advances in Geographical and Environmental Studies, Springer
23. Singh, R.B. (Eds.) (2001): Urban Sustainability in the Context of Global Change, Science Pub., Inc., Enfield (NH), USA and Oxford & IBH Pub., New Delhi.
24. Smailes A. E. (1953), The Geography of Town, Hutchinson, London.
25. Smith, P.D. (2012): City: A Guidebook for the Urban Age.
26. Verma, L.N. (2008): Urban Geography. Rawat publication.

SEMESTER: VI
(January - June)

Title of the Paper: Environmental Geography
Core Theory
Credits- 6, Contact hours per week - 6

Objective of the Study: This paper will promote a sensitive awareness of environment, to encourage students about biological life, places and landscapes. This will help to explore the relationship between humans and environment amidst diverse landscapes. The students will study how soils are forming in physical environment and its importance on life system. This course will also provide the students the opportunity to understand global ecosystems and differential biomes. It also make student aware about the environmental problems and the necessity of conservation and environmental planning.

Unit I: Nature and Concepts
1.1. Environmental Science: Introduction, Scope, approaches to study of environment
1.2. Components of environment: Energy, Abiotic and Biotic components
1.3. Human-Environment Relationships – Historical Progression, Environmental degradation and pollution

Unit II: Ecosystem - A Biotic Components of Environment
2.2. Concepts of Ecology, Ecosystem; Trophic structure, Food chain and Food web; Laws of Thermodynamics; Energy flow in ecosystems; Bio-geo-chemical cycles
2.3. Concept of Biomes, Niche, Adaptation and Climax in different Biomes; Ecotone and Community; study of Tropical rain forest, Taiga and Grasslands.
2.4. Environmental Problems in Tropical, Temperate and Polar Ecosystems; Biodiversity Management

Unit III: Environmental Problems and Policies
3.1. Concept of Hazards and Disaster; Physical, biological and social Hazards
3.2. Global resource crisis; environmental movements-Chipko and Silent valley; Concept of sustainable development
3.3. Resource use and Ecological imbalance with reference to soil, forests and energy resources.

Unit IV: Environmental Management
4.1. Environmental Programmes and Policies – Global, National and Local levels
4.2. Global Summits & Agencies of Environment Conservation.
4.3. Environmental education and legislation.

Recommended Readings:
1. Anderson, J.M. (1981): Ecology for Environmental Science: Biosphere, Ecosystems and Man, Arnold, London.
2. Nobel and Wright (1996): Environmental Science, Prentice Hall, New York.
3. Odum, E.P. (1971) : Fundamental of Ecology, W.B. Sanders, Philadelphia.
4. Saxena, H.M. (1994): PrayavaranevnParisthitikiBhugool (Geography of Environment and Ecology) Rajasthan Hindi Granth Academy, Jaipur.
5. Singh, S. (1991): Environmental Geography, PrayagPustakBhawan, Allahabad.
6. Strahler, A.H. and Strahler A.N. (1977): Geography and Mans Environment, John Wiley, New York.

7. William, M.M. and John, G. (1996): Environmental Geography - Science, Landuse and Earth System, John Wiley and Sons, New York.
8. Chandna, R.C. (2002): Environmental Geography, Kalyani, Ludhiana.
9. Cunninghum, W.P. and Cunninghum, M.A. (2004): Principals of EnvironmentalScience: Inquiry and Applications, Tata Macgraw Hill, New Delhi.
10. Goudie, A. (2001): The Nature of the Environment, Blackwell, Oxford.
11. 4. Mal, S. and Singh, R.B. (Eds.) (2009) : Biogeography and Biodiversity. Rawat Publication, Jaipur
12. Miller, G.T. (2004): Environmental Science: Working with the Earth, Thomson BrooksCole, Singapore.
13. MoEF, (2006): National Environmental Policy-2006, Ministry of Environment and Forests, Government of India.
14. Biswas, T.D. and Mukherjee, S.K. (1987): Text book of Soil Science, Tata McGraw Hill, New Delhi.
15. Daji, J.A., Kadam, J.R. and Patil, N.D. (1996): A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd, Mumbai.
16. Buckman, H.R. and Brady, N.C. (1974): Nature and Properties of Soil, McMillan, New York.
17. Bunting, A. (1965): Geography of Soil, Hutchinson, London.

Title of the Paper: Soil Geography

Paper Code:

Core Theory

Credits- 3, Contact hours per week - 3

Objective of the Study: This paper addresses how soil formed in different parts of the landscape influences productivity in the broad sense

Unit I : Introduction to Soil Geography

1.1 Nature and Scope of Soil Geography.

1.2 Relationship of Soil Geography with Pedology.

1.3 Significance of Soil Geography.

Unit II: Formation and Properties of Soils:

2.1 Factors of Soil Formation: Parent Material, Organic, Climatic, Topographic.

2.2 Processes of Soil Formation and Soil Development: Physical, Biotic and Chemical.

2.3 Physical Properties of Soils: Morphology, Texture, Structure, Water, Air, Temperature.

2.4 Chemical Properties of Soils: pH, Organic Matter, NPK(Nitrogen, Phosporous and Potassium) and Other Properties of Soils.

Unit III: Classification and Distribution of Soils

3.1 Genetic Classification of Soils

3.2 Characteristics and World Distribution of Soils.

3.3. Soil Profile: Laterite, Podzol; and Chernozem

3.4. Soil Erosion: Concept, Causes and Controlling Factors; Degradation and Conservation of Soils.

Unit IV: Soil Management

4.1 Concept of Soil Management

4.2 Need of Soil Management
4.3 Methods of Soil Management

Title of the Paper: Field Work and Report Writing and Disaster Management based Project Work
Paper Code: SGY33402
Core Practical
Credits- 4

Objective of the Study: The first part of this paper is designed to provide an introduction to some of the basic analytical methods employed by geographers when undertaking any common research problem. In the second part the students will analyse specific disaster based problems through analyses of appropriate documents and presentations of the report.

Unit I: Selection of study area

1.1. Selection of either a rural area or an urban area based on cadastral or municipal maps to study specific problems (Rural / Urban / Physical / Human / Environmental).
1.2. Field Techniques and Tools: Merits, Demerits and Selection of the Appropriate Technique; Observation (Participant / Non Participant), Questionnaires (Open/ Closed / Structured / Non-Structured); Interview with Special Focus on Focused Group Discussions; Space Survey (Transects and Quadrants, Constructing a Sketch)
1.3. Field Tour Planning: Collection of Material for Physical and Socio-Economic Surveys.

Unit II: Physical and Socio – Economic Status Analysis and Report Writing

2.1. Identification of physical problem, data collection and post field discussion.
2.2. Preparation of Questionnaire and Survey schedule for assessing data of households, industrial and market for perception study; Post field discussion.
2.3. Designing the Field Report: Aims and Objectives, Methodology, Analysis, Interpretation and Writing the Report

Unit III: Project on Disaster Management

The Project Report based on any field based case studies among following disasters and one disaster preparedness plan of respective college or locality:

i. Flood
ii. Drought
iii. Cyclone and Hailstorms
iv. Earthquake
v. Landslides
vi. Human Induced Disasters: Fire Hazards, Chemical, Industrial accidents

Unit IV: Field Notebook and viva – voice

Recommended Readings:

1. Basu, R. and Bhaduri, S. ed, (2007): Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
2. Hammond, R, and McCullagh, P. (1978): Quantitative Techniques in Geography: An Introduction, Oxford University Press, Oxford.
3. Creswell, J. (1994): Research Design: Qualitative and Quantitative Approaches Sage Publications.
4. Mukherjee, N. (1993): Participatory Rural Appraisal: Methodology and Application. Concept Publs. Co., New Delhi.
5. Mukherjee, N. (2002): Participatory Learning and Action: with 100 Field Methods. Concept Publs. Co., New Delhi.

6. Robinson, A. (1998): "Thinking Straight and Writing That Way", in Writing Empirical Research Reports: A Basic Guide for Students of the Social and Behavioural Sciences, eds. by F. Pryczak and R. Bruce Pryczak, Publishing: Los Angeles.
7. Special Issue on "Doing Fieldwork" The Geographical Review 91:1-2 (2001).
8. Stoddard, R.H. (1982): Field Techniques and Research Methods in Geography, Kendall/Hunt.
9. Wolcott, H. (1995): The Art of Fieldwork. Alta Mira Press, Walnut Creek, CA.

Title of the Paper: Political Geography
Discipline Specific Elective Theory - III (Option I)
Credits- 6, Contact hours per week - 6

Objective of the Study: This course will make the students familiar with key concepts of political geography, including the state, nations, territory, boundaries etc, and focus will be on questions of space and power by considering the interconnections of geography and politics. Students will be acquainted with the political actions that will have several impacts as they affect places and people at a variety of scales with special reference to partition of India, its impact and the current political scene of the Indian Subcontinent. This paper is also concern about the contemporary Global conflicts in differential issues.

Unit I: Concepts and Nature of Political Geography

1.1. Definition and scope of Political Geography; Approaches and schools of political geography
1.2. State and Nation: The idea of the state, special factors of the state (Location, size and shape); Concept of Nation, elements and characteristics of nation, Nationalism; Concept of Nation-State
1.3. Frontiers and boundaries: Definitions, Classifications of boundaries; Border lands and Buffer zones; Buffer states; Land locked nations; Enclaves and Exclaves; Territory and Sovereignty

Unit III: Global strategic views

2.1. Geo- strategic views of Mackinder and Spykeman
2.2. Concept of Geopolitics, Concept of cold war; bi-polarisation and unipolarisation
2.3. Electoral Geography: Geography of Voting, Geographic Influences on Voting pattern, Geography of Representation, Gerrymandering

Unit III: Political Geography of India

3.1. Impact of partition of India
3.2. International borders and disputes; Terrorism and Indian Defence Policies
3.3. International and interstate water dispute in Indian subcontinent: Water Sharing between India and Bangladesh and Karnataka and Tamil Nadu.

Unit IV: Geopolitics of global resources and role of multinational organizations

4.1. Political Geography of Resource Conflicts – Water Sharing Disputes, Disputes and Conflicts Related to Forest Rights and Minerals.
4.2. Politics of Displacement: Issues of relief, compensation and rehabilitation: with reference to Dams and Special Economic Zones
4.3. Significance of ASEAN, SAARC and EU; Role and emergence of NATO

Recommended Readings:

1. Adhikari, S. (2004): Political Geography, Rawat Publication, New Delhi.
2. Alexander, L.M. (1963): World Political Patterns Ran McNally, Chicago.
3. De Blij, H.J. and Martin, G. (1968): Systematic Political Geography, John Wiley, New York.
4. Dikshit, R.D. (1996): Political Geography: A Contemporary Perspective. Tat McGraw Hill New Delhi.
5. Dwivedi, R.L. (2004): Fundamentals of Political Geography, Chaitanya Publishing House, Allahabad

6. Dick, H. Llyod, S.J. and McLachlan, K.S. (1998): Land Locked States of Africa and Asia (vo.2), Frank Cass.
7. Agnew, J. (2002): Making Political Geography, Arnold.
8. Agnew, J., Mitchell, K. and Toal, G. (2003): A Companion to Political Geography, Blackwell.
9. Cox, K.R., Low, M. and Robinson, J. (2008): The Sage Handbook of Political Geography, Sage Publications.
10. Cox, K., (2002): Political Geography: Territory, State and Society, Wiley-Blackwell
11. Gallaher, C. (2009): Key Concepts in Political Geography, Sage Publications.
12. Glassner, M. (1993): Political Geography, Wiley.
13. Jones, M. (2004): An Introduction to Political Geography: Space, Place and Politics, Routledg .
14. Mathur, H.M. and Cernea, M.M. (eds.) Development, Displacement and Resettlement – Focus on Asian Experience, Vikas, Delhi
15. Painter, J. and Jeffrey, A. (2009): Political Geography, Sage Publications.
16. Taylor, P. and Flint, C. (2000): Political Geography, Pearson Education.
17. Verma. M.K. (2004): Development, Displacement and Resettlement, Rawat Publications, Delhi
18. Dick, H., Llyod S.J. and McLachlan, K.S. (1998): Land Locked States of Africa and Asia (vo.2), Frank Cass

Title of the Paper: Geography of Health and Well Being
Discipline Specific Elective Theory - III (Option II) Credits- 6,
Contact hours per week - 6

Objective of the Course: Thiscourse is designed to introduce students with an emerging branch of geography dealing exclusively with the human health and well beings. In this course students will learn to identify the basic concepts of health and health geography, linkages within environment, development and health while identifying factors affecting changing health and disease pattern on the global scale. The healthcare system of developed and developing countries would be analysed and the role of international organization such as WHO, UNICEF and Red Cross will be evaluated in the subsequent sections.

Unit I: Basic Concepts

1.1. Introduction to geography of health and well being: Definition, Nature and Scope
1.2. Perspectives on Health and wellbeing: Linkages with environment, development and health
1.3. Driving forces in health and environmental trends - population dynamics, urbanization, poverty and inequality.

Unit II: Environmental Degradation and Health Risk

2.1. Pressure on Environmental Quality and Health: Anthropogenic interferences and environmental pressure on land; climate change and human health – heat and cold; Biological disease agents; food production and nutrition
2.2. Environment vs. Development: agricultural development; industrialisation; transport and energy
2.3. Exposure and Health Risks: Air pollution; Water pollution; Land pollution; Housing Wastes; Changing Workplace.

Unit III: Disease Patterns and Distribution

3.1. Mortality and Morbidity: concept and measurements
3.2. Diseases – Concepts and classifications - genetic, communicable and non communicable, occupational and deficiency diseases; WHO classification of diseases; Epidemiological Transition Theory.

3.3. Spatio - Temporal distribution of disease in Environmental Context with special reference to India, Types of Diseases and their regional pattern (Communicable and Lifestyle related diseases).

Unit IV: National and Global Issues in Healthcare Systems

4.1. Health care systems of developed and developing countries; regional disparity in healthcare distribution - issues of accessibility and availability of healthcare

4.2. Role of international organization and healthcare - World Health Organizations (WHO), UNICEF and Red Cross

4.3. Health Care Systems in India; National Health Policies, Health Care Programmes – Family welfare, Immunization, National Disease Eradication, and National Rural Health Mission.

Recommended Readings

1. Akhtar Rais (Ed.), 1990: Environment and Health Themes in Medical Geography, Ashish Publishing House, New Delhi.
2. Avon Joan L. and Jonathan A Patzed. 2001: Ecosystem Changes and Public Health,Baltimin, John Hopling Unit Press(ed).
3. Bradley,D.,1977: Water, Wastes and Health in Hot Climates, John Wiley Chichesten.
4. Christaler George and HristopolesDionissios, 1998: Spatio Temporal Environment Health Modelling , Boston Kluwer Academic Press.
5. Cliff, A.D. and Peter,H., 1988 : Atlas of Disease Distributions, Blackwell Publishers, Oxford.
6. Gatrell , A.C. (2002) Geographies of Health: An Introduction, Blackwell,
7. Gatrell, A.,andLoytonen (1998). GIS and Health, London : Taylor and Francis Ltd.
8. Gatrell, A.,andLoytonen, 1998 : GIS and Health, Taylor and Francis Ltd, London.
9. Gesler, W.M. (1992). Therapeutic landscapes: Medical issues in light of the new cultural geography.
10. Hardham T. and Tannav M.,(eds): Urban Health in Developing Countries; Progress, Projects, Earthgoan, London.
11. Meade.M.S and Emch M: Medical Geography, London: The Guilford Press.
12. Moeller Dade wed., 1993: Environmental Health, Cambridge, Harward Univ. Press.
13. Murray C. and A. Lopez, 1996 : The Global Burden of Disease, Harvard University Press.
14. Phillips, D.andVerhasselt, Y., 1994: Health and Development, Routledge, London.
15. Rais, A. and Learmonth, A.T.A.: Geographical Aspects of Health and Diseases in India.
16. Smyth, Fiona (2008). Medical geography: Understanding health inequalities. Progress in Human Geography 32 (1): 119-127.
17. Tromp, S., 1980: Biometeorology: The Impact of Weather and Climate on Humans and their Environment, Heydon and Son.

Title of the Paper: Hydrology and Oceanography
Discipline Specific Elective Theory - IV (Option I)
Credits- 6, Contact hours per week - 6

Objective of the Study: This paper will deal with two major discipline of geography, namely Hydrology and Oceanography. The first part incorporates the main hydrological processes including precipitation, evaporation, rainfall interception, soil water, ground water and runoff. It also provides an understanding of global hydrological cycle, fundamental mechanisms behind it and basic hydrological analysis. The second part of this paper studies the physical, chemical and biological aspects of the oceans. The objective of this part is to help the student to understand our oceans and their influence on environment, climate. The economic importances of oceans and potential environmental damage have also been considered.

Unit I: Introduction to Hydrology

1.1. Definition, Scope and Content of Hydrology
1.2. Global Hydrological Cycle: Its Physical And Biological Role; Drainage Basin as a Hydrological Unit; Human impact on the hydrological cycle; Systems approach in hydrology
1.3. Components of Hydrology and their controlling Factors: interception, evaporation, evapo-transpiration, infiltration, ground-water, run off and over land flow

Unit II: Subsurface and Surface Hydrology

2.1. Sub-Surface Zonation of Ground Water; Controlling Factors of the Movement of the Ground Water - Recharge, Discharge and Storage; Darcy's Laws
2.2. Types of Aquifers, their formations and issues related to their over utilization
2.3. Surface flow: Characteristics of river basins; Drainage Basin and its morphometric analysis; measurement of river discharge, runoff; Hydrographs, Rating Curves; River Regimes; floods and droughts.

Unit III: Concepts and Nature of Oceanography:

3.1. Nature and scope of oceanography; Major properties (Physical and Chemical) of Ocean water
3.2. Concept of water mass; Waves, Tides, Ocean currents and their influence
3.3. Coral reefs and atolls: types and factors; Theories of Origin; coral and volcanic islands; Oceanic sediments-origin and classification

Unit IV: Surface configuration of the Ocean Floor

4.1. Configuration of the ocean floor, continental shelf, continental slope, abyssal plain, mid-oceanic and oceanic trenches; Relief of Atlantic, Pacific and Indian Oceans
4.2. Major features of the ocean floor: formation explained by Plate Tectonics
4.3. Resource potential of the oceans, exclusive economic zone; Marine Pollution

Recommended Readings:

1. Linsley, K., Kohler, M. and Paulhus, J.L. (1975): Applied Hydrology, Tata McGraw Hill, New York.
2. Meinzer, O.E. (1942): Hydrology, Dover Publication Inc. New York.
3. Rahgunath, H.M. (1997): Hydrology- Principles, analysis, Design, New Age International Pvt. Ltd, New Delhi
4. Sverdrup, H.U. (1942): The Oceans, their Physics, Chemistry and General Biology, Prentice-Hall, New York.
5. Todd, D.K. (1959): Ground Water Hydrology, John Wiley and Sons, New York

6. Walton, W.C. (1970): Ground Water Resource Evaluation, McGraw Hill, Tokyo
7. Andrew. D. ward and Stanley, Trimble (2004): Environmental Hydrology, 2nd edition, Lewis Publishers, CRC Press.
8. Karanth, K.R. (1988): Ground Water: Exploration, Assessment and Development, Tata- McGraw Hill, New Delhi.
9. Ramaswamy, C. (1985): Review of floods in India during the past 75 years: A Perspective. Indian National Science Academy, New Delhi.
10. Rao, K.L. (1982) : India's Water Wealth 2nd edition, Orient Longman, Delhi,.
11. Singh, Vijay P. (1995): Environmental Hydrology. Kluwar Academic Publications, The Netherlands.
12. Anikouchine, W. A. and Sternberg, R.W. (1973): The World Oceans: An Introduction to Oceanography, Prentice-Hall.
13. Garrison T. (1998): Oceanography, Wordsworth Company, Belmont.
14. Kershaw S. (2000): Oceanography: An Earth Science Perspective, Stanley Thornes, UK.
15. Pinet P. R. (2008): Invitation to Oceanography (Fifth Edition), Jones and Barlett Publishers, USA, UK and Canada.
16. Sharma, R.C. and Vatal, M. (1980): Oceanography for Geographers, Chaitanya Publishing House, Allahabad.
17. Sverdrup, K.A. and Armbrust, E.V. (2008): An Introduction to the World Ocean, McGraw Hill, Boston.

Title of the Paper: Geography of Tourism and Transport
Discipline Specific Elective Theory - IV (Option II)
Credits- 6, Contact hours per week - 6

Objective of the Study: The paper will helpthe students to understand the spatial constitution, dynamics and multiple functions of tourism in relation to Geography. This course will also lay light on the emerging concept of tourism industry and make them understand the impact of tourism on physical and human environments. Students will get the opportunity to inculcate global and national tourism aspects in this part. This paper will also cultivate geographical thought among the students about the basic concepts, modes of transport and examine institutional policies in transportation management. This course will provide a practical understanding to travel patterns and behaviour and introduces the student with the basic concepts of transport and different modes of transport.

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Unit I: Introduction to Tourism Geography

1.1. Scope and Nature: Concepts and Issues, Tourism, Recreation and Leisure Inter-Relations; Geographical Parameters of Tourism.
1.2. Type of Tourism: Nature Tourism, Cultural Tourism, Medical Tourism, Pilgrimage; Impact of Tourism: Environment, economic and social, Positive and negative impact of tourism
1.3. Recent Trends of Tourism: International and Regional; Eco-Tourism, Sustainable Tourism, Meetings Incentives Conventions and Exhibitions (MICE)

Unit II: Tourism in India

2.1. Tourism Infrastructure and support system – accommodation, other facilities and amenities
2.2. Tourism industry in India: Regional attraction and promotion of tourism; Problems of Tourism in India
2.3. Case Studies of Tourism Industry: Himalaya, Desert and Coastal Areas; Tourism Policy and planning in India

Unit III: Introduction to Transport Geography

3.1. Nature and scope of transport geography

3.2. Transport networks – Network structure and concepts and measures of distance, accessibility and connectivity

3.3. Transport and development; Factors associated with the development of transport system: physical, economic, social, cultural and institutional; economic, technological and regional development; Theoretical framework and The Taffe, Morril and Gould Model

Unit IV: Transport System – Policy and Planning

4.1. Transport Network and regional development: Transport policies, development and planning in developing countries with reference to India

4.2. Surface transportation : Growth and problems of Road and Rail transportation networks of India; National Highway Development and Planning

4.3. Transport and environmental degradation: Vehicular pollution and congestion; alternatives to transport system in mega cities of India (Case studies of Delhi, Kolkata and Bangalore)

Recommended Readings:

1. Babu, S. S., Mishra, S., and Parida, B.B. (eds.): Tourism Development Revisited – Concepts, Issues and Paradigms, Sage.
2. Bamford, C.G. and Robinson, H. (1978): Geography of Transport, Macdonald and Evans, London.
3. Bhaduri S. (1992): Transport and Regional Development, Concept Publishing Company, New Delhi.
4. Bhardwaj, (eds.): International Tourism: Issues and Challenges, Kanishka New Delhi
5. Bhatia, A.K., (1991): International Tourism: Fundamentals and Practices, Sterling Publishers, New Delhi.
6. Boniface, B.G. and Chris, C. (2005): Worldwide Destinations: The Geography of Travel and Tourism, Elsevier Butterworth-Heinemann, Oxford.
7. Chorley R.J. &Haggett P.(1967): Models in Geography Methuen & Co. London.
8. Dhar, P.N. (2006): International Tourism: Emerging Challenges and Future Prospects, Kanishka, New Delhi.
9. Hagget, F and Chorley, R.J. (1968): Network Analysis', Edward Arnold, London.
10. Hall M. and Stephan P., (2006): Geography of Tourism and Recreation – Environment, Place and Space, Routledge, London.
11. Hay, A(1973): Transport Economy, MacMillan, London.
12. Hoyle, B.S. (1973): Transport and Development, Macmillan, London.
13. Hoyle, Band Knowles, R. (2000): Modern Transport Geography, John Wiley and Sons, New York.
14. Hurst, M.E.(ed.) (1974): Transportation Geography, McGraw-Hill.
15. Kamra, K.K. and Chand, M. (2007): Basics of Tourism: Theory, Operation and Practise, Kanishka Publishers, Pune.
16. Page, S. J. (2011): Tourism Management: An Introduction, Butterworth-Heinemann- USA. Chapter 2.
17. Raj, R. and Nigel, D. (2007): Morpeth Religious Tourism and Pilgrimage Festivals Management: An International perspective by, CABI, Cambridge, USA, www.cabi.org.
18. Raza, M. and Agrawal Y.P.(1985): Transport Geography of India, Concept, New Delhi.
19. Robinson H & Bamford C.G.(1978): Geography of Transport Macdonald & Evans.
20. Singh, J. (2014): Eco-Tourism. I.K. International Pvt. Ltd. S-25, Green Park Extension, Uphaar Cinema Market, New Delhi, India (www.ikbooks.com).
21. Taffe, E.J. & Gauthier (Jr.) H.L.(1973): Geography of Transportation, Prentice-Hall
22. Tourism Recreation and Research Journal, Center for Tourism Research and Development, Lucknow.

SEMESTER: VII
(July to December)

Title of the Paper: Advanced Geomorphology and Geotectonics
Credits- 3, Contact hours per week - 3

Course Objective: This course is designed to define the basic concept of Geomorphology, categorize different endogenetic processes and their impacts on land evolution, concept of different exogenetic processes and their individual influences on land degradation. It will enrich students' knowledge on the mechanism and causes of tectonic events and its impact in the distribution of continents and oceans and other seismic landforms. This course will further illustrate the implication of geomorphic knowledge in different constructional sites and hazards managements.

Unit I: Concepts in Geomorphology and Geotectonics

1.1. Origin and the evolution of Universe; Origin of earth magnetic field, paleomagetism; Paleomagnetic polar wondering curve; Reconstruction of plate tectonics motion
1.2. Mechanism of Plate dynamics; Application of plate tectonics theory in explaining orogenesis, volcanism, earthquake; Neo-tectonics and its worldwide evidences
1.3. Spatial scale, temporal scale and related concepts: Systems, feedback, equilibrium and threshold
1.4. Morphogenetic regions; Models of slope evolution

Unit II: Rivers and Coastal Landforms

2.1. River hydraulics: flow and energy; Hydraulic geometry of streams
2.2. Catchment processes and fluvial processes; Factors regulating entrainment, transportation and deposition of sediments; Adjustment of channel forms and patterns to morphodynamic variables;
2.3. Coastal morphodynamic variables and their influence on evolution of coastal forms
2.4. Fluvial landforms: genetic classification, ordering, formation and evolution

Unit III: Evolution of Landforms

3.1. Classification and evolution of periglacial landforms
3.2. Impact of Pleistocene on landform evolution
3.3. Tectonic significance of the evolution of Bengal Basin
3.4. Planetary geomorphology and geotectonics with special reference to Moon and Mars

Unit IV: Applied Geomorphology

4.1. Application of geomorphology in feasibility assessment of engineering and industrials projects; geomorphic approach to hazard studies
4.2. Factors, vulnerability, consequences and management of earthquakes, tsunamis and landslides
4.3. Factors, vulnerability, consequences and management of riverbank erosion, storm surges and floods
4.4. Principles of integrated coastal management

Recommended Readings

1. Bloom, A.L. 1992: Geomorphology- Systematic Analysis of Late Cenozoic Landforms, Prentice Hall India, New Delhi.

2. Chorley, R.J. 1969: Introduction to Fluvial Processes, Methuen, London
3. Chorley, R.J., Schumm, S. A. and Sugden, D.E. 1984: Geomorphology, Methuen, London
4. Dayal, P. 1996: Textbook of Geomorphology, Shukla Book Depot ,Patna.
5. Husain Majid (2002), Fundamenatls of Physical Geography, Second Edition, Rawat Publications, Jaipur and New Delhi.
6. K. Siddartha – Earth Dynamic Surface (Transworld Media & Communications – Publication – Patna , 1994)
7. Kale, V. and Gupta, A. 2001: Introduction to Geomorphology, Orient Longman, Kolkata
8. McCullagh, P. 1978: Modern Concepts in Geomorphology, Oxford University Press, Oxford.
9. Ollier, C.D. 1975: Weathering, Longman, London
10. Ollier, C.D. 1981: Tectonics and Landforms, Longman, London
11. Selby, M.J., (2005), Earth's Changing Surface, Indian Edition, OUP
12. Singh Savindra (1993), Physical Geography,PrayagPustakBhawan, Allahabad.
13. Small, R.J. 1978: The Study of Landforms, Cambridge University Press, Cambridge
14. Sparks, B.W. 1960: Geomorphology, Longman, London.
15. Strahler, A .N. (1988), Earth Sciences, Harper and Row Publishers,N.D.
16. Strahler, A.N. and Strahler, A.H.(1996), Introducing Physical Geography, John Willey and Sons, NY.
17. Thornbury, W.D. 1954: Principles of Geomorphology, John Wiley, New York.
18. Wooldridge, S.W. and Morgan, R.S. 1959: The Physical basis of Geography- An Outline of Geomorphology, Longman, London

Title of the Paper: Advanced Climatology
Credits- 3, Contact hours per week - 3

Course Objective: The course will provide knowledge on distinction between basic concepts of weather and climate on various scales including its linkages with the other environmental systems. It will identify the role of heat and moisture as an important element of atmosphere while explaining various atmospheric phenomenons such as adiabetic heating and cooling, atmospheric instabilities, cloud formation and mechanism of precipitation, tropical circulations, air mass, atmospheric convergence and divergence and related weather hazards. The course will also explain the distinguished features of tropical climate with special emphasis on Asian Monsoon System, tropical weather disturbances and techniques of tropical weather forecasting.

Unit I: Concepts of Weather and Climate

1.1. The climate system: Micro, Meso and Macro; Linkages of climate with other environmental systems
1.2. Role of heat and moisture in the atmosphere; Adiabatic processes and instabilities
1.3. The wind circulation systems: Primary, Secondary and Tertiary
1.4. Clouds: Formation and classification; Precipitation: Forms and functions

Unit II: Tropical Climates and Weather Hazards

2.1. Tropical circulations: Hadley and Walker, ENSO phenomena
2.2. Tropical air mass; Convergence and divergence
2.3. The Asian Monsoon: Importance, characteristics, and prediction
2.4. Weather hazards – Heat and cold waves, thunderstorm, tornado and cyclone: Distribution, significance and forecasting.

Unit III: Climate Change

3.1. Scientific evidences of climate change; Reconstruction of past climates
3.2. Theories of climate change; Prognostication of future climates
3.3. The climate cycle; Climate trends in the Holocene period
3.4. Recent trends of global climates: Implications and arguments

Unit IV: Applied Climatology

4.1. Approaches and techniques of weather forecasting with reference to the tropics: short, medium and long range
4.2. Climate and agriculture: Agro-climatology – Water budget and Crop Calendar
4.3. Climate and settlements: Urban climatology – Urban Heat Island and Architecture
4.4. Climate and health: Bio-climatology – Human Comfort and morbidity

Recommended Readings:

1. Ahmad, R. 1997: Abahaoa O Jalavayu Vijnan (Bengali) , University Of Rajshahi,Rajshahi, Bangladesh
2. Barry, R.G. and Chorley, R.J. 1985: Atmosphere, Weather and Climate, Methuen,London
3. Blair, T.A. and Fite, R.C. 1965: Weather Elements: A Text in ElementaryMeteorology, Prentice Hall, New York
4. Critchfield, H.J. 1966: General Climatology, Prentice Hall, New York.
5. Das, P.K., 1988: The Monsoons, National Book Trust, India, New Delhi.
6. Das. P.K., 2004: Mousumi Vayu (Bengali), National Book Trust, India, NewDelhi (Bengali).
7. Henderson-Sellers, A. and Robinson, P.J. 1966: Contemporary Climatology,ELBS/ Longman.
8. Lal, D.S. 1986: Climatology, Chaitanya Publishing House, Allahabad.
9. Lutgens, F.K. and Tarbuck, E.J. 1982: The Atmosphere: An Introduction toMeteorology, Prentice Hall, New York.
10. Lydolph, P.E. 1985: The Climate of the Earth, Rowman and Allan Held, NewJersey.
11. Mather, J.R.,1974.: Climatology: Fundamentals and Applications, McGraw Hill,New York
12. Musk, L.F. 1988: Weather Systems, Cambridge University Press, Cambridge.
13. Pettersson, S. 1958: Introduction to Meteorology, McGraw Hill, Tokyo.
14. Robinson, H. 1982: Biogeography, ELBS/ McDonald and Evans, London.
15. Trewartha, G.T. 1968: An Introduction to Climatology, McGraw Hill, New York.

Title of the Paper: Demography and Settlement Geography
Credits- 3, Contact hours per week - 3

Course Objective: The course is framed to describe and explain the factors influencing the size, development and function of urban and rural settlements and their spheres of influence; to describe and identify factors for the characteristics of land-use zones of urban; to identify some of the problems of urban areas, their causes and possible solutions. The course will introduce the students with the growth of the world's population and associated problems and show an understanding of the causes and consequences of over-population and under-population. It will increase analytical skills of the students while highlighting the population structures and dynamics overall, as well as the specific study of fertility, mortality, and migration.

Unit I: Population Geography

1.1. Evolution of Population Geography- - Contemporary trends; Relationship of population geography with other disciplines

1.2. Population- Demographic characteristics- reproduction, health and education- Challenges for developed and developing countries
1.3. Theories of Population Growth: Pre Malthusian views, Malthus Theory and Theory of Economic Growth, Neo classical School, Socialist and Marxist writings on Population Growth– demographic transition and demographic dividend- critic
1.4. Population Composition; Population Policy: Post Independence development

Unit II: Migration, Mobility and Displacement

2.1. Factors, processes and typology – Contemporary trends in developed and developing countries - Rural and urban dimensions; Impact of Migration on population change and economy in source area and destination
2.2. Theories of Migration: Neo-classical Theories, Neo-Economic Theories
2.3. Population as social capital- Status of developed and developing countries
2.4. Population and Vulnerability: Displacement – Diaspora and Identity Crisis

Unit III: Settlement

3.1. Concept of settlement: Rural and Urban, Census categories of settlement; Characteristics of Rural Settlement
3.2. Evolution and Growth of Rural Settlements – World, India; Dispersion and Segregation of Rural Settlement; Rural service centres and Hierarchy
3.3. Characteristics of Urban Settlement: Concept of Conurbation, Metropolitan concept, Megalopolis and Ecumenopolis; Urban society and Urban Form - Colonial City, Industrial City, Post Industrial City, Global City
3.4. Morphology of Towns: Classical models and Non-classical models. Theories of Spacing of Urban Settlement; Urban Hierarchy;

Unit IV: Urban Infrastructure

4.1. Concept of Urban Re-development, Renewal and New Town
4.2. Urban Housing, Policies, Problems with special reference to Slums; subaltern urbanization
4.3. Water Supply, Sanitation and sewerage, Solid waste management
4.4. Urban Transport: New models of public transport

Recommended Readings

1. Carter, H.1975: The Study of Urban Geography, Edward Arnold, London
2. Daniel, P. 2002: Geography of Settlement, RawatPubls., Jaipur & New Delhi.
3. G. Dickinson, R. E. (1964): City and Region.
4. Ghosh, S. 1998 : Settlement Geography, Orient Longman Ltd. , Kolkata.
5. Hudson, F. S. (1976): Geography of Settlement.
6. Johnson, J.H. 1977 Urban Geography- An Introductory Analysis, Pergamon press, Oxford
7. Mandal, R.B. 2001: Introduction to Rural Settlements, Concept Publishing Company, New Delhi
8. Misra, H.N. (1987) Rural Georaphy, Vol. IX, Contributions to Indian Geography, Heritage Publishers, New Delhi.
9. Ramachandran R., 1989: Urbanisation and Urban Systems of India, Oxford University
10. Singh R.L. & K.N. Singh : Readings in Rural Settlement Geography, NGSI Varanasi, 1975
11. Agarwala, S.N. 1985: India's Population Problems, Tata McGraw hill, New Delhi
12. Chandna, R.C. 1986: A Geography of Population, Kalyani Publishers, New Delhi
13. Clarke, J. I. 1971: Population Geography and the Developing Countries, Pergamon Press, Oxford
14. Clarke, J. I. 1972 Population Geography, Pergamon Press, Oxford
15. Hassan, M.H. 2005: Population Geography, Rawat Publications, New Delhi

16. Mamoria, C.B. India's Population Problem, KitabMahal New Delhi, 1981.
17. Mitra, Ashok India's Population: Aspects of Quality and Control Vol I & II. Abhiman Publications, New Delhi, 1978.
18. Trewartha, G.T. 1969: A Geography of Population- World Patterns, John Wiley, New York.
19. Zacharia, E. and Sinha, V.C., 1986 : Elements of Demography, Allied publishers Pvt Ltd, New Delhi
20. Zelinsky, W. 1966: A Prologue to Population Geography, Prentice Hall India, New Delhi

Title of the Paper: Regional Geography
Credits- 3, Contact hours per week - 3

Course Objective: This course introduces students to the regional aspects of geography. It will help students to understand the concepts and approaches of regions and regional geography. Students will learn various aspects of regions and regionalisation scheme considering climate, vegetation, population, settlement and global resources while highlighting vulnerable issues of such distribution.

Unit I: Introduction to Regions and regional Geography

1.1. Nature and scope of regional geography; Approaches to Regional study
1.2. Regions and Regionalisation - methods and techniques of regionalisation
1.3. Concept and approaches of Physical Regions, Socio - Cultural Regions and Planning Regions.
1.4. Economic Base theorems, Inter- regional Trade Multiplier, Growth Pole theory

Unit II: Regionalisation of Climate and Vegetations

2.1. Climate and Regionalisation – Global Climatic Provinces after Koppen, Trewartha and Thornthwaite.
2.2. The regional aspects of Monsoon – Behavioural differences of The Asian Monsoon and the Pseudo – Monsoon
2.3. Distribution of climate and vegetation – Phytogeographical regions of the world
2.4. Climate change and vegetation shifts – Global patterns and concerns

Unit III: Regional Dimensions of Population and Settlement

3.1. World Population – growth, patterns and distribution, regional and global projections of world population
3.2. Regional overview of Population Dynamics – Fertility, Mortality, Morbidity and Migration
3.3. Global distribution of Rural Settlements – Morphology (Ground Plan, Architecture, Building Material) and Characteristics; Rural transformation

3.4. Distribution of Urban Population, Urban Morphology and type of Urbanized Regions: Conurbation, Metropolis, Megalopolis

Unit IV: Resource Distribution and Regionalisation

4.1. Major Agricultural Systems of the World - Patterns and distribution
4.2. Delineating Industrial Regions of the world; patterns and distribution with special reference to North America
4.3. Knowledge Economy and Regionalisation; Role of IT Sector and regionalisation
4.4. Health resources and regionalisation; pattern of world distribution of major diseases, health care system of developed and developing countries

Recommended Readings:

1. Critchfield, H.J. 1966: General Climatology, Prentice Hall, New York.
2. Das, P.K., 1988: The Monsoons, National Book Trust, India, New Delhi.

3. Barry, R.G. and Chorley, R.J. 1985: Atmosphere, Weather and Climate, Methuen,London.
4. Kormondy, E. J. 1991 : Concepts of Ecology.
5. Nebel, J.B. 1981: Environmental Science, Prentice Hall, New York.
6. Odum, F.P. 1971: Fundamentals of Ecology, W.B. Sanders, Philadelphia.
7. Robinson, H. 1982 : Biogeography.
8. Carter, H.1975: The Study of Urban Geography, Edward Arnold, London
9. Daniel, P. 2002: Geography of Settlement, RawatPubls., Jaipur & New Delhi.
10. Mandal, R.B. 2001: Introduction to Rural Settlements, Concept Publishing Company, New Delhi
11. Misra, H.N. (1987) Rural Georaphy, Vol. IX, Contributions to Indian Geography, Heritage Publishers, New Delhi.
12. Trewartha, G.T. 1969: A Geography of Population- World Patterns, John Wiley, New York.
13. Zacharia, E. and Sinha, V.C., 1986 : Elements of Demography, Allied publishers Pvt Ltd, New Delhi
14. Zelinsky, W. 1966: A Prologue to Population Geography, Prentice Hall India, New Delhi
15. Clarke, J. I. 1971: Population Geography and the Developing Countries, Pergamon Press, Oxford
16. Clarke, J. I. 1972 Population Geography, Pergamon Press, Oxford
17. Hassan, M.H. 2005: Population Geography, Rawat Publications, New Delhi
18. Ahuja R. 2001: Social problem in India Rawat Publication
19. Claval P.2002: An Introduction to regional geography, Blackwell Publishers
20. Sen P.K. & Prasad N. 2002 An introduction to Geomorphology of India, Allied publishers Pvt. Ltd.
21. Singh R.L. (ed) 1971 India: a regional geography NGSI
22. Spate O.H.K. &Learmonth A.T.A.1967 :India & Pakistan Munsiram Monoharlal pub. Pvt. Ltd

Mishra, R.P (ed): Regional Planning- Concepts, Tools, Techniques and case studies.

Title of the Paper: Geopolitics, History and International Relation
Credits- 3, Contact hours per week - 3

Course objective: This course examines history and politics through the lens of Geography. The course of Political Geography focuses on the interrelation between geography and politics and will make the student familiar with the concepts of state, nations, nation-state, frontier, boundaries Geopolitics etc. The student will also learn what it means to be a historical geographer, and how modern technology has allowed historical geography from relative obscurity into a new prominent role within the realm of geography. Students will be acquainted with the ancient society, culture and economic conditions of the Indian Subcontinent.

Unit I: Political Geography and Geopolitics

1.1 Definition, nature and scope of Political Geography
1.2 Geo- strategic views of Mackinder and Spykeman and their relevance in contemporary world
1.3 Themes in Political Geography; State, Nation, Nation-state, Nation- building, Capitals, Frontiers and Boundaries, Buffer zone and Buffer state, Land-locked nation, Enclaves and Exclaves, Concept of cold war; bi-polarisation and unipolarisation
1.4 Role of WTO, NATO and other political/economic blocks and geopolitics of global resources; Relevance of north-south dialogue and importance of ASEAN and SAARC

Unit II: Political Geography of India

2.1 Impact of partition of India; India's borders and border disputes
2.2 Federalism and other forms of governance of India; federal structure of India
2.3 Electoral Geography; scope nature, and relevance of study
2.4 Geopolitical significance of Indian Ocean; International water dispute problem between India and Bangladesh

Unit III: Basic of Historical Geography

3.1 Scope and content of Historical Geography and its relation with other branches of Geography
3.2 Patterns of urbanization, Territorial organization of the Janapadas in ancient India
3.3 Social and cultural structure of Harappa Society, Vedic Society and Medieval Society
3.4 Regionalization of Medieval India as derived from the travel accounts

Unit IV: Political and economic scenario of different Empires of India

4.1 Economic status of India during Mughal Period with emphasis on agriculture, industry and trade
4.2 The nature of polities: the Gupta empire and its contemporaries: post- Gupta polities – Pallavas, Chalukyas, and Vardhanas
4.3 Characteristics of colonial economy with special reference to Eastern India
4.4 Development of Indian capitalism

Recommended Readings

1. Ali, S.M. (1966): The Geography of the Puranas, Peoples Publishing House, New Delhi.
2. Baden-Powel (1960): Land Systems of British India, Publication Division, Govt. of India, New Delhi.
3. Bhagwati, J.N. (ed) (1976): New International Economic Order – The North-South Debate, M.I.T. Press, London.
4. Carter, H. (1983): An introduction to Urban Historical Geography, Edward Arnold, Baltimore.
5. Chattopadhyaya, B.D. (1994): The Making of Early Medieval India.
6. Cunningham, A. (1975): The ancient geography of India, Bharatiya Publishing House, Varanasi.
7. Dikshit, R.D. (1982): Political Geography: A Contemporary Perspective, Tata McGraw Hill Publishing Co., New Delhi.
8. Glassner, M.I. (19930: Political Geography, John Wiley, New York.
9. Habeeb, I. (1963): The agrarian system of Mughal India, Oxford University Press, London.
10. Habeeb, I. (1982): An Atlas of the Mughal Empire, Oxford University Press, London.
11. Kosambi, D.D. (1975): An Introduction to the Study of Indian History.
12. Maity, S.K. (1970): Economic Life in Northern India in the Gupta Period.
13. Norton, W. (1984): Historical analysis in Geography, Longman, New York.
14. Panikkar, K.M. (1956): Geographical factors in Indian History, Bharatiya Vidya Bhavan, Mumbai.
15. Pounds, N.T. (1972): Political Geography, McGraw Hill, New York.
16. Prescott, J.R.V. (1972): Political Geography, Methuen and Co. London.
17. Sahu, B.P. (ed) (1997): Land System and Rural Society in Early India.
18. Schwartzberg, J. (1980): Historical Atlas of South Asia, Chicago University Press, Chicago.
19. Short, J.R. (1982): An introduction to Political Geography, Routledge and Kegan Paul, London.
20. Sircar, D.C. (1960): Studies in the Geography of Ancient and Medieval India, Motilal Banarasi Das Publishers, New Delhi.
21. Taylor, P. (1985): Political Geography, Longman, London.

Title of the Paper: Geostatistics
Credits- 4, Contact hours per week – 6

Course Objectives: This course will enable students to understand basics of geostatistics and geographers' data matrix. Students will learn various spatial techniques considering geography as a spatial science.

Unit I: Introduction to Geostatistics

1.1. Geostatistics and Geographical Data: Introduction to GDM (Geographer's Data Matrix)
1.2. Measuring Geographical Data: scales and methods
1.3. Sampling and estimation

Unit II: Visualization and mapping of Spatial Data

2.1. Hypsometric curve, Relative Temperature curve, Ombrothermic graph, Climograph, Hythergraph, Rank - size graph, Lorenz curve, Dispersion diagram, Ergograph, Ternary graph
2.2. Isanomals, Cropping Intensity, Agricultural Productivity, Agricultural Efficiency, Crop Diversification, Crop Combination
2.3. Scatter Plot: Bi-variate analysis and Residuals of Bi-variate Analysis

Unit III: Spatial Analysis

3.1. Analysis of Point Pattern: measures of central tendency (locating mean centre of point pattern and population with shift), dispersion (standard distance), randomness and uniformity of point pattern (Chi-square, Nearest Neighbour Analysis)
3.2. Analysis of line pattern: directional analysis and network analysis
3.3. Analysis of Areal Pattern: Measures of Regionalisation (Mean and Standard Deviation, Variability, Standard Score, Dominant and Distinctive Function and Inequality Analysis)

Unit IV: Laboratory Notebook and Viva voce

Reading Lists:

1. Alvi, Z. 1995: Statistical Geography-Methods & Application, Rawat Publications,Jaipur.
2. *Ashis Sarkar, Quantitative Analysis in Geography, Blackswan Publishers.*
3. Clark, W.A.V. and Hosking, P.L. 1986: Geographical Methods for Geographers, John Wiley and Sons, New York.
4. Croxton, F.E., Cowden, D.J. & Klein, S 1969: Applied General Statistics, PrenticeHall of India Pvt. Ltd., New Delhi.
5. Dickinson, G.C. (1973): Statistical Mapping and Presentation of Statistics.
6. Goon, A.M., Gupta, M.K. & Dasgupta, B. 1992: Basic Statistics, Volume 1, TheWorld Press Pvt. Ltd., Kolkata.
7. Goon, A.M., Gupta, M.K. & Dasgupta, B. 1992: Fundamentals of Statistics,Volume 1, The World Press Pvt. Ltd., Kolkata.
8. Gregory, S. 1985: Statistical Methods and the Geographer, Longman, London.
9. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi.
10. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London.
11. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction,Hutchinson and Co., London.
12. Pal, S.K. 1998: Statistics for Geo-Scientists- Techniques and Application, Concept Publishing Company, New Delhi.

13. Peter A. Rogerson, Statistical Methods for Geography, Sage Publications.

Title of the Paper: Advanced Quantitative Techniques
Credits- 4, Contact hours per week – 6

Course Objective: This course is framed to provide students a basic competence in spatial pattern analysis as a central theme of geographical enquiry while focussing on manipulation, mapping and interpretation of various geographical databases.

Unit I: Spatial Statistics

1.1. Computation of shape indices
1.2. Distance based point pattern measures: Quadrat count method, Test of Randomness and Uniformity
1.3. Probability of Events / Occurrences

Unit II: Multivariate Data Analysis

2.1. Principles and techniques of Matrix Algebra and Correlation Regression Matrix
2.2. Multiple Regression Analysis (MRA)
2.3. Principal Component Analysis (PCA) - Eigen Vector Method

Unit III: Spatial Relationship and interdependence

3.1. Spatial relationships: Join Count Statistics (Free Sampling and Non – free sampling methods), Moran's Coefficient.
3.2. Measures of interdependence: Cluster Analysis (CA), Discriminant Analysis (DA)

Unit IV: Laboratory Notebook and Viva voce

Reading Lists:

1. Alvi, Z. 1995: Statistical Geography-Methods & Application, Rawat Publications,Jaipur.
2. *Ashis Sarkar, Quantitative Analysis in Geography, Blackswan Publishers.*
3. Clark, W.A.V. and Hosking, P.L. 1986: Geographical Methods for Geographers, John Wiley and Sons, New York.
4. Croxton, F.E., Cowden, D.J. & Klein, S 1969: Applied General Statistics, PrenticeHall of India Pvt. Ltd., New Delhi.
5. Cole, J. P. and King, C.A.M., 1968: Quantitative Geography, Techniques and Theories in Geography, John Wiley & Sons Ltd, Glasgow.
6. Dickinson, G.C. (1973): Statistical Mapping and Presentation of Statistics.
7. Goon, A.M., Gupta, M.K. & Dasgupta, B. 1992: Basic Statistics, Volume 1, TheWorld Press Pvt. Ltd., Kolkata.
8. Goon, A.M., Gupta, M.K. & Dasgupta, B. 1992: Fundamentals of Statistics,Volume 1, The World Press Pvt. Ltd., Kolkata.
9. Gregory, S. 1985: Statistical Methods and the Geographer, Longman, London.
10. Hammond, R, and McCullagh, P. 1978: Quantitative Techniques in Geography:An Introduction, Oxford University Press, Oxford.
11. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi.
12. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London.
13. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction, Hutchinson and Co., London.

14. Pal, S.K. 1998: Statistics for Geo-Scientists- Techniques and Application, Concept Publishing Company, New Delhi.
15. Peter A. Rogerson, Statistical Methods for Geography, Sage Publications.

SEMESTER: VIII
(January - June)

Title of the Paper: Advanced Hydrology and Ocean Science
Credits- 3, Contact hours per week - 3

Course Objective: This course is divided into two parts. First part of the paper is deals with the major hydrological processes, including precipitation, evaporation, rainfall interception, soil water, ground water and runoff, an understanding of global hydrological cycle, and fundamental mechanisms behind it and basic hydrological analysis. Students also get detailed information about applied water management techniques. The second part of the paper deals with the Oceanography, the study of the physical, chemical and biological aspects of our oceans. The goal of this course is to help the student to understand our oceans and the influence they have on our environment, climate and future. The economic importance of oceans and potential environmental damage will also be considered

Unit I: Basic Concepts of Hydrology

1.1. Water in earth: forms, occurrences and properties
1.2. Significance of the global hydrological cycle with special reference to global storage and transportation of heat; measurement and analysis hydrological data
1.3. Precipitation, Run- off, Infiltration, evaporation and transpiration in different landuse/land cover conditions, Modern methods of recording these attributes
1.4. Key Concept of ground water flow: Hydraulic potential; Darcy's Law, Flow analysis

Unit II: Water Management Techniques in Hydrology

2.1. Water management in tropical farmlands: Techniques and approaches. Artificial rainmaking
2.2. Water management in tropical cities: Techniques and approaches. Rainwater harvesting
2.3. Principles of integrated basin management with reference to micro-watershed planning
2.4. Consequences of river impoundment; Issues related to damming of large rivers

Unit III: Concepts, Models and Configurations of Oceans

3.1. Classification, characteristics and origin of the major structural and morphological features of the ocean floor with particular reference to plate tectonics
3.2. Bottom topography of Indian Ocean: characteristics and evolution
3.3. Waves and tides: Genetic classification and models of formation
3.4. Ocean circulation: classification and significance; Temperature and salinity of oceans

Unit IV: Ocean Properties and Resources

4.1. Water mass: origin, evolution, physical and chemical properties. Air-sea interactions
4.2. Sea-level change: types, causes and implications
4.3. Ocean as a resource: Anthropogenic utilization of the oceans
4.4. EEZ and CRZ: delimitation, significance and policy issues

Recommended Readings:

1. Linsley, K., Kohler, M. and Paulhus, J.L. 1975: Applied Hydrology, Tata McGraw Hill, New York.

2. Meinzer, O.E. 1942: Hydrology, Dover Publication Inc. New York.
3. Rahgunath, H.M. 1997: Hydrology- Principles, analysis, Design, New Age International Pvt. Ltd, New Delhi
4. Sverdrup, H.U. 1942: The Oceans, their Physics, Chemistry and General Biology, Prentice-Hall, New York.
5. Todd, D.K. 1959: Ground Water Hydrology, John Wiley and Sons, New York
6. Walton, W.C. 1970: Ground Water Resource Evaluation, McGraw Hill, Tokyo
7. Davis Rechard J.A.: "Oceanography-An Introduction to the Marine Environment". Wm. C. Brown lowa, 1986.
8. Garrison, T.: "Oceanography - An Introduction to Marine Science" Books/Cole, Pacific Grove, USA, 2001.
9. Sharma, R. C. "The Oceans" Rajesh N. Delhi, 1985.
10. Shephard – An introduction to Marine Geography
11. Siddartha, K.:Oceancgraphy : A Brief Introduction, Kislya Pub. New Delhi.
12. Singh Savindra – Oceanography
13. Chow. V.T; Applied Hydrology
14. Chow V.T. Applied Hydrology and Hydrological Handbook.

Title of the Paper: Energy, Environmental Technology and Development
Credits- 3, Contact hours per week - 3

Course Objective: This paper will highlight the sensitive issues of changing environment. It will help to explore the relationship between humans and environment amidst diverse landscapes. The students will learn the holistic concept of environment while highlighting environmental degradation, pollution and its management. This course will provide the students the opportunity to understand major global environmental problems and the conservation and environmental policy with special reference to India.

Unit I: Concepts

1.1. Geographers' approach to environmental studies; Significance of environmental perception
1.2. Physical Components of Environment: Lithosphere, Hydrosphere, Atmosphere, Biosphere and their relationship; Man - Land relationships; Ecological balance; Restoring damaged ecosystems
1.3. Socio-cultural components with special reference to Demographic characteristics, Health and Nutrition, Income and Education, Housing and Sanitation
1.4. Concept of land and landuse; factors of landuse and factors of landuse change; Principles of landuse; Landuse planning - principles and methods;

Unit II: Environmental Hazards, Pollution and Technology

2.1. Perception of Degradation, Pollution, Hazards and Disaster; Natural hazards: Vulnerability and risk; Social response, hazard reduction and disaster management
2.2. Social hazards: Poverty, disease and crime- Responsible factors, impact and redressal
2.3. Pollution of air, water and soil: Sources, management, health impact and control measures- role of green technology
2.4. Environmental impacts of landuse change; Landscape structure - patches, corridors and mosaics; Measuring metrics (Shannon's Diversity Index and Simpson Diversity Index); Semi-variograms; Threats to landscape diversity: Potentially damaging operations; Geosensitivity analysis;

Unit III: Global Environmental Issues

3.1. Global resource crisis and population equilibrium
3.2. History of Earth Summits and significance of Sustainable Development
3.3. Relevance of Montreal and Kyoto Protocols
3.4. Biodiversity conservation and Genetically Modified Organisms (GMOs)

Unit IV: Environmental Issues in India

4.1. Big dams and their viable alternatives; International and Inter-State Water Dispute in Indian subcontinent
4.2. Conservation of wetland and wasteland management
4.3. Forest policies in India and problems of forest- society interface
4.4. Urban- industrial expansion and social conflict

Recommended Readings:

18. Anderson J.M. (1981): Ecology for Environmental Science : Biosphere, Ecosystems and Man, Arnold, London.
19. Nobel and Wright (1996): Environmental Science, Prentice Hall, New York.
20. odum, E.P. (1971) : Fundamental of Ecology, W.B. Sanders, Philadelphia.
21. Saxena, H.M. (1994): Prayavaranevn Paristhitiki Bhugool (Geography of Environment and Ecology) Rajasthan Hindi Granth Academy, Jaipur.
22. Singh, Savinder (1991): Environmental Geography, Prayag Pustak Bhawan, Allahabad.
23. Strahler, A.N. and Strahler, A.H. (1973) : Environmental Geosciences : Interaction between natural systems and Man, John Wiley and Sons, New York.
24. Strahler, A.H. and Strahler A.N. (1977) : Geography and Mans Environment, John Wiley, New York.
25. William, M.M. and John, G. (1996) : Environmental Geography - Science, Landuse and Earth System, John Wiley and Sons, New York.
26. Chorley & Bennett R. J.: Environmental Systems.
27. Alexander, D. (1993): Natural Disasters, Research Press, New Delhi, 619 P.
28. Blaikie, P. Cannon, Davis and Wisenes (1994): At Risk, Natural Hazards, People's Vulnerability and Disasters, Pouthledge, London, 320 P. 15.
29. Bryant, E. A. (1991): Natural Hazards: Cambridge University Press, Cambridge, Pg 294.
30. Burotn, I. Kates, R. W. and White, G. F. (1974): The Environment as a Hazard, Oxford University Press. 17. Coch, N. C. (1994): Geo-Hazards, Prentice Hall, N. Y., Pg.305.
31. Environment and Development: R. Bhattacharyya, (Edited).
32. Environmental Geology: B. W. Murck and et al, John Willey.
33. Gilbert, F. White, ed. (1974): Natural hazards – Local, Natural and Global, Oxford University Press, N. Y.
34. Morrisawa, M., (1996):Geomorphology and Natural Hazards,Elscvia, Amsterdam, pg 411
35. Natural Hazard: Edited by White.
36. Smith, K. (1996): Environmental Hazards: Assessing Risk and Reducing Disaster, Routledge, Pg.398.
37. Survey on Environment: Hindu, Chennai, Published Annually.
38. Turner, M.G., Gardner, R.H. and O'Neill, R.V. (2001): Landscape Ecology in Theory and Practice: Pattern and Process, Springer Science & Business Media, New York
39. Jana, N.C. and De, N.K. (1997): The Land - Multifaceted Appraisal and Management, Sribhumi Publishing Company, Kolkata 8. Forman, R.T.T. (1995): Land Mosaics: The Ecology of Landscapes and Region, Cambridge University Press, Cambridge
40. Vink, A.P.A. (1983): Landscape Ecology and Land Use, Longman, London and New York
41. Turner, M.G. (2011): Landscape Heterogeneity and Disturbance, Springer, London

Title of the Paper: Regional Entity of India and West Bengal
Credits- 3, Contact hours per week - 3

Course Objective: This course will explore the approaches of regions and regional planning. It will introduce the physical and cultural settings of India and West Bengal including physical environment, resource base and cultural groups while highlighting major contemporary issues related to regions and regionalisation.

Unit I: Geography of India

1.1. Physical Geography of India: physiographic division, zones of natural vegetation and climate, national parks and reserves
1.2. Resources Base of India: Coastal and marine resources, water resource region, agricultural regionalization, mineral and power resources, major industrial regions
1.3. Major Tribes in India: Distribution and culture
1.4. Races and Linguistic groups of India. Problem of regionalization

Unit II: Regional entity of India

2.1. Morpho-structural characteristics of Western Himalayas, Ecotourism and Ecological Protection; Tectonics and Geomorphology of the Islands of Andaman and Nicobar
2.2. Chhotanagpur plateau: Potentialities, Problems and Prospects of agricultural and industrial development; Western coast and its interior industrial region
2.3. Thar desert with special reference to Marusthali
2.4. North-eastern Region: Ethnic Identity, Backwardness and Regionalism

Unit III: Geography of West Bengal

3.1. Physiographic division of Wet Bengal, zones of natural vegetation, climate, drainage network and soil
3.2. Dynamics of demography – growth, distribution and pattern, Age-Sex Composition, Population structure and composition, distribution of settlements
3.3. Resource base and economy of West Bengal – Land and forest resources, agricultural system, major industrial regions – problems and prospects
3.4. West Bengal Disaster Risk Profile – vulnerability to earthquake, landslide, flood, drought and Cyclone

Unit IV: Regional entity of West Bengal

4.1. Geomorphology of Darjeeling Himalaya and Terai Region with special reference to landslides and alluvial fans, Tea and Tourism in Darjeeling
4.2. North Bengal Plain with special reference pedo floral characteristics
4.3. Rarh Bengal with special reference to Forestry and Mining
4.4. Ganga Delta with special reference to Sundarbans

Recommended Readings:

1. Ahuja R. 2001: Social problem in India Rawat Publication
2. BhatL.S : Regional Planning in India.
3. Bose, A. et. al. eds, 2001: Population in India's Development, 1947-2000, Vikas, New Delhi.
4. Chand and Puri : Regional Planning in India.

5. Chatterjee, S. P. (1973): Physiography of India, Gazetteer of India, Vol. I, Chopra, P. N. (Ed.), Govt. of India, New Delhi.
6. Claval P.2002: An Introduction to regional geography, Blackwell Publishers
7. Deshpande C. D., 1992: India: A Regional Interpretation, ICSSR, New Delhi.
8. Johnson, B. L. C., ed. 2001. Geographical Dictionary of India. Vision Books, New Delhi.
9. Khullar, D. R. (2006): India. A Comprehensive Geography. Kalyani Publishers., New Delhi.
10. Mandal R. B. (ed.), 1990: Patterns of Regional Geography – An Intenational Perspective. Vol. 3 – Indian Perspective.
11. Mishra, R.P (ed): Regional Planning- Concepts, Tools, Techniques and case studies.
12. Mita, A. Levels of regional Development India Census of India, Vol. Part I-A (i) and (ii) New Delhi, 1967.
13. Mitra, A.: Regional Geography of India.
14. Pathak, C. R. 2003: Spatial Structure and Processes of Development in India. Regional Science Assoc., KolkataRoutray, J.K. Geography of Regional Disparity Asian Institute of Technology, Bankok, 1993.
15. Rob, M.A. and Ashaduzzaman, M. 2009. The Sundarbans Mangrove: Studies in Geomorphology and Hydrology. Rubi Enterprise.
16. Roy Chaudhuri, S. P. et. al. (1963): Soils of India, Council of Agricultural Research, New Delhi.
17. Sdyasuk Galina and P Sengupta (1967): Economic Regionalisation of India, Census of India
18. Sen P.K. & Prasad N. 2002 An introduction to Geomorphology of India, Allied publishers Pvt. Ltd.
19. Sharma, T. C. 2003: India - Economic and Commercial Geography. Vikas Publ., New Delhi.
20. Singh R. L., 1971: India: A Regional Geography, National Geographical Society of India
21. Spate O. H. K. and Learmonth A. T. A., 1967: India and Pakistan: A General and Regional Geography, Methuen.
22. Taher M (1986) Physiographic framework of north east India. North East Geography.
23. Tirtha, Ranjit 2002: Geography of India, RawatPubls., Jaipur & New Delhi.
24. Valdiya, K.s. Dyanamic Himalaya, University Press, Hyderabad, 1998.
25. Wadia, D.N: Geogrphy of India, McMillan & Co., London, 1967.

Title of the Paper: Ecological Dynamics and Pedology
Credits- 3, Contact hours per week - 3

Course Objective: This course will examine the spatial aspects of soils, soil development processes, physical properties of soils, soil classification and soil management and conservation problems. Students will learn the geographic distribution of plants and animals and the causes of these patterns.

Unit I: Soil Geography

1.1. Soil as a component of Biosphere; Concept of land and soil; Plant-water-soil relationship
1.2. Bio-functions of Soil; Soil organic matter, Soil organisms and Micro-organisms and their relation with soil fertility
1.3. Soil mineralogy and Soil nutrients; Role of physico-chemical properties in soil fertility and productivity

1.4. Soil degradation and pollution: causes, processes and consequences; Preventive, ameliorative and conservation measures

Unit II: Plant Geography

2.1. Plant ecology: habitat factors and plant responses to environment: adaptation, and climax: domestication of plants
2.2. Phyto-geographical regions; Concept of plant species, family and genera; taxonomy
2.3. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest
2.4. Concept of degeneration and regeneration of plants

Unit III: Zoo Geography

3.1. Theory of evolution of species and its critics
3.2. Dispersal of animals in different geological periods
3.3. Dispersal and migration of animals; means and barriers; Zoo-geographical regions of the world
3.4. Principles of animal ecology; Wild life management; Relevance of sanctuaries with special reference to India

Unit IV: Ecosystem and Ecology

4.1. Principles of physical and human ecology; Ecosystem models
4.2. Concepts of biological desert and deep ecology; Forms and functions of forest and marine ecosystems
4.3. International Biological Programme, Man and Biosphere Programme
4.4. Biodiversity conservation with special reference to humid tropics

Recommended Readings:

1. Anderson: Ecology for Environmental Science.
2. Biswas, T.D. and Mukherjee, S. K. 1987: Text book of Soil Science, Tata McGraw Hill, new Delhi.
3. Buckman, H.R. and Brady, N.C. 1974: Nature and Properties of Soil, McMillan, New York.
4. Bunting, A. 1965: Geography of Soil, Hutchinson, London.
5. Chapman, J.L. and Reiss, M.J. 1992: Ecology Principles and Applications, Cambridge University Press, Cambridge.
6. Daji, J.A., Kadam, J.R. and Patil, N.D. 1996: A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd, Mumbai.
7. Joffe, J. S. 1965 : ABC of Soil.
8. Kormondy, E. J. 1991 : Concepts of Ecology.
9. Nebel, J.B. 1981: Environmental Science, Prentice Hall, New York.
10. Odum, F.P. 1971: Fundamentals of Ecology, W.B. Sanders, Philadelphia.
11. Robinson, H. 1982 : Biogeography.
12. Jenny, H. 1943. Soil science
13. Strahler, A.N.1972. Planet Earth: Data Resources.

Title of the Paper: Culture and Society
Credits- 3, Contact hours per week - 3

Course Objective: The course is framed in two parts. First part explores social geography, focusing on opening up students' perspectives to the different social issues that affect people's lives, different social processes and the components of social geography. Second part deals with elements and components of cultural geography. The course will introduce threefold division of the societies while highlighting socio – cultural transformations of society.

Unit I: Social Geography

1.1. Social Geography: definition and elements; Social Structure, Social Processes, Social groups.
1.2. Concept of Welfare and Social Well-being; Social Well-being in India, Social pathology.
1.3. Social Impact Assessment (SIA)
1.4. Social Security, Social Change, Social Justice and Social Inequality.

Unit II: Elements of Social Geography

2.1. Genetics and Geography; Problem of classification.
2.2. Caste: Depiction in the Ancient Texts of India - Varna and Jati - Patron Client Relationship, Caste in Colonial Period, Post Independent Caste Identity, Scheduled Caste and Backward Caste, Spatial Distribution of various castes in India; Concept of Tribe, spatial distribution in India, Society and cultural identity
2.3. Ethnicity– World and India; Concept of Religion - major religions of the World and India, minority population and issues of communalism
2.4. Dialects and Language – Geographical Pattern and Classification.

Unit III: Cultural Geography

3.1. Cultural Hearth and Realm.
3.2. Cultural System and Diffusion.
3.3. Culture, Technology and Development- Role of Technology in the Evolution of Culture, Cultural Take off
3.4. Cultural Segregation, Social disintegration and spatial segmentation in India - examples from rural and urban areas, Cultural Diversity and Cultural Regeneration, Folk Culture

Unit IV: Social – Cultural Relations

4.1. Threefold Division of Societies.
4.2. Theories of Social Formation and Transformation: Functional Theory (T. Sarsons); Conflict Theory (Marx); Critical Theory (Adorno); Culture and Environment.
4.3. Cultural landscape after Carl Sauer, Cultural area and Cultural region.
4.4. Acculturation, Metropolitan culture and Cultural globalization and Segregation: Space and Power

Recommended Readings:

1. Admed, A (2004) : Social Geography, Rawat Publication, New Delhi
2. Chapman, K. (1979): People, Pattern and Process – An Introduction to Human
3. Guha, R. C: Social Geography.
4. Jones, E. and Eyles, J. (1977): An Introduction to Social Geography, Oxford University Press, Oxford.
5. Rubenstain, J. M. and Becon, J. M. (1990): Cultural Geography, John Wiley and Sons Inc., New York.

Title of the Paper: Advanced Cartography and Surveying
Credits- 4, Contact hours per week - 6

Course Objective: This course is framed to provide idea about advanced cartography and surveying. Students will learn various techniques to measure distance and azimuth on map as well on ground.

Unit I: Basics of Map Projection

1.1. Cartography – scope, content, principles and development
1.2. Basic concepts — parallels & meridians, latitudes & longitudes,great circle, map projection, scale factor, deformations, orthodrome, loxodrome and geodesic (simple problems); co-ordinate system and location on globe and 2D planes
1.3. Drawing Graticules, Scale Variation, Mapping Countries, Continents, World with Geographical Features on –

a. Planer (Polar Zenithal Gnomonic, Stereographic, Orthographic, Equidistant and Equal Area) Projections
b. Conical (Simple Conic – I, Bonne's, Polyconic, Sinusoidal, Simple Conic - II) Projections
c. Cylindrical (Equal-area and Orthomorphic) Projections
d. Conventional (Mollweide) Projections

Unit II: Distance and Azimuth – Simple Problems

2.1. Planer Case (PZ Gnomonic, Stereographic, Orthographic, Equidistant and Equal Area) Projections – simple problems and solutions
2.2. Conical Case (Simple Conic – I, Bonne's, Polyconic, Sinusoidal, Simple Conic - II) Projections – simple problems and solutions
2.3. Cylindrical Case (Equal-area and Orthomorphic) Projections – simple problems and solutions
2.4. Conventional Case (Mollweide) Projections) – simple problems of distance and azimuth

Unit III: Basic Surveying

2.1. Nature and Principles of Surveying; Types of Surveying
2.2. Basic concepts of Traversing, Triangulation, Trilateration, Levelling and Contouring (including solutions of related problems) with –

a. Prismatic Compass,
b. Dumpy Level

2.3. Preparing ground plan and determining height and distance of an object using Theodolite
2.4. Observation and recording with the following instruments –

a. Slide calliper
b. Abney level
c. Brunton Compass

Unit IV: Laboratory Notebook and Viva Voce

Recommended Readings:

1. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
2. Elfic. M.H. Fryer. J.G. Brinkners. R.C. and Wolf. P.R. 1994, *Elementary Surveying* 8th edition. Harper Collins Publishers. London.
3. Hussain. S.K. AND Nagaraj. M.S. 1992, *Text Book of Surveying.* S. Chand & Co. Ltd. New Delhi.
4. Ishtiaque, M. 1989: Practical Geography, Heritage Publishers, New Delhi.
5. Kanetkar. R.P. and Kulkarni. S.V. 1988, *Surveying and Levelling, Part-I* Pune Vaidyarthi Griha Prakashani, Pune.
6. Kanetkar. R.P. and Kulkarni. S.V. 1988, *Surveying and Levelling, Part-II* Pune Vaidyarthi Griha Prakashani, Pune
7. Kellaway, G.P., 1979: Map Projections, B.I. Publications, New Delhi
8. Kellaway. G.P. 1979, *Map Projections*. 1st Indian edition. B.I. Publication. Delhi.
9. Kochher, C.i. 1993, *A Text Book of Surveying.* S.K. Katariya & Sons. Delhi
10. Mishra R.P. Ramesh. A 2000, *Fundamentals of Cartography.* Concept Publishing Company, New Delhi.
11. Misra, R.P. and Ramesh, A. 1986: Fundamentals of Cartography, Macmillan,New Delhi
12. Monkhouse, F.J. and Wilkinson, H.R. 1980: Maps and Diagrams, B.I.Publications Private Limited, New Delhi.
13. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C.1995: Elements of Cartography, John Wiley and Sons, New York.
14. Roy P. 1988, *An Analytical Study of Map Projections*. Volume I, Kolkata.
15. Sarkar, A. 1997, *Practical Geography: A Systematic Approach,* Orient Blackswan Ltd. Hyderbad.
16. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.
17. Steers, J.A.1954: An Introduction to the Study of Map Projections, University ofLondon Press, London..
18. Steers. J.A. 1965, *An Introduction to Map Projections.* 14th edition. University of London Press. London.
19. Venkatramaiah. C. 1996, *A Textbook of Surveying.* Universities Press/Orient Longman Ltd. Hyderabad.

Title of the Paper: Geospatial Analysis and its Applications
Paper Code:
Credits- 4, Contact hours per week - 6

Course Objective: In this course the students will learn to extract information from maps, photos and images. They will learn to recognize symbols, identify simple geographical features and relationships. Students will learn to relate maps to photographs and other sources of information. This paper introduces the basics of features extraction from aerial photo and satellite images.

Unit I: Interpretation of Topographical Maps

1.1 Geospatial data sources – Comparative utility of topographical maps, aerial photos and satellite images as sources of geographical data

1.2 Identification and interpretation of physical features with the help of Indian Toposheets – a. Identification and mapping of macro and micro geomorphic features

b. Demarcation and mapping of fluvial features - Long and cross profiles, channel and drainage pattern, channel meandering, river terraces and alluvial fan
c. Quantitative analysis and measurement of fluvial features - hypsometric curves, Stream ordering after Horton, Shreve, Scheidegger and Strahler, Bifurcation Ratio, channel shifting and bank erosion

1.3 Identification and interpretation of cultural features with the help of Indian Toposheets –

a. Preparation of maps showing types and patterns of settlements depending on its sites and situation
b. Demarcation and mapping of hierarchy of settlements and utility centres, measuring spatial interactions through network analysis
c. Interpretation and interactions among Physical and Cultural features

Unit II: Interpretation of Aerial Photos

2.1. Basic concepts of remote sensing and aerial photography
2.2. Determination of scale, point transfer; Delineation of overlapping and effective area
2.3. Identification of physical and cultural features
2.4. Preparation of maps and interpretation

Unit III: Analyses of satellite images

3.1. Introduction to satellite images, common types of IRS and Landsat sensors and their suitability for analysis of geographical information; Indian referencing scheme of IRS sensors
3.2. Extraction of physical features from satellite images of various resolution and band combinations
3.3. Extraction of cultural features from satellite images of various resolution and band combinations
3.4. Detection of change from multi-dated maps and/or images

Unit IV: Laboratory Notebook and Viva Voce

Recommended Readings:

1. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
2. Ishtiaque, M. 1989: Practical Geography, Heritage Publishers, New Delhi.
3. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
4. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C. 1995: Elements of Cartography, John Wiley and Sons, New York.
5. Bhatta B., 2011: Remote Sensing and GIS, Oxford Publisher
6. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
7. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
8. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
9. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
10. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
11. Rees W. G., 2001: Physical Principles of Remote Sensing, Cambridge University Press.
12. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.
13. Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.

Title of the Paper: Geocomputation
Credits- 2, Contact hours per week - 3

Unit I: Basics of Geocomputation and Programming

1.1 Introduction to Geocomputation and model.

a. Definition of Geocomputation, Components of Geocomputation. Philosophical issues of Geocomputation, GIS and Geocomputation.

c. Model definition and its properties. Model input, processing, output and validation

1.2 Introduction to R and R Studio

a. Origin of R and R studio.

b. Different Libraries of R, Load data into R, Understanding different types of variables

1.3 Basic Remote Sensing and GIS function in R

a. Read raster data in R, projection assignment, reprojection, resampling, preparation of FCC in R, subseting, band arithmetic, reclassification.

b. Read vector data in R, explore .shp file attributes in R, basic visualisation with .shp file, splitting and merging of .shp file, basic analysis of .shp file.

1.4 Introduction to Python and Basic python programming

a. Introduction of computer programing and Python IDEs

b. Variables, data type & structure, operators & expression,

c. Control flow, functions, input-output, error & exception handling

Unit II: GIS Automation, Modelling and Web mapping

2.1 Model building and GIS automation

a. Model building and its objectives, parameters for model building, exploring tool box for model building in software environment, environment associated with tools

b. GUI based tool operation for model building, advanced geoprocessing and model building.

2.2 Society and web mapping using Geoserver

a. Evolution of web mapping, web mapping in recent cartography, societal application of web mapping,

b. System architecture for web mapping, elements of web map, setting up Geo server, analyses two web maps

2.3 Cellular automata and agent based modelling.

a. The origins of cellular automata, concept of neighbourhoods, transitions, and conditions,

b. Basic cellular automata: growth from single seeds, many seeds, complete development and self-organization

c. Application of cellular automata

d. Agent based model (ABM): procedure, action, interaction, environments and agents, building of ABM, how to work with ABM, visualisation, potential benefit of ABM

2.4 Expert system

a. History and origin of expert systems, differences between expert systems and conventional systems, building expert systems, elements and processes of an expert system,

b. knowledge representation, knowledge engineering, efficiency measures, error modelling in expert systems, expert systems and GIS

Unit III: Fuzzy Application in GIS and Advanced Classification.

3.1 Fuzzy logic based optimisation in GIS

a. Introduction to fuzzy, classic sets and logic, fuzzy set theory, fuzzy memberships, fuzzy logic, fuzzy regression, fuzzy sets, possibility and probability, application of fuzzy in GIS.

3.2 Neural networks

a. Introduction of computational neural network, how do computational neural networks work, characteristics of the processing elements, network topologies, learning in a computational neural network, advantages, application domains and examples

3.3 Advanced Classification Methods (Segmentation based and SVM)

a. History of image classification, understanding advanced image classification, Object based image classification, artificial neural network and support vector machine based classification, estimation of accuracy

3.4 Project Management.

Recommended Readings:

1. Fisher M.M., 2006: Spatial Analysis and GeoComputation, Springer
2. Longley P.A et al., 1998: Geocomputation: A Primer, Wiley
3. Xing H., 2009: Advances in Geocomputing, Springer
4. Openshaw S. & Abrahart R. J., 2000: GeoComputation, CRC Press
5. Fisher M.M. & Leung Y. (Ed.), 2001, GeoComputational Modelling: Techniques and Applications, Springer
6. Murganate B et al., 2009: Geocomputation and Urban Planning, Springer
7. Dixon B. & Uddameri V., 2015: GIS and Geocomputation for Water Resource Science and Engineering, Wiley.
8. Thill J. C & Dragicevic S. (Ed.), 2018: GeoComputational Analysis and Modeling of Regional Systems, Springer.
9. Sanders L.(Ed.), 2007: Models in spatial analysis, Wiley
10. Brusdon C. & Comber L., 2015: An Introduction to R for Spatial Analysis and Mapping, SAGE Publications
11. Beazley D.,2013: Python Cookbook, O'Reilly Media Incorporated
12. Haltem R. V., 2016: Mastering Python, Packt Publishing

SEMESTER: IX
(July to December)

Title of the Paper: Geography of Economic Behaviour
Credits- 3, Contact hours per week - 3

Course Objective: The aim of this course is to identify the paradigm shift in economic geography with an emerging horizon of New Economic Geography. Students will learn to analyze the relevance of Environments to Economic Geography under the system approach and will be enabled to investigate the applicability of various agricultural, manufacturing and tertiary system models considering the real world approach.

Unit I: Toward Geography of Economic Behaviour – Some Basic Concepts

1.1. The New Economic Geography (NEG); A Geography of Economic Behaviour
1.2. Some economic terms: economy, consumer, economic organization, economic behaviour, human behaviour and decision making; the domain of space and time
1.3. The economic system: system, equilibrium, feedback, entropy and negentropy, cybernetics
1.4. Rising themes in Economic Geography: corporate geography, knowledge economy, financialisation, consumption and sustainable development

Unit II: Environmental and Economic Milieux – An Overview

2.1. The phenomenal environment and the behavioural environment
2.2. The operational milieu and its components
2.3. Models of Natural and Human Milieux I – Functional Model (Zimmerman), Decision Model (Kirk), Synoptic Model (Harvey) and Behavioural Model (Pred)
2.4. Models of Natural and Human Milieux II – System Model (Brookfield)

Unit III: Agricultural and Manufacturing Systems

3.1. Nature of agricultural system; environmental constraints, altitudinal variations. Economics of agriculture, agricultural structure and agricultural organizations
3.2. Classical model of agricultural behaviour; Von Thunen's Model (with modifications) and Diffusion Model (Hagerstrand); Economic and Behavioural Model of agriculture; Actual and theoretical agricultural locations (some case studies)
3.3. Nature of manufacturing system; economic structure, entrepreneurial behaviour, systems and organisations
3.4. Traditional approaches to industrial locations; Least – Cost Model (Weber) and Profit Maximization Model (Lösch); Alternative approaches (Smith, Isard and Kuenne); Actual and theoretical industrial behaviour patterns (some case studies)

Unit IV: The Tertiary Systems and the Total Spatial System

4.1. Nature, location of services and trade of tertiary system and sub-system; components of tertiary subsystem (retailing, recreational activities, medical, wholesaling); the transportation system
4.2. Central place theory (Christaller) as a Classical study of mechanics of the tertiary sub system with modifications and extensions
4.3. The total spatial organization of the economy; economic regions
4.4. Malfunctions of the System - the three worlds; population and resources; economy and ecology; the corporate society

Recommended Readings:

1. Hurst. M.E.E. (1972): Geography of Economic Behaviour – An Introduction, Duxbury Press, California.
2. Leyshon, A. and et.,al. (2011): The SAGE Handbook of Economic Geography, Sage, Los Angeles.
3. Aoyama, Y., Murphy, J.T. and Hanson, S. (2011): Key Concepts in Human Geography, Sage, Los Angeles.
4. Berry, B.J.L., Conklin, E.C. and Ray, M. D. (1976): The Geography of Economic Systems, Prentice Hall, New Jersey.
5. Alexandersson, C, 1971: Geography of Manufacturing, Prentice Hall India, New Delhi.
6. Hartshorn, T.A. and Alexander, J.W. 1988: Economic Geography, Prentice Hall India, New Delhi.
7. Leong. G.C. and Morgan, G.C. 1975: Human and Economic Geography, Oxford University Press, Hong Kong.
8. Smith, D.N. 1971: Industrial Location- An Economical Geographical Analysis, John Wiley, New York.
9. Thoman, R.S. and Corbin, P.B. 1968: Geography of Economic Activity, McGraw Hill, New York.
10. Wheeler, J.O. and Muller, P.O., 1986: Economic Geography, John Wiley, New York.

Title of the Paper: Philosophy of Geography
Paper Code:
Credits- 3, Contact hours per week - 3

Course Objective: This course will introduce with the history and philosophy of geography as a spatial science. It will highlight the modern thoughts of Geography with special emphasis on the changing viewpoint in contemporary geography during the later part of the 19th century. The ideas and concepts included in this course will enable students to understand the contemporary man – environment relationships and led them to identify emerging research frontiers of contemporary world on temporal and spatial scale.

Unit I: Development in Modern Geographical Thought

1.1. Place of Geography in the classification of knowledge after Varenius and Kant; Evolution of Geography as a spatial science and Quantitative Revolution
1.2. Positivism in Geography: Explanation and search for scientific routes
1.3. Critiques of Positivism: Behavioural Geography and Radical Geographies
1.4. Existential phenomenology and Humanistic Geography

Unit II: Emergence of Critical Perspectives

2.1. Crisis of Modernity, Impact of World Wars, and the shift towards critical perspectives
2.2. Post modernity and the production of space after Lefebvre, Harvey and Soja
2.3. Feminist Geography: space, place and identity- concepts and evolution
2.4. Geography of Gender – chronological geographies of Gender

Unit III: Changing trends and Dimensions

3.1. Geography of inequality
3.2. Colonial and Post-colonial interpretations in Geography
3.3. Geography in the era of globalization: Political-economic perspectives in spatial relations

3.4. New Geographies: Select ideas of Environment and Human Geography- Contesting environment and socializing Nature. New Social Geographies: Clustering and Segregation, Hybrid Geography, Mental Map and Local Imaginaries

Unit IV: Contemporary Pedagogies and Research Frontiers in Geography

4.1. Revival of Classical ideas
4.2. Critical appreciation of Darwin's contribution
4.3. Man-environment relations: Revival of Ecological Studies
4.4. Development of Geography in India

Recommended Readings:

1. Adhikari, S. (1992): Fundamentals of Geographical Thought, Chaitanya Publishing . House, Allahabad.
2. Harvey, D. (1969): Explanations in Geography, London.
3. Hartshorne, R. (1939): The Nature of Geography: Association of American Geographers, USA.
4. Harvey, Milton E. and Brian, P. Holly (Ed.) (1981): Themes in Geographical Thought, Rawat Publication, Delhi.
5. Hossain, M. (1988): Evolution of Geographical Thought, Rawat Publications, Jaipur.
6. Johston, R. J. et al (Ed.) (1981) The Dictionary of Human Geography, Blackwell, England1
7. Peet, R. (Ed.) (1977): Radical Geography, Methuen, London.
8. Haggett. Geography – A Modern Synthesis.

Title of the Paper: Advanced Elective Theory I- Urban ecology, Environment and conservation-I
(Advanced Elective Option I)
Credits- 3, Contact hours per week - 3

Course Objective: This course will introduce the concepts of environmental geography while focussing on man – environment relationships. It will help to understand the effect of man on environment and changing modes of production.

Unit I: Concept

1.1. Scope, Content and Recent Dimensions of Environmental studies in Geography
1.2. Symbiosis between Man and Environment; Effects of Environment on man: Bio-physical, Perceptional, Behavioral and that related to Resource Availability
1.3. Effects of Man on Environment with changes in Mode of Production
1.4. Physical, Ecological and Human Ecological Issues, Holistic and Reductionist Approaches to Environment

Unit II: Atmospheric Changes and the Biosphere

2.1. Climatic Factors shaping the Geographical, Zoning and its Periodicity
2.2. Changing Climate of the World
2.3. Climatic Hazards and Management, Social Response to Climatic Hazard
2.4. Biomes and their relationships to Climate and Hydrological Cycle

Unit III: Energy and the Environment

3.1. Ecosystem Approach in Environmental Studies
3.2. Bio-geo-chemical Cycles and their significance

3.3. Flow, Fixation and Balance of Energy in the Biosphere
3.4. Energy and Biomass Pyramid; Exchanges among Ecosystems and Changes of Ecosystems, Environmental Modelling

Unit IV: Environmental Degradation and Hazards

4.1. Water, Air and Noise problems in urban-industrial Environment; Water and soil pollution in rural landscape
4.2. Impact of Green Revolution; Problems of Solid waste and nuclear fallout
4.3. Human response to Flood, Drought, Landslide, Earthquake and Cyclone
4.4. Disaster Management

Recommended Readings:

1. Anderson: Ecology for Environmental Science.
2. Biswas, T.D. and Mukherjee, S. K. 1987: Text book of Soil Science, Tata McGraw Hill, New Delhi.
3. Buckman, H.R. and Brady, N.C. 1974: Nature and Properties of Soil, McMillan, New York.
4. Bunting, A. 1965: Geography of Soil, Hutchinson, London.
5. Chapman, J.L. and Reiss, M.J. 1992: Ecology Principles and Applications, Cambridge University Press, Cambridge.
6. Daji, J.A., Kadam, J.R. and Patil, N.D. 1996: A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd, Mumbai.
7. Joffe, J. S. 1965 : ABC of Soil.
8. Kormondy, E. J. 1991 : Concepts of Ecology.
9. Nebel, J.B. 1981: Environmental Science, Prentice Hall, New York.
10. Odum, F.P. 1971: Fundamentals of Ecology, W.B. Sanders, Philadelphia.
11. Robinson, H. 1982 : Biogeography.

Title of the Paper: Advanced Elective Theory I: Geomorphology and Hazard-I
(Advanced Elective Option II)
Credits- 3, Contact hours per week – 3

Course Objective: The course is designed to introduce the concept of Applied Geomorphology, highlight geomorphological raw material and contribution of Geomorphology in search natural resources. Students will understand the concept of tectonic, hydrology and climatic geomorphology. It will also introduce anthropogenic geomorphology and impact of human interventions on geomorphological and geohydrological processes will be highlighted. The course will outline the mechanism and causes of earthquake as natural hazards, its impact and measures to mitigate it.

Unit I: Introduction to Applied Geomorphology

1.1. Geomorphology vs. Applied geomorphology
1.2. Environmental impacts on Geomorphological processes
1.3. Geomorphological Resources: Geomorphological raw materials
1.4. Contribution of geomorphology in the search for other natural resources

Unit II: Concept of Tectonic, Hydrology and Climatic Geomorphology

2.1. Geology, tectonic and geomorphology: Lithology and landforms; structure and landforms
2.2. Hydrology and Geomorphology: Hydrology vs. landform development; Environmental conditions governing precipitation, evaporation, runoff and Hydrological Cycle

2.3. Climatic Geomorphology: Concept, Weathering and Landforms, Diagnostic landforms (Arid, tropical and quaternary)
2.4. Geomorphological processes and climatic control, climate change and geomorphology, morphogenetic regions

Unit III: Introduction to Anthropogenic Geomorphology

3.1. Anthropogenic Geomorphology: Meaning and concept
3.2. Man's impacts on Geomorphological and Geohydrological processes
3.3. Geomorphological consequences of hunting, animal farming, agriculture
3.4. Impacts of resource exploitation and engineering works on Geomorphological landscape

Unit IV: Endogenetic hazards-Earthquake and Volcanism

4.1. Causes, impact and Assessment of Earthquake; Seismic risk and seismic susceptibility. Morpho – neotectonics
4.2. Earthquake-triggered mass movements; Causes, impact and Assessment of Earthquake
4.3. Causes, types, impact and Assessment of Volcanic harzards
4.4. Prediction and Management of Volcanic harzards

Recommended Readings:

1. Faniran, A. and Jeje, L. K. (1983): Humid Tropical Geomorphology, Longman, London.
2. Thomas, M. F. (1994): Geomorphology in the Tropics: A study of weathering and denudation in low latitudes. John Wiley and Sons, Chichester.
3. Kale, V. S. and Gupta, A. (2001): Introduction to Geomorphology, Orient Longman, Calcutta.
4. Goudie, A. (1985): Duricrusts in tropical and sub-tropical landscapes. Alien Unwin.
5. Savindra Singh (2002): Geomorphology, PrayagPustakBhawan, Allahabad.
6. Bloom, A. L. (2002). Geomorphology: A systematic analysis of late Cenozoic landforms. Prentice-Hall of India, New Delhi .
7. Panizza, M. (2002): Environmental Geomorphology, Elsevier.
8. Gutierrez Elorza, M., (2005): Climatic Geomorphology, Elsevier.
9. Thornbury, W. D. (1986): Principles of Geomorphology. Willey Eastern Limited.
10. Dayal, P.: A Textbook of Geomorphology. Shukla Book Depot, Patna.
11. Burbak. Tectonic Geomorphology.

Title of the Paper: Advanced Elective Theory I- Urban landscape, Infrastructure and Management-I
(Advanced Elective Option III)
Paper Code:
Credits- 3, Contact hours per week - 3

Course Objective: This course will explore the heritage of regional development theory. It will explain in details the concept of regions and regional planning while highlighting concepts and theories of spatial organisation and integration. Students will learn how a state is responsible for the developments and regional conflicts take place with special reference to India. Various regional planning units will be also evaluated to understand the actual picture of different planning and policies.

Unit I: Basics of Regional Planning

1.1. Regions and regional planning: concepts, indicators, strategies, issues and significances
1.2. Evolution: concept of growth and development, heritage of regional planning and development, need of planning, Rethinking on development: Concepts of Seers, Club of Rome, Neo-Marxist
1.3. Theories of spatial organisation and integration: North, Perloff, Friedmann, Raza and Chattopadhay
1.4. Planning regions: concepts, typology, hierarchy and methods of delineation (Nath, Bhatt, Sengupta and Sdasyuk)

Unit II: Urbanization and Urban Planning

2.1. Urbanization and history of urban space: determinants of urbanization, processes and forms
2.2. Early Urban hearths – emergence of town planning and post industrial urbanization, post - modern urban spaces and types, urban morphology – urban landscape and landuse
2.3. Concept of urban planning; elements of urban structure (networks, buildings, open spaces etc.) and aspects of urban planning, Rationality and Sustainability in planning
2.4. Urban planning and Contribution of Planners: Robert Owen, James Silk, Don Arturo, Soria y Mata, Patrick Geddes, Patrick Abercrombie, Tony Garnier, Le Corbusier, Clarence Perry , Frank Lloyd Wright

Unit III: City and Metropolitan Planning

3.1. Concept and growth of cities – city on time, scale and space, cities and national development, cities as engines of growth, cities as ecosystems, resources in cities, City and its linkages - City, fringe and the periphery
3.2. Concept of metropolitan: evolution, composition, historical background and functional hierarchy; Planning of early metropolitan regions – case studies from Western and Eastern countries, Introduction to Global metropolitan regional plans – twin towns, policy of London – Industrial Location Policy of South Korea – Finger Plan of Copenhagen
3.3. Metropolitan regions in India – processes and forces, influencing the metropolitan development – historical, background of colonization and regional imbalance; Five Year Plans and metropolitan planning in India – Metropolitan regional development agencies in India
3.4. Case studies of Metropolitan regional development plans - Delhi, Mumbai and Calcutta metropolitan regional development plans – important features and policy initiatives undertaken

Recommended Readings:

1. Carter, H (1972): The Study of Urban Geography, Edward Arnold.
2. A. Latham, D. McCormack, K. McNamara, D. McNeill (2009): Key Concepts in Geography, Sage.
3. Harvey, D.(1973): Social Justice and the City, Arnold
4. Abu-Lughod, J. and Hay, R. Jr. (1977): Third World Urbanisation, Maarouta Press.
5. Gugler. J. (ed.)(1988): The Urbanisation of the Third World, O.U.P
6. Sassen, S. (1991): The Global City, Princeton University Press.
7. Clarke, D. (1982): Urban Geography: An Introductory Guide, Groom Helm.
8. Marcuse, P. and Kempen, R.V. (eds.),(2000): Globalizing Cities: A New Spatial Order, Blackwell,
9. Short, J. R. (1996): The Urban Order, Basil Bleckwell.
10. Smith, N. (1996): The New Urban Frontier, Routledge

11. King A. D. (1990): Global Cities, Routledge.
12. Simmonds, R. and Hack, G. (2000): Global City Regions, Spon Press.
13. Markusen, A.R., et al. (1991): Second Tier Cities- Rapid Growth beyond the Metropolis, University of Minnesota Press.
14. Allen J. Scott (ed.), (2001): Global City Regions, Trends, Theory & Policy, Oxford University Press.
15. David Harvey (1985): The Urbanization of Capital, John Hopkins University Press.
16. Edward Soja (2000): Postmetropolis, Critical Studies of cities and Regions, Blackwell Publisher Ltd.
17. G. P. Chapman, A.K. Dutt and R.W. Bradnock (ed.) (1999): Urban growth & Development in Asia, Vol.2: Living in the Cities, Ashgate Publishing Ltd.
18. Pieterse E, (2008): City Futures, Confronting the Crisis of Urban Development, Zed Books Ltd, London and New York.
19. G. K. Bandopadhyaya , "Text Book of Town Planning".
20. Peter Hall, "Urban and Regional Planning".
21. F. S. Hudson," Geography of Settlements", and Evans Ltd. Estover, Plymouth PL 6 7 PZ UK
22. Abdul Razak, M. (2004) Mobility patterns and strategies used for spatial access to work of the squatter households in the peri-urban Delhi, India. Paper presented at the International
24. Workshop on 'Peri-urban Dynamics', National University of Singapore, December.
25. Abu-Lughod, J. L. (1999) New York, Chicago, LosAngeles: America's Global Cities. Minneapolis, MN: University of Minnesota Press.
26. AIILSG (All India Institute of Local Self Government)(2004) Transforming Mumbai into a
27. world class city. AIILSG, Mumbai.
28. Banerjee-Guha, S. (1997) Spatial Dynamics of International Capital. Hyderabad: Orient Longman.
29. Banerjee-Guha, S. (2002a) Metropolitan dominance and regional disparity in India: observations from relevant planning measures of Japan, Visiting Research Fellow Series No. 358, Institute of Developing Economics, Japan External Trade Organization.
30. Banerjee-Guha, S. (2002b) Shifting cities: urban restructuring in Mumbai, Economic and Political Weekly, pp. 121–128.
31. Banerjee-Guha, S. (2008) Space relations of global capital and significance of new economic enclaves: SEZs in India, Economic and Political Weekly, 43(47), pp. 51–61.
32. Beaverstock, J. V., Smith, R. G. and Taylor, P. J.(1999) A roster of world cities, Cities, 16, pp. 445– 458.
33. Cadene, P. and Marius-Gnanou, K. (2004) Peri urban dynamics: around the Indian metropolises:some findings from the Chennai experience, Paper presented at the International workshop on 'Peri-urban Dynamics', National University of Singapore, December.
34. CIDCO (City and Industrial Development Corporation of Maharashtra) (1973) A report on the development of New Bombay, Bombay
35. D'Monte, D. (2002) Ripping the Fabric: The Decline of Mumbai and Its Mills. New Delhi: Oxford University Press.
36. Dea´k, C. and Schiffer, S. (2007) Sa˜o Paulo: the metropolis of an elite society, in: K. Segbers (Ed.) The Making of Global City Regions: Johannesburg, Mumbai/Bombay, Sa˜o Paulo, and Shanghai, pp. 85–112. Baltimore, MD:Johns Hopkins University Press.
37. Dupont, V. (2004) Peri-urban dynamics: population, habitat and environment on the peripheries of large Indian metropolises. Introductory paper at the International Workshop on 'Periurban Dynamics', National University of Singapore,December.
38. Dupont, V. (2005) Peri-urban dynamics: population,habitat and environment on the peripheries of large Indian metropolises: review ofconcepts and general issues. Occasional PaperNo. 14, Centre de Sciences Humaines, New Delhi
39. Friedmann, J. (1995) Where we stand: a decade of world city research, in: P. L. Knox and P. J.Taylor (Eds) World Cities in a World-system, pp. 21–47. Cambridge: Cambridge University Press.

Title of the Paper: Advanced Elective Theory I- Hydro-meteorology-I
(Advanced Elective Option IV)
Credits- 3, Contact hours per week - 3

Course Objective: This course has been planned to impart knowledge on principles of advanced hydrology at a postgraduate level. It emphasizes on essential mechanisms of various components of hydrologic cycle especially on atmospheric water, evaporation, rainfall, infiltration, overland flow, river

discharge, sub-surface flow, groundwater flow, and hydrograph analysis. The students will learn the mathematical relation and equations that govern the various hydrological processes.

Unit I: Fundamental Concepts

1.1. Components of Hydrologic cycle, Available quantities of water on earth and its atmosphere and their residence time
1.2. Systems concept in hydrology and the water budget equation,
1.3. Transfer function operators
1.4. Essentials of Unit hydrograph, Hydrologic models and their classification

Unit II: Theories and Equations governing in Hydrologic Processes

2.1. Reynold's Transport Theorem, Continuity equation, momentum equation,
2.2. Energy equation, Naiver Stokes equation
2.3. Saint Venant equation, Discrete time continuity
2.4. Richard's equation, Green Ampt equation

Unit III: Surface and sub-surface hydrology

3.5. Rainfall–runoff relationship: Measurement of runoff by rational method, SCS curve number method
3.6. Flood routing, Kinematic overland flow routing, Kinematic channel modelling
3.7. Horton's Phillip's, Green Ampt methods,
3.8. Groundwater flow in confined and unconfined aquifers, Dupit's assumptions

Recommended Readings:

1. Applied Hydrology by Ven T. Chow, David R. Maidment, and Larry W. Mays,McGraw Hill International Editions.
2. Engineering Hydrology by K. Subramanya, Tata McGraw Hill Publishing Company, New Delhi.
3. Maidment, David R., ed. (1993). Handbook of hydrology. New York: McGraw-Hill.
4. Viessman, Jr., Warren; Gary L. Lewis (2003). Introduction to hydrology (5th ed.). Upper Saddle River, N.J.: Pearson Education
5. Anderson, Malcolm G.; McDonnell, Jeffrey J., eds. (2005). Encyclopedia of hydrological sciences. Hoboken, NJ: Wiley.
6. Hendriks, Martin R. (2010). Introduction to physical hydrology. Oxford: Oxford University Press.
7. Viessman, Jr., Warren; Gary L. Lewis (2003). Introduction to hydrology (5th ed.). Upper Saddle River, N.J.: Pearson Education

Title of the Paper: Advanced Elective Theory I- Remote Sensing and GIS-I
(Advanced Elective Option V)
Credits- 3, Contact hours per week - 3

Course Objective: This course will explore the Remote Sensing and GIS theory. It will explain in details the fundamentals of remote sensing, GIS and GPS while highlighting concepts and application of Geoformatics. Students will also learn data structure fundamentals and allied concepts. Apart from it, this unit will also cover fundamentals of aerial photogrammetry**.**

Unit I: Fundamentals of Remote Sensing

1.1 EMR, spectral signature and resolution, multispectral and hyperspectral remote sensing (RS), thermal and microwave RS.
1.2 Types and characteristics of satellite, various satellite mission and sensor types, sensor and platforms.
1.3 Fundamentals of Aerial Photography, Stereo Photogrammetry, Digital photogrammetry, photo interpretation key.

Unit II: Fundamentals Geographic Information System

2.1. Fundamental of GIS, potential of GIS, concept of space & time, spatial information Theory, History of GIS, Hardware & software requirements, GIS applications in different fields.
2.2. Spatial and non-spatial database, spatial, functionaland logical relationship,data model - raster and vector, quadtree tessellation.
2.3. Database management system Conceptual models, different implementational models- hierarchical, network and relational.

Unit III: Fundamentals Global Positioning System

3.1. Introduction to GPS, basic concept of geopositing, space segment, control segment, user segment, types and component of GPS, almanac and ephemeris data.
3.2. GPS operation: absolute and differential positioning, static, rapid static, real time kinematic survey.
3.3. Data processing and accuracy, factors affecting GPS accuracy, NAVSTAR, GLONASS, IRNSS applications of GPS

Recommended Readings:

1. Bhatta B., 2011: Remote Sensing and GIS, Oxford Publisher.
2. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
3. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
4. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
6. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
7. Rees W. G., 2001: Physical Principles of Remote Sensing, Cambridge University Press.
8. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.
9. Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.

Title of the Paper: Advanced Geo-imaging and GIS
Credits- 4, Contact hours per week - 6

Course Objective: This course is framed to upgrade students' knowledge on Remote Sensing and Geographic Information System. They will learn art and science of map making and interpretation in RS – GIS environment. They will also be enhanced by learning the applicability of the discipline in the broader arena of academics. It will directly expose them to the industry.

Unit I: Remote Sensing and Global Navigation Satellite System

1.1. Remote Sensing and Geospatial Data collection - Techniques
1.2. Georeferencing using ortho – images and Global Navigation Satellite System (GNSS) data; Generation of spectral library of Landuse and Landcover (LU/LC) features from LISS 3 and Thermal Mosaicing (TM) data and preparation of image enhancement and image rectifications
1.3. Preparation of band combination, selection of objects, image classification and change detection from multidated maps and images
1.4. Principles of GNSS positioning with special reference to Global Positioning System (GPS); Collection and retrieval of GNSS positions, preparation of maps from GNSS data

Unit II: Geographical Information System

2.1. Managing Geodatabase - Conversion: Raster ↔ Vector ↔ American Standard Code for Information Interchange (ASCII) and others
2.2. Preparation of annotated thematic maps – Digitisation, managing attribute table, Geometric measurements tools & changing projection
2.3. Spatial analysis through vector overlay, Spatial Queries, Neighbourhood Analysis, Connectivity Analysis
2.4. Preparation of digital elevation Model (DEM) from spot heights, contours and Shuttle Radar Topography Mission (SRTM) data – Flow analysis and Network generation

Unit III: Geoweb Services and Geoportal Application

3.1. Introduction to Geoportal Applications – Google Earth, Openstreet Map and ISRO Bhuvan
3.2. Identification of Spatiotemporal Change and elevation profiling from Google Earth
3.3. Working with ISRO Bhuvan Geoportal – Data extraction, vector overlay and data import
3.4. GIS Data Capture – Crowdsourcing, Volunteered Geographic Information (VGI)I and Mobile GIS

Unit IV: Laboratory Notebook and Viva Voce

Recommended Readings:

1. Bhatta B., 2011: Remote Sensing and GIS, Oxford Publisher.
2. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
3. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
4. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
6. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
7. Rees W. G., 2001: Physical Principles of Remote Sensing, Cambridge University Press.
8. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.

9. Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.
10. Wolf P. R. and Dewitt B. A., 2000: Elements of Photogrammetry: With Applications in GIS, McGraw-Hill.

Title of the Paper: Term Paper Leading to Field Project
Credits- 2

A term paper to be prepared and submitted individually by each student, based on the secondary survey of an area, done jointly or in groups with other students under the supervision of a Prof–in–Charge, Field Study. **The Survey** shall involve "literature review, data collection of the Habitat, Economy and Society of the Local Inhabitants".

Unit I: Introduction to fieldwork in geography

Definition, Need and Objectives, Major Problems or Limitations of field work in Geography

Unit II: Survey techniques and Preparation for the field work

Methods and Techniques, Stages, Equipment, Visit and interaction with national laboratories for data collection

Unit II: Literature Review

Literature Review and report writing
Preparation of Questionnaires for Socioeconomic Survey.
Computation of secondary data.

Unit IV: Preparation of Term Paper and Viva voce

Title of the Paper: Advanced Elective Practical I: Urban ecology, Environment and conservation-I (Advanced Elective Option I)
Credits- 4, Contact hours per week - 6

Course Objective: In this course students will learn various techniques to detect and measure environmental pollution. Students will learn environmental survey and mapping techniques.

Unit I: Environmental Survey and Field Techniques
1.1. Identification and study of an Environmental Problem in field
1.2. Sampling and survey procedures for different environmental parameters
1.3. Sampling and survey procedures for identification of impact parameters
1.4. Laboratory visit at the major research institutes: Central Ground Water Board (CGWB), Central Pollution Control Board (CPCB), National Environmental Engineering Research Institute Zonal Laboratory (CSIR – NEERI)

Unit II: Laboratory Techniques to Detect Environmental Pollution
2.1. Acidity and Alkalinity of Water
2.2. Nitrate and Phosphate content in Water
2.3. BOD and Total hardness in Water
2.4. Dust fall and Measurements of Air-pollutants, Noise pollution

Unit III: Mapping Techniques

3.1. Regression Analysis, Correlation and (bi – variate) Time Series Analysis of Environmental data, Concentration by Lorenz Curve
3.2. Probability distributions- binomial, poisson and normal. Sampling theory- hypothesis testing and interval estimation for large samples. Chi-square test, t-test and F-test of significance.
3.3. Cartographic representation of Primary/Secondary data and generation of Environmental Maps in GIS platform
3.4. Preparation of the Environmental Management Plan (EMP)

Unit IV: Laboratory Note Book and Viva-voce

Recommended Readings:

1. William J. Sutherland (2006): Ecological Census Techniques Edited by Cambridge 2nd edition
2. Lagacherie Philippe, McBratney Alex and Voltz Marc(2006) : Digital Soil Mapping :An Introductory Perspective, Elsevier
3. Scull, P.; J. Franklin, O.A. Chadwick & D. McArthur (June 2003). Predictive soil mapping - a review. Progress in Physical Geography ,Sage Publications.
4. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
5. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.
6. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C. 1995: Elements of Cartography, John Wiley and Sons, New York.
7. Basu, R. and Bhaduri, S. ed, 2007: Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
8. Gupta, K. K. and Tyagi, V. C. (1992): Working with maps, Survey of India Publication, Dehradun

Title of the Paper: Advanced Elective Practical I : Geomorphology and Hazard I
(Advanced Elective Option II)
Credits- 4, Contact hours per week - 6

Course Objective: The course will introduce both lab based and field based analysis of weather, topography, slope etc. They will also learn field data collection through various field instruments.

Unit I: Lab based- Weather analysis
1.1 Rainfall depth and persistence analysis
1.2 Rainfall coefficient analysis
1.3 Stage-discharge rating curve
1.4 Rainfall threshold estimation

Unit II: Lab based- Topography analysis
2.1 Determination of topographic erosivity
2.2 Annual flood frequency analysis; Flood Hazard Zonation
2.3 Landslide hazard zonation
2.4 Earthquake hazard zonation

Unit III: Field based
3.1. Micro-slope mapping and identification by Abney level
3.2. Traversing and contouring of a slope by Prismatic and Dumpy level
3.3. Slope analysis by Theodolite

Unit IV: Laboratory Note Book and presentation

Recommended Readings:

1. Lagacherie Philippe, McBratney Alex and Voltz Marc(2006) : Digital Soil Mapping :An Introductory Perspective, Elsevier
2. Scull, P.; J. Franklin, O.A. Chadwick & D. McArthur (June 2003). Predictive soil mapping - a review. Progress in Physical Geography , Sage Publications.
3. Basu, R. and Bhaduri, S. ed, 2007: Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
4. Gupta, K. K. and Tyagi, V. C. (1992): Working with maps, Survey of India Publication, Dehradun
5. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
6. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.

Title of the Paper: Advanced Elective Practical I - Urban landscape, Infrastructure and Management-I
(Advanced Elective Option III)
Credits- 4, Contact hours per week - 6

Course Objective: The course will equip students with the techniques of sampling and data collection. Students will learn to delineate regions using various multivariate techniques considering regional inequality, regional interaction and associations.

Unit I: Data Collection and Mapping

1.1. Geospatial and non – spatial data collection – characteristics and techniques
1.2. Field visit and perception mapping (e.g. housing typology and layouts, building and population densities, streets, junctions, open spaces and its hierarchy, heritage buildings, etc.) and socio-economic surveys

Unit II: GIS Application in Planning

2.1. Techniques of preparing base maps using RS and GIS environments including understanding the concepts of scales, components and detailing for various levels of plans like regional plan, city plan, zoning plan, and local area plan.
2.2. Project on:
   a. Asset Mapping and GIS
   b. Area Profile Report and spatial planning

Unit III: Laboratory Notebook and Viva voce

Recommended Readings:

1. Robinson, A. H. and Others (1995): Elements of Cartography, VI Edition, John Wiley & Sons, New York.
2. Anson, R. W. and Ormeling, F. J., (Ed.) (1993): Basic Cartography for Students and Technicians, Vol.I, International Cartographic Association and Elseiver Applied Science Publishers, London
3. Dickinson, G. C. (1977) Statistical Mapping and the Presentation of Statistics, Edward Arnold Ltd., London.
4. Monkhouse, F. J. and H. R. Wilkinson, (1971): Maps and Diagrams, Methuen & Co. Ltd., London.
5. Agrawal, N.K.(2006), Essentials of GPS (Second Edition), Book Selection Centre, Hyderabad

6. American Society of Photogrammetry (1983): Manual of Remote Sensing, ASP PalisChurch,V.A.
7. Barrett, E.G. and Curtis, L.F. (1992): Fundamentals of Remote Sensing in Air Photo-interpretation, McMillan, New York.
8. Bernhardsen, Tor (2002): Geographical Information Systems: An Introduction, Third Edition, John Wiiey& Sons, Inc., New York.Burrough, Peter A and McDonnell, R.A. (1998): Principles of Geographical Information Systems, Oxford University Press, Mumbai.
9. Campbell. J. (1989): Introduction to Remote Sensing, Guilford, New York.
10. Clarke, Keith C. (1998): Getting Started with Geographic Information Systems, Prentice-Hall Series in Geogl. Info. Science, Prentice-Hall, Inc. N.J.
11. Curran, Paul, J, (1988): Principles of Remote Sensing, Longman, London.
12. Heywood, I.et al (2002): An Introduction to Geological Systems, Pearson Education Limited, New Delhi.
13. Iliffe, J.C (2006), Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, New York.
14. Jonson. R. J. (2003): Remote Sensing of the Environment-An Earth Resources Perspective, Pearson Education Series in Geographical Information Science, Keith C. Clarke (Series editor) Pearson Educators Private Limited. (Singapore), New Delhi.
15. Yeates, M. (1974): An Introduction to Quantitative Analysis in Human Geography, McGraw Hill Book Co., New York.
16. Taylor, P. J. (1977): Quantitative Methods in Geography, Houghton and Miffin Co., Boston.
17. King, L. J. (1969): Statistical Analysis in Geography, Prentice Hall, Inc., Englewood Cliffs, New Jersey.
18. Hammond, R. and McCullagh, P.S. (1974): Quantitative Techniques in Geography: An Introduction, Oxford University Press, London.
19. Mahmood Aslam (1977): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi.
20. Cole, J.P. and King, C.A.M.(1968): Quantitative Geography, John Wiley and Sons, London.
21. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis – A reader in statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.
22. Levin, J. (1973): Elementary Statistics in Social Research, Harper and Row, New York.
23. Norcliff, G. B. (1982), Inferential Statistics for Geographers, Hutchinson, London.
24. Wilson A. G. and Bennet, R. J., (1985), Mathematical Methods in Geography and Planning, John Wiley and Sons, New York.
25. Cressie, N., (1991), Statistics for Spatial Data, John Wiley and sons, New York.
26. Wicox, P.R. (2003), Applying Contemporary Statistical Techniques, Academic Press, Amsterdam
27. Crang M. and Cook, I. 2007, Doing Ethnographies, Sage.
28. Rogerson P.A. (2010), 3rd Ed. Statistical Methods for Geography, a Students Guide, Sage.
29. Vallentine G. Clifford N. (2010), Key Methods in Geography, Sage
30. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis – A reader in statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.

Title of the Paper: Advanced Elective Practical I- Hydro-meteorology I
(Advanced Elective Option IV)
Credits- 4, Contact hours per week - 6

Course Objective: The course will endow students with the knowledge in collecting compiling, analysing, mapping data and modelling hydro-meteorological processed from both secondary source and through field based surveys with the help of state-of -the art laboratory instrumentation facilities available with the university.

Unit I: Measurement and processing of rainfall data

1.1. Methods of collection of hydrologic data, classification of hydrologic data, types of hydrological data networks and precipitation gauges
1.2. Errors in hydrological observations. Validation of data: primary validation, secondary validation.
1.3. Processing of datasets: Single series test of homogeneity, identification of consistency check within the data (both attribute and spatial), error correction of data by multiple time series analysis, spatial averaging of data, estimation of missing data: normal ratio method, distance power method
1.4. Averaging of Data: arithmetic mean, thiessen polygon, isohyetal method, disaggregation of rainfall data, rain storm analysis

Unit II: Measurement and processing of runoff data

2.1. River flows, stages, types of station control, main elements of a stream flow gauging station,
2.2.Measurement of interception, through fall , litterfall and processing of data, Measurement of infiltration through infiltrometer and data processing
2.3.Stream flow measurement by non-recording river stage gauges, depth sounding and suspension equipment, water level recorder Direct determination of discharge by current meters, floats, discharge by slope-area method, dilution methods, electromagnetic method
2.4.Constraints in stream flow measurements in arid and Ice covered regions

Unit III: Statistical analysis and hydrological models

3.1.Graphical representation of measures of central tendency , measure of dispersion or variation, measures of peakedness or flatness, measures of symmetry using hydrological datasets
3.2. Probability distribution by normal distribution, binomial distribution, extreme value distribution, poisson distribution. Parameter estimation methods by maximum likelihood and least squares
3.3.Application of hydrological model like HEC-RAS
3.4.Application of ground water hydrological model USGS MODFLOW

Recommended Readings:

1. Arnell, N.W., 1996: Global Warming, River Flows and Water Resources. John Wiley and Sons, Chichester, United Kingdom,
2. Braga, B.P.F. and L.C.B. Molion, 1999: Assessment of the impacts of climate variability and change on the hydrology of South America. In: Impacts of Climate Change and Climate Variability on Hydrological Regimes [van Dam, J.C. (ed.)]. UNESCO, International Hydrology Series, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA,
3. D ö l l , P. and S. Siebert, 2001: Global Modeling of Irrigation Wa t e r Requirements. University of Kassel, Kassel, Germany.
4. David K. Pickard, E. M. Tory (auth.), Ian B. MacNeill, Gary J. Umphrey, A. Ian McLeod (eds.): Advances in the Statistical Sciences, 1986: Stochastic Hydrology: Volume IV Festschrift in Honor of Professor V. M. Joshi's 70th Birthday, Springer Netherlands
5. Ven Chow, David Maidment, Larry Mays, 1988: Applied Hydrology, McGraw-Hill Science
6. James J. Sharp and Peter G Sawden (Auth.), 1984: Basic Hydrology, Butterworth-Heinemann

7. Bellie Sivakumar (auth.), 2017: Chaos in Hydrology: Bridging Determinism and Stochasticity, Springer Netherlands
8. Nicolas G. Adrien, 2003: Computational Hydraulics and Hydrology: An Illustrated Dictionary, CRC Press
9. Gour-Tsyh (George) Yeh (auth.): 1999, Computational Subsurface Hydrology: Fluid Flows, Springer US

Title of the Paper: Advanced Elective Practical I: Remote Sensing and GIS-I
(Advanced Elective Option V)
Credits- 4, Contact hours per week - 6

Course Objective: This course mainly covers the basic and rudimentary application of Remote Sensing and GIS. It will alsocover the basics of data structure and architecture. This paper will provide opportunity to work on hand different facets of remote sensing and GIS.

Unit I: Introduction to satellite images and aerial photo

1.1.Spectral bands, band combination, image registration (ground control point and image to image).
1.2. Image interpretation keys using FCC, interpretation of physical and cultural features.
1.3. Determination of photo scale, fusionof stereo-pair under mirror stereoscope, Identification and mapping of geomorphological units and land use.

Unit II: Introduction to Geographic Information System

2.1. Creation of vector database: point, line and polygon, geopackage creation and attribute joining.
2.2. Topology creation and correction, measurement tools, changing projection,vector processing: Union, intersection, clip, merge, dissolve, append.
2.3. Thematic mapping: map composition and representation.

Unit III: Database management and application of GPS

3.1. Preparation of data tables, file environment, editing and updating of the table in DBMS, preparation of RDBMS.
3.2. SQL based query in database, query by location and attribute
3.3. GPS and its initial setting, point data collection with GPS using different datum, area measurement using GPS, post processing of GPS data, GPS and GIS integration and output preparation.

Recommended Readings:

1. Bhatta B., 2011: Remote Sensing and GIS, Oxford Publisher.
2. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
3. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
4. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
6. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
7. Rees W. G., 2001: Physical Principles of Remote Sensing, Cambridge University Press.
8. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.

Title of the Paper: Term Paper Leading to Dissertation
Credits- 4**, Contact hours per week - 6**

Dissertation Term Paper comprises an Object–specific goal–oriented Geographical Study based on the following types: 1) those which test a hypothesis or theory, as virtually all aspects of Geography have theories attached to them, 2) those which compare the geographical characteristics of two places or phenomena. A variation on this theme is a comparison of the geographical characteristics of one place or phenomena at two or more stages of time, i.e., a study of changes over time, and 3) those which study a geographical problem related to the habitat, economy and society of people

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

Unit I: Identifying the Research Questions

1.1. By analysing the goals, situation, and work habits students will anticipate the dissertation project.
1.2. Pilot test" of work plan.
1.3. Developing a methodological framework, **Preliminary research, Secondary data collection**
1.4. **Outline** proposal and reviewing the literature

Unit II: Documentation and Presentation on Literature review and Viva voce

SEMESTER: X
(January-June)

Title of the Paper: Advanced Elective Theory II - Urban ecology, Environment and conservation-II
(Advanced Elective Option I)
Credits- 3, Contact hours per week – 3

Course Objective: The aim of this course is to provide students an in-depth knowledge on anthropological aspects of environmental planning and development, highlight social hazards and its impact on human and techniques of environmental management.

Unit I: Anthropogenic Aspects

1.1. Environment and Development: Utilization and Conservation of Renewable Resources, Recycling of Materials, Afforestation, Biodiversity and Biotechnology
1.2. Population Growth, Economic Development and Environmental Conservation with Special Reference to Third World Countries
1.3. Basic Principles of Spaceship Earth---Ecosystem Balance
1.4. Agricultural and Industrial Planning and Environment

Unit II: Social hazards and Human Impacts

2.1. Social Hazards: Poverty and Famine, Crime and Human Trafficking; National Food Security Bill in India 2013
2.2. Population, Health and Environment in India
2.3. Confronting Environmental issues: Social Movements in India*:* Bisnoi, Chipko, Silent valley and Narmada;
2.4. Man-animal Conflict in Forest-society Interface of Sundarbans

Unit III: Environmental Impact Assessment and Environmental Management

3.1. Environmental Impact Assessment, Environmental Audit
3.2. Environmental Management Plan; Case Studies of East Calcutta Wetland and Chilika;
3.3. Sustainable Development, Peri- urban inference of Indian cities, Sustainable cities, Sustainable consumption
3.4. Urban Environmental Management: Local Self-governance and Community Action; Significance of Slum Development and Ecotourism; Solutions for a cultivated planet

Unit IV: Environmental Policy and Management in India

4.1. Environmental Ethics, Laws and Policies: Concept and development of environmental philosophy, Ecocentrism and Anthropocentrism, the land ethic (Aldo Leopold), Gaia concept, Eco-feminism.
4.2. Formal and non-formal environmental education, Tbilisi conference, environmental awareness; Landscape ecology and ethno-ecology, environmental stewardship.
4.3. Collective action, Property rights and Participatory Management of forests in India
4.4. Environmental Laws in India: Legal Intervention, Government Policy, Institutional set-up and Role of NGOs in Environmental Management in India, Bhopal Gas Tragedy and Ganga Action Plan

Recommended Readings:

1. Anderson: Ecology for Environmental Science.
2. Biswas, T.D. and Mukherjee, S. K. 1987: Text book of Soil Science, Tata McGraw Hill, new Delhi.
3. Buckman, H.R. and Brady, N.C. 1974: Nature and Properties of Soil, McMillan, New York.
4. Bunting, A. 1965: Geography of Soil, Hutchinson, London.
5. Chapman, J.L. and Reiss, M.J. 1992: Ecology Principles and Applications, Cambridge University Press, Cambridge.
6. Daji, J.A., Kadam, J.R. and Patil, N.D. 1996: A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd, Mumbai.
7. Joffe, J. S. 1965 : ABC of Soil.
8. Kormondy, E. J. 1991 : Concepts of Ecology.
9. Nebel, J.B. 1981: Environmental Science, Prentice Hall, New York.
10. Odum, F.P. 1971: Fundamentals of Ecology, W.B. Sanders, Philadelphia.
11. Robinson, H. 1982: Biogeography.

Title of the Paper: Advanced Elective Theory II - Geomorphology and Hazard- II
(Advanced Elective Option II)
Credits- 3, Contact hours per week - 3

Course Objective: While emphasizing landslide hazards and its management this course will enable students to understand the fluvial hazards its impact and management and impact and mitigation of soil erosion. In detail students will learn relationship between geomorphology and environmental impact assessment.

Unit I: Landslide and Soil erosion hazards

1.1 Mechanism, types and causes of landslides; Methods for landslide investigation
1.2 Landslide hazard assessment; Controlling measures
1.3 Physical bases of erosion: Water erosion; Aeolian erosion
1.4 Estimation of Soil Erosion, Management of soil erosion

Unit II: Fluvial hazards

2.1 River bank erosion - causes, mechanism and remedial measures.
2.2 Causes and impact of flood
2.3 Assessment of flood, Flood hazard zonation
2.4 Management of flood.

Unit III: Coastal Hazards-

3.1 Mechanism and causes of coastal erosion; Methods of coastal erosion management
3.2 Problems and impacts of Dune Encroachment; Dune encroachment management
3.3 Mechanism and causes of tsunami; Management and Early warning systems
3.4 Formation, types and causes of Cyclone; prediction and management planning

Unit IV: Vulnerability and Risk assessment

4.1 Sea level rise and its impacts on coastal geomorphology
4.2 Concepts of Vulnerability and Risks
4.3 Parametric approaches for Hazard zonation
4.4 Geomorphology and Environmental Impact Assessment; Environmental Impact Scheme(EIS) and Environment Management Planning (EMP)

Recommended Readings:

1. Bull, William B. (1991): Geomorphic Responses to Climate Change. The Blackburn Press.
2. Ollier, C. D. : Weathering.
3. Tripathi, R. P. and Singh, H.P. (1993): Soil Erosion and Conservation. Willey Eastern Limited.
4. Singh, S., Sharma, H. S. and De, S. K. (2004): Geomorphology and Environement. Acb Publications, kolkata .
5. Thornbury, W. D. (1986): Principles of Geomorphology. Willey Eastern Limited.
6. Zaruba, Q. and Mencl, V. (1976): Landslides and their control. Elsevier Science .
7. Raghunath, H.M. (2006) : Hydrology. New Age International Ltd.
8. Singh, S, Starkel, L. and Syiemlieh, H. J. (2008): Environmental Changes and Geomorphic Hazards. Bookwell
9. Pandey. Environmental engineering.

Title of the Paper: Advanced Elective Theory II - Urban landscape, Infrastructure and Management-II
(Advanced Elective Option III)
Credits- 3, Contact hours per week - 3

Course Objective: This course will provide detailed knowledge of Indian economy and its policies and planning. In detail, this course will evaluate the concepts and schemes of rural and urban development. Development and role of infrastructure, institutions and planning and its prospects will be highlighted in details considering some specific case studies of India.

Unit I Modelling in Planning

1.1.Role of Models in Planning: Systems view of planning and use of quantitative models in planning, principles for designing and model formulation
1.2.Evaluation of Models and its application in planning: Linear models, gravity models, population forecasting model, regional transportation models and issues
1.3.Contemporary cities and critical perspectives – inclusion versus exclusion, urban space and gender sensitive planning; need for planning and social justice.

Unit II: Urban Landscape

2.1. Urban aesthetics: terms and concepts in urban aesthetics, content and development of an urban aesthetic plan, urban designing schemes and evaluation
2.2. Landscape designing: purpose and concerns for landscape assessment, man – landscape relationship over centuries – landscape architecture of western and oriental regions (Egyptian, Babylonian, Greek, Roman, Italian, French, English, Persian, Moghul, Indian, Chinese, Japanese), modern and contemporary trend
2.3. Urban forms and designing: standard and regulatory control on urban design and forms, impact of technology and role of urban designing in planning process.
2.4. Landscape assessment and evaluation: Open space and landscape planning, planning consideration with new projects like expressway, river roads, abandoned quarries, tree plantation and street furniture and utility

Unit III: Infrastructure, Governance and Smart City

3.1. Urban infrastructure – elements of infrastructure, land requirement and rights; Urban renewal and rehabilitation; concept in India and in developing countries, policies, legislation, comparative evaluation and critical appraisal with case studies.

3.2. Urban governance and Urban legislation: planning and development; Town and country planning act, Land acquisition Act, Zoning of urban land use (slum clearance, housing, landscape and traffic), Urban land ceiling and regulation; urban conservation and restoration; Urban Environmental Laws and concerns; Technology and E-governance

3.3. Sustainable urban planning: Theory and background of sustainable urban planning, Three E's of sustainability and urban development debate, Sustainable planning for different scales and emergence of new urbanism and smart growth

3.4. Smart cities: Concepts, typologies approaches and characteristics, smart city planning in developed and developing economy – critical evaluation on economic and financial viability; Smart city mission in India, Future urbanism and vision

Recommended Readings:

1. Allwinkle, S., & Cruickshank, P. (2011). Creating smart-er cities: An overview. Journal of Urban Technology, 18(2), 1–16.
2. Amin, A., & Thrift, N. (2002). Cities: Reimagining the Urban, London: Polity, Bates, J. (2012). ''This is what modern deregulation looks like'': Co-optation and contestation in the shaping of the UK's Open Government Data Initiative. The Journal of Community Informatics, 8(2). http://www.ci-journal.net/index. php/ciej/article/view/845/916. Accessed 6 Feb 2013.
3. Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A.,Bazzani, A., Wachowicz, M., et al. (2012). Smart cities of the future. European Physical Journal Special Topics, 214(1), 481–518.
4. Bowker, G., & Star, L. (1999). Sorting things out: Classification and Its consequences. Cambridge: MIT Press.
5. Boyd, D.,&Crawford, K. (2012). Critical questions for big data, Information, Communication and Society, 15(5), 662–679.
6. Dodge, M., &Kitchin, R. (2004). Flying through code/space: The real virtuality of air travel. Environment and Planning A, 36(2), 195–211.
7. Dodge, M., &Kitchin, R. (2005). Codes of life: Identification codes and the machine-readable world. Environment and Planning D: Society and Space, 23(6), 851–881.
8. Dodge, M., &Kitchin, R. (2007a). The automatic management of drivers and driving spaces. Geoforum, 38(2), 264–275.
9. Dodge, M., &Kitchin, R. (2007b). Outlines of a world coming in existence': Pervasive computing and the ethics of forgetting, Environment and Planning B, 34(3), 431–445.
10. Dutton, W. H., Blumler, J. G., & Kraemer, K. L. (1987). Wired cities: Shaping future communication. New York: Macmillan.
11. Farber, D. (2013). Counting the internet of things in real time, C|Net, July 30th. http://news.cnet.com/8301-11386_3-57596162-76/counting-the-internet-of-things-in-real-time/, Accessed 18 Sep 2013.
12. Ferro, E. &Osella, M. (2013). Eight business model archetypes for PSI re-use. Open Data on the Web workshop. http:// www.w3.org/2013/04/odw/odw13_submission_27.pdf.
13. Accessed 10 May 2013.
14. Haque, U. (2012). What Is a City that It Would Be 'Smart'? Volume #34: City in a Box. http://volumeproject.org/blog/ 2012/12/21/volume-34-city-in-a-box/.
15. Hill, D. (2013). On the smart city: Or, a 'manifesto' for smart citizens instead. City of Sound, 1st Feb 2013. http://www.cityofsound.com/blog/2013/02/on-the-smart-city-a-callfor-
16. Smart-citizens-instead.html. Accessed 5 Feb 2013.
17. Hollands, R. G. (2008). Will the real smart city please stand up? City, 12(3), 303–320.

18. Ishida, T., &Isbister, K. (2000). Digital cities: Technologies, experiences, and future perspectives. LNCS: Springer, 1765.
19. Brook D. (2013): A History of Future Cities, W.W. Norton & Company, New York
20. Allwinkle, S., & Cruickshank, P. (2011). Creating smart-er cities: An overview. Journal of Urban Technology, 18(2), 1–16.
21. Amin, A., & Thrift, N. (2002). Cities: Reimagining the Urban, London: Polity, Bates, J. (2012). ''This is what modern deregulation looks like'': Co-optation and contestation in the shaping of the UK's Open Government Data Initiative. The Journal of Community Informatics, 8(2). http://www.ci-journal.net/index.php/ciej/article/view/845/916. Accessed 6 Feb 2013.
22. Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A.,Bazzani, A., Wachowicz, M., et al. (2012). Smart cities of the future. European Physical Journal Special Topics, 214(1), 481–518.
23. Bowker, G., & Star, L. (1999). Sorting things out: Classification and Its consequences. Cambridge: MIT Press.
24. Boyd, D.,&Crawford, K. (2012). Critical questions for big data, Information, Communication and Society, 15(5), 662–679.

Title of the Paper: Advanced Elective Theory II - Hydro-meteorology-II
(Advanced Elective Option IV)
Credits- 3, Contact hours per week - 3

Course Objective: This course will provide an understanding into the laws and equation governing the atmospheric dynamics. It gives a detailed know how as to the causes and impacts of climate change in the light of international politics.

Unit I: Atmospheric Thermodynamics

1.1. Introduction to Atmospheric Thermodynamics and its basic concepts
1.2. Laws and Equations governing the dynamics: hydrostatic equation, Hypsometric equation, Clausius Clayperon equation, Stefan-Boltzmann law, Kirchoff's law, Equation of Radiative Transfer
1.3. Physics of Absorption, Emission and Scattering, Radiative transfer
1.4. Skew-T ln-P chart, Lifting Condensation Level (LCL)

Unit II: Climate variability

2.1.Earth's Climate Past and Future, Tectonics and Climate; Insolation and Monsoons,
2.2. Hydrostatic and Geostrophic approximation, Cyclostrophic approximation and Thermal winds, Surface energy balance and bulk aerodynamic formulae,
2.3. Radiative forcing, Greenhouse gases(GHG), Climate sensitivity, Transient and equilibrium response
2.4.Aerosol Radiative Forcing and improved estimates of climate sensitivity,

Unit III: The politics of climate

3.1. Linkages between atmosphere, oceans, biosphere, and cryosphere under climate variability issues
3.2. Future technologies in reducing GHG emissions: carbon sequestration, biofuels, hydrogen, geo-engineering.
3.3. International Agreements: the United Nations Framework Convention on Climate Change and Kyoto Protocol
3.4. India's role in climate politics, India's Initial National Communication (NATCOM) to United Nations Framework Convention on Climate Change and the Forestry Sector, A critical review of climate change adaptation plan of West Bengal

Recommended Readings:

1. Atmospheric science – An Introductory Survey, J.M. Wallace and P.V. Hobbs, 2nd Edition, Academic Press, London, 2006.
2. An Introduction to Atmospheric Thermodynamics, A.A. Tsonis, 2nd Edition, Cambridge University Press, Cambridge, 2007
3. Climate Change 2007 – The Physical Science Basis, IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, 2007
4. The Physics of Atmospheres, John Houghton, 3rd Edition, Cambridge University Press, Cambridge, 2002.
5. An Introduction to Dynamic Meteorology, J.R. Holton, 4th Edition, Academic Press, London, 2004. 5.
6. A Climate Modelling Primer, K. McGuffie and A. Henderson-Sellers, 3rd Edition, John-wiley, New York, 2004.
7. Advances in Meteorology, Climatology and Atmospheric Physics, D. D. Alexakis, D. G. Hadjimitsis, S. Michaelides, I. Tsanis, A. Retalis, C. Demetriou (auth.), Costas G. Helmis, Panagiotis T. Nastos (eds.), Springer-Verlag Berlin Heidelber, 2013
8. Adaptation and Mitigation Strategies for Climate Change, So Kazama, Ayumu Sato, Seiki Kawagoe (auth.), Akimasa Sumi, Kensuke Fukushi, Ai Hiramatsu (eds.) Springer Japan, 2010
9. A Perfect Moral Storm: The Ethical Tragedy of Climate Change, Stephen Mark Gardiner, Oxford University Press, 2011
10. A history of the science and politics of climate change: the role of the Intergovernmental Panel on Climate Change, Bert Bolin, Cambridge University Press, 2007

Title of the Paper: Advanced Elective Theory II - Remote Sensing and GIS-II
(Advanced Elective Option V)
Credits- 3, Contact hours per week - 3

Course Objective: This course will explore the Remote Sensing and GIS theory. It will explain in details the fundamentals of remote sensing, GIS and GPS while highlighting concepts and application of Geoformatics. Students will also learn data structure fundamentals and allied concepts. Apart from it, this unit will also cover fundamentals of aerial photogrammetry**.**

Unit I: Digital Image Processing

1.1. Image pre-processing: geometric and radiometric correction; image enhancement- spatial and spectral;
1.2.Multi-band enhancement techniques—band Ratios, indices, spatial filtering; resolution merge techniques.
1.3. Image classification: supervised and unsupervised; multi-date data analysis and change detection processes, accuracy assessment

Unit II: Advanced Geographic Information System

2.1. Concept of Decision Support Systems (DSS), Spatial Decision Support Systems (SDSS), Multi criteria decision support system (MDCA).
2.2. Spatial Analysis: measurement in GIS, data query by attributes and location, neighbourhood analysis, connectivity & network analysis, overlay analysis, interpolation.
2.3. GIS Data Quality- Errors and Uncertainty, Positional and Attribute Accuracy, Web GIS, Mobile GIS.

Unit III: Remote Sensing & GIS integration

3.1. Remote sensing application of natural resource mapping; environmental monitoring, geomorphic and geological mapping, land use mapping; water resources management and mapping, flood hazard mapping, disease and stress detection; soil erosion and salinity mapping; crop stress and crop yield estimations.
3.2. GIS based infrastructure mapping, resource and utility mapping, rural and urban information system; migration and population dynamics, GIS in planning; GIS in health services and tourism; solid waste management; wild life habitat suitability studies.
3.3. Mobile mapping and GPS applications: mobile mapping basic concepts and applications , GPS application in surveying and mapping

Recommended Readings:

1. William J. Sutherland (2006): Ecological Census Techniques Edited by Cambridge 2nd edition
2. Lagacherie Philippe, McBratney Alex and Voltz Marc(2006) : Digital Soil Mapping :An Introductory Perspective, Elsevier
3. Scull, P.; J. Franklin, O.A. Chadwick & D. McArthur (June 2003). Predictive soil mapping - a review. Progress in Physical Geography , Sage Publications.
4. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
5. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.
6. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C. 1995: Elements of Cartography, John Wiley and Sons, New York.
7. Basu, R. and Bhaduri, S. ed, 2007: Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
8. Gupta, K. K. and Tyagi, V. C. (1992): Working with maps, Survey of India Publication, Dehradun

Title of the Paper: Advanced Elective Practical II - Geomorphology and Hazard II
(Advanced Elective Option II)
Credits- 4, Contact hours per week - 6

Course Objective: This course will enable students to perform laboratory based experiments including field and computer based advanced techniques of applied geomorphology.

Unit I: Laboratory based
1.1. Grain size analysis
1.2. Determination of soil pH and organic carbon and other major elements.
1.3. Determination of soil and water pollutants.
1.4. Atterberg limits

Unit II: Field based
2.1. Estimation of soil loss along slope
2.2. Bank erosion estimation by using Bank Erosion Hazard Index Method
2.3. Contouring of a slope by Total Station
2.4. Soil moisture determination by Tensiometer

Unit-3: Computer based
3.1 Use of GPS for collecting Ground Control Point and Geo-referencing of map with the help of GCP
3.2 LULC analysis, Spatio- temporal change detection and Matrix calculation
3.3 Determination of Soil loss and Sediment Yield by using computer aided programmes
3.4 Image enhancement and analysis

Unit IV: Laboratory Note Book and presentation

Reading Lists:
1. Department of Agriculture. Field Book for Describing and Sampling Soils: National Soil Survey Center Natural Resources Conservation Service U.S., 3rd Version.
2. Soil Survey Division Stuff. Soil Survey Manual. Published by- Department of Agriculture, U.S.
3. G. M. Coen: Soil survey handbook. Technical Bulletin 1987-9E. Published by Agriculture, Canada.
4. Lagacherie Philippe, McBratney Alex and Voltz Marc. Digital Soil Mapping. An Introductory Perspective, Elsevier.
5. S. Wieprecht, S. Haun, K. Weber, M. Noack and Kristina Terheiden. River Sedimentation: Proceedings of the 13th International Symposium on River Sedimentation (Stuttgart, Germany, 19-22 September, 2016)
6. M. Promisky. A. Stockman. S. Zeller and D. Stimberg. River Space design. Planning Strategies, Methods and Projects for Urban Rivers.
7. S. V. Estopinal. A Guide to Understanding Land Survey. 3rd edition.
8. M.H. Elfic, J.G. Fryer, R.C. Brinkners and P.R. Wolf. Elementary Surveying. 8th edition. Harper Collins Publishers. London.
9. C. Venkatramaiah. A Textbook of Surveying. Universities Press/Orient Longman Ltd. Hyderabad.

Title of the Paper: Advanced Elective Practical II: Urban landscape, Infrastructure and Management-II
(Advanced Elective Option III)
Credits- 4

Course Objective: In this course students will learn various methods of advanced data collection considering both virtual and physical data base structure. Delineations of regions and regionalization will be learnt under GIS environment while various statistical techniques will be applied using various statistical packages.

Unit I: Population-Infrastructure: Critical Problems and Solutions

1.1.Spatial distribution of select elements like population – population forecasting models, Composite population forecasting models - The cohort- survival model, Migration model.
1.2.Change detection using vector and raster data – site suitability analysis using GIS
1.3.Location-Allocation Problems – spatial distribution of basic infrastructural facilities – critical evaluation – practical solutions

Unit II: Geospatial Modelling

2.1.General approaches to land use and transportation Forecasting and modelling
2.2.Basic sector land use models: Residential distribution models, Retail and local service activity location models.
2.3.General introduction to various decisions making models
2.4.Project on: a. Utilization of space technology for grass root level planning and governance
b. GIS and Activity Planning

Unit III: Laboratory Notebook and Viva voce

Recommended Readings:

1. Robinson, A. H. and Others (1995): Elements of Cartography, VI Edition, John Wiley & Sons, New York.
2. Anson, R. W. and Ormeling, F. J., (Ed.) (1993): Basic Cartography for Students and
3. Technicians, Vol.I, International Cartographic Association and Elseiver Applied Science
4. Publishers, London.
5. Dickinson, G. C. (1977) Statistical Mapping and the Presentation of Statistics, Edward Arnold Ltd., London.
6. Monkhouse, F. J. and H. R. Wilkinson, (1971): Maps and Diagrams, Methuen & Co. Ltd., London.
7. Agrawal, N.K.(2006), Essentials of GPS (Second Edition), Book Selection Centre, Hyderabad
8. American Society of Photogrammetry (1983): Manual of Remote Sensing, ASP PalisChurch,V.A.
9. Barrett, E.G. and Curtis, L.F. (1992): Fundamentals of Remote Sensing in Air Photo-interpretation, McMillan, New York.
10. Bernhardsen, Tor (2002): Geographical Information Systems: An Introduction, Third Edition, John Wiiey& Sons, Inc., New York.Burrough, Peter A and McDonnell, R.A. (1998): Principles of Geographical Information Systems, Oxford University Press, Mumbai.
11. Campbell. J. (1989): Introduction to Remote Sensing, Guilford, New York.
12. Clarke, Keith C. (1998): Getting Started with Geographic Information Systems, Prentice-Hall Series in Geogl. Info. Science, Prentice-Hall, Inc. N.J.
13. Curran, Paul, J, (1988): Principles of Remote Sensing, Longman, London.
14. Heywood, I.et al (2002): An Introduction to Geological Systems, Pearson Education Limited, New Delhi.

15. Iliffe, J.C (2006), Datums and Map Projections for Remote Sensing, GIS and Surveying, Whittles Publishing, New York.
16. Jonson. R. J. (2003): Remote Sensing of the Environment-An Earth Resources Perspective, Pearson Education Series in Geographical Information Science, Keith C. Clarke (Series editor) Pearson Educators Private Limited. (Singapore), New Delhi.
17. Yeates, M. (1974): An Introduction to Quantitative Analysis in Human Geography, McGraw Hill Book Co., New York.
18. Taylor, P. J. (1977): Quantitative Methods in Geography, Houghton and Miffin Co., Boston.
19. King, L. J. (1969): Statistical Analysis in Geography, Prentice Hall, Inc., Englewood Cliffs, New Jersey.
20. Hammond, R. and McCullagh, P.S. (1974): Quantitative Techniques in Geography: An Introduction, Oxford University Press, London.
21. Mahmood Aslam (1977): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi.
22. Cole, J.P. and King, C.A.M.(1968): Quantitative Geography, John Wiley and Sons, London.
23. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis – A reader in statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.
24. Levin, J. (1973): Elementary Statistics in Social Research, Harper and Row, New York.
25. Norcliff, G. B. (1982), Inferential Statistics for Geographers, Hutchinson, London.
26. Wilson A. G. and Bennet, R. J., (1985), Mathematical Methods in Geography and Planning, John Wiley and Sons, New York.
27. Cressie, N., (1991), Statistics for Spatial Data, John Wiley and sons, New York.
28. Wicox, P.R. (2003), Applying Contemporary Statistical Techniques, Academic Press, Amsterdam
29. Crang M. and Cook, I. 2007, Doing Ethnographies, Sage.
30. Rogerson P.A. (2010), 3rd Ed. Statistical Methods for Geography, a Students Guide, Sage.
31. Vallentine G. Clifford N. (2010), Key Methods in Geography, Sage
32. 16. Berry, B.J.L. and Marble, D.F. (1968): Spatial Analysis – A reader in statistical Geography, Prentice Hall, Englewood Cliffs, New Jersey.

Title of the Paper: Advanced Elective Practical- II – Hydro-meteorology-II
(Advanced Elective Option IV)
Credits- 4, Contact hours per week - 6

Course Objective: This course has been designed in order to train the students to collect, assimilate, map and model various meteorological parameters with the help of both state -of -the art instruments available at the University combined with secondary attribute data sets and remote sensing data sets.

Unit I: Measurement and processing of attribute climate data

1.1 Measurement of Collection and Processing of Temperature Data (Maximum/Minimum) from Automatic Weather Evaporation and Evapotranspiration using Pan Evaporimeters, Processing of Pan
1.2. Evaporation Data, Estimation of Lake Evaporation from Pan Measurements
1.3. Station, Adamas Knowledge City Campus and India Meteorological Department
Collection and processing of relative humidity data from Automatic Weather Station, Adamas
1.4. Knowledge City Campus and India Meteorological Department
Collection and processing of wind speed and solar radiation with data from Automatic Weather Station, Adamas Knowledge City Campus and India Meteorological Department

Unit II: Processing of remote sensing data

2.1. Trend analysis of Land surface temperature and emissivity from MODIS (Moderate Resolution
2.2. Image Spectro radiometer) and Landsat Thermal images
Processing of rainfall data from gridded data sets of India Meteorological Department and
2.3. TRMM (Tropical Rainfall Measuring Mission) dataset
Solar Radiation data processing and analysis by METEONORM software and analysis of SWERA
2.4. (Solar and Wind Energy Resource Assessment) datasets
Analysis of spatial and Temporal variability of AOD (Aerosol Optical Depth) using MODIS images

Unit III: Laboratory Notebook and Viva voce

Recommended Readings:

1. Calculating the Weather: Meteorology in the 20th Century, Frederik Nebeker (Eds.), Elsevier, Academic Press, 1995
2. An Introduction to Atmospheric Thermodynamics, A.A. Tsonis, 2nd Edition, Cambridge University Press, Cambridge, 2007
3. Handbook of weather, climate, and water : dynamics, climate, physical meteorology, weather systems, and measurements, Thomas D Potter; Bradley Roy Colman, Wiley-Interscience, 2003.
4. Integrated Ground-Based Observing Systems: Applications for Climate, Meteorology, and Civil Protection, Domenico Cimini, Ed R. Westwater (auth.), Domenico Cimini, Guido Visconti, Frank S. Marzano (eds.), Springer-Verlag Berlin Heidelberg, 2011

Title of the Paper: Advanced Elective Practical- II: Remote Sensing and GIS II
(Advanced Elective Option V)
Credits- 4, Contact hours per week - 3

Course Objective: This course will unfold advance application of Remote Sensing and GIS. It will cover the digital image processing, advanced GIS and application of GPS. This paper will also highlight application of newer concept like web GIS and mobile mapping. Students will also gather theoretical knowledge about different application of remote sensing and GIS in different domains.

Unit I: Digital Image Processing

1.1. Pre-processing techniques: Geometric and atmospheric correction, Image enhancement and filtering.
1.2. Multi-band enhancement techniques—band Ratios, indices, spatial filtering; resolution merge techniques.
1.3. Image classification: supervised and unsupervised; multi-date data analysis and change detection processes, accuracy assessment

Unit II: Advanced Geographic Information System

2.1. Concept of Decision Support Systems (DSS), Spatial Decision Support Systems (SDSS), Multi criteria decision support system (MDCA).
2.2. Connectivity & network analysis, neighbourhoodanalysis, Interpolation and TIN generation.
2.3. Preparation of DEM and DTM using SRTM and ASTER data.

Unit III: Application of Remote Sensing and GIS

3.1. Remote sensing application of water resources management and mapping, flood hazard mapping, disease and stress detection, soil erosion and salinity mapping; crop stress and crop yield estimations.
3.2. GIS based infrastructure mapping, resource and utility mapping, rural and urban information system, migration and population dynamics.
3.3. GIS in planning, GIS in health services and tourism, solid waste management, wild life habitat suitability studies

Recommended Readings:

1. Bhatta B., 2011: Remote Sensing and GIS, Oxford Publisher.
2. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press.
3. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
4. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
6. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
7. Rees W. G., 2001: Physical Principles of Remote Sensing, Cambridge University Press.
8. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.

Title of the Paper: Major Field project and comprehensive viva
Credits- 6

A Field Report to be prepared and submitted individually by each student, based on actual Field Survey of an area, done jointly or in groups with other students under the supervision of a Prof–in–Charge, Field Study. **A Field Survey** shall involve "Identification, Mapping and Interpretation of Salient Features of the Habitat, Economy and Society of the Local Inhabitants".

- Measurement and mapping of slope using Clinometer / Dumpy Level / Abney Level etc
- Measurement and mapping of geomorphic and geographical features with GPS and other relevant instruments
- Acquisition and mapping of landuse pattern by 'plot–to–plot' survey using cadastral map
- Acquisition and mapping of socio-economic data by 'door–to–door' household enumeration using questionnaire
- Identifying the relations between and among the attributes / components of : habitat, economy and society
- Pages containing illustrations (sketches, graphs, diagrams, maps, photographs, etc) = 20 (maximum)
- Documentation and generation of the field report with the following arrangement : preface, introduction, objectives, methodology, data acquisition, data analysis, data display and interpretation, analysis and conclusion, appendices (of data), and bibliography / references
- Word Limit = 8000 (maximum) excluding Tables and Appendix (Computer typed, Line Spacing = 1½, Arial Narrow / Times New Roman / Helvetica 10 / 11/ 12)
- Time allotted for Viva Voce / Examinee = 15 minutes (maximum)
- Marks on Report shall be awarded by the Internal Examiners and on Viva Voce by the External Examiners and then added together.

Title of the Paper: Project: Dissertation writing and seminar presentation (Project)
Project on Literature Review
Credits- 12

Dissertation Paper comprises an Object–specific goal–oriented Geographical Study based on the following types: 1) those which test a hypothesis or theory, as virtually all aspects of Geography have theories attached to them, 2) those which compare the geographical characteristics of two places or phenomena. A variation on this theme is a comparison of the geographical characteristics of one place or phenomena at two or more stages of time, i.e., a study of changes over time, and 3) those which study a geographical problem related to the habitat, economy and society of people.

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

2. The Report must be documented in triplicate (1 = examinee, 2 = seminar library, 3 = supervisor) under the following Heads – *Introduction & 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.*

3. The Dissertation Paper should contain *Acknowledgement, Preface, Table of Content, List of Tables, List of Figures, List of Photographs, List of References, Appendix, and Bibliography/ Reference.*

4. Pages containing Illustrations (Sketches, Graphs, Diagrams, Maps, Photographs, etc.) = 25 (maximum).

5. Word Limit = 8000 (maximum) excluding Tables and Appendix (Computer typed, Line Spacing = 1½, Arial Narrow / Times New Roman / Helvetica 10 / 11 / 12).

6. Each Examinee shall submit a copy of the Report before the actual day of Examination (to be announced by the convener each year).

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

8. Time allotted for each presentation = 20 minutes (maximum).

9. Marks on Report and Presentation shall be separately awarded by the Internal and External Examiners and then averaged.