

Parvatibai Chowgule College of Arts and Science Autonomous

Accredited by NAAC with Grade 'A' (CGPA Score 3.41 on a 4 Point Scale in 3rd cycle) Best affiliated College-Goa University Silver Jubilee Year Award

LEARNING OUTCOME-BASED EDUCATION (LOBE)

for

Undergraduate Programme BSc GEOGRAPHY (LOCF)



DEPARTMENT OF GEOGRAPHY PARVATIBAI CHOWGULE COLLEGE OF ARTS & SCIENCE (AUTONOMOUS) MARGAO GOA

Introduction

Geography has been broadly accepted as a bridge discipline between human and physical sciences. In the beginning, geography focussed on the physical aspects of the earth but the modern geography is an all-encompassing discipline that seeks to understand the earth and all of its human and natural processes as integrating elements. Geography has emerged through time as a transdisciplinary subject integrating the regional diversity with the concepts of the timing of space and the spacing of time. It provides broad, human and place-centred perspectives on the transformation of rural ecology to globalized urban landscape at different levels, from the local/regional/national to global.

Geography as a discipline has undergone constant change due to socio-economic dynamics, demographic changes and technological advancements. Geography has adopted global to micro-level studies to focus on the current socio-spatial problems, issues and challenges to make the students aware of the application of geography to sort out the societal upcoming problems. It is important for the policy makers to consider the geo-spatial aspects with references to the location and in context of the best utilization of public utilities. It is further expected that if the above said spatial aspects are considered, it will certainly develop the lagging regions and people living therein.

Ever since the inception of the college in 1962, geography is being offered for Bachelor of Arts students. Initially, it was offered as three units. From 1991, six units (entire geography) is being offered. The main focus of the discipline is physical geography, human geography, cartography, regional planning, quantitative techniques and participatory appraisal techniques. The curriculum has adopted Learning Outcomes based Approach. It incorporates dynamic processes including fundamental and modern techniques, global initiatives like Sustainable Development Goals (SDGs), Disaster Risk Reduction (DRR), national initiatives like smart cities, Securities of food, water, energy, human health and livelihood, biodiversity, and disaster management. The approaches are to make geography more scientific and societal-need oriented that could address India's developmental challenges. Geography uses scientific knowledge with the current focus that includes spatio-temporal analysis, skill development, Remote Sensing and Geographic Information System.

Aim of B.Sc. Programme in Geography

The Department has defined aims and objectives of B.Sc. Programme in Geography in its Mission Statement which is as follows:

Mission Statement:

The Department of Geography at Chowgule College aims to provide in-depth knowledge in geographical domains with a special focus on research and skill-building.

It offers core subjects in Physical Geography, Cultural Geography, Geoinformatics, Cartography, Spatial Studies and an array of allied electives. The teaching learning methodologies focus on self focused learning through problem based learning, laboratory experiments, field works and project works.

The faculty has expertise in specialized fields of geography, which ensure that their experience is transcended to the students through discussion forums, workshops, seminars, field works and research work. The department emphasizes that the students participate in intercollegiate events, present papers in conferences, assist faculty in research works and undertake internships.

Our department has the necessary ICT-enabled infrastructure to enable curious learners to acquire essential skills and knowledge. This helps to develop expertise in areas of spatial studies, physical geography, human geography and Geoinformatics.

The department aims to develop skills of fieldwork, survey and research to seek suitable employment as teachers, researchers, surveyors, GIS analysts, cartographers and in allied fields like tourism and regional planning.

Students interested in joining the department, should have passed Higher secondary (12th Grade) and should be genuinely interested in field work and surveys. The students need to have some basic knowledge in statistics and should be curious observers and report writers.

The above specified aims and objectives are achieved through the below mentioned courses offered to B.Sc. Geography students

Sr. No.	Mission Key points	Methodology
1	In-depth knowledge	GEG-I.SC1, GEG-I.SC2, GEG-II.SC3, GEG-II.SC4
2	Research	GEG-III.SC5, GEG-SE1, GEG-SE2, GEG-SE3, GEG-SE4,
		GEG-SE9, GEG-SE13, GEG-VI.SC8, GEG-SE14, GEG-SE15,
		GEG-SE16,
		Project Work
3	Skill-building	Problem Solving, Lab experiments, fieldworks, internships,
		workshops, seminars, group discussions, classroom
		presentations, research paper presentations
4	Physical Geography	GEG-I.SC2, GEG-IV.SC6, GEG-SE5, GEG-SE6, GEG-
		SE7,
		GEG-V.SC7,GEG-VI.SC8, GEG-SE9, GEG-SE11, GEG-
		SE14, GEG-SE15, GEG-SE16
5	Cultural Geography	GEG-II.SC3
6	Geoinformatics	GEG-III.SC5, GEG-SE1, GEG-SE2, GEG-SE3, GEG-SE4,
		GEG-SE13
7	Cartography	GEG-I.SC1, GEG-I.SC2
8	Spatial Studies	GEG-SE1, GEG-II.SC4, GEG-II.SC3, GEG-SE7, GEG-
		VI.SC8,
		GEG-SE14, GEG-SE15, GEG-SE13

Eight distinct key-points have been incorporated from B.Sc. Course such as: In-depth knowledge, Research, Skill-building, Physical Geography, Cultural Geography, Geoinformatics, Cartography and Spatial Studies. This helps students to:

- i. Appreciate the relevance of geographical knowledge to everyday life.
- ii. Demonstrate the ability to communicate geographic information by utilising both lecture and practical exercises.
- iii. Inculcate the ability to evaluate and solve geographical problems effectively.
- iv. Demonstrate the skills in using geographical research tools including spatial statistics, cartography, remote sensing, and Geographic information systems.
- v. Based on the field knowledge and advanced technologies, the students should be able to understand the on-going geographical problems in different regions and levels with appropriate solutions.

Overview of the Department

We are proud to state that Department of Geography and Research Centre is a leading and pioneer department in the State of Goa that offers Graduate, Postgraduate and Ph.D. programmes in Geography and Postgraduate Diploma in Geoinformatics.

Well equipped laboratories, well qualified faculty with strong academic background, collaborations with various national and international institutes, active involvement in consultancy, extension activities and research and an established GIS and Remote Sensing section are the fortes of the department.

Over the decades, the department has achieved significant milestones since its inception in 1962. Looking at the popularity and demand of Geography, in 1991, entire Geography was introduced at third year level and then, subsequently, Masters' Degree (M.A.), in 2004. To increase the employability of graduates, in 2009, the department started Postgraduate Diploma in Geoinformatics (PGDGIS), and to enhance the research aptitude, Ph.D. Programme commenced from 2014. B.Sc. in Geography at third year level was introduced in 2012.

The department, to its credit, has completed four, with two ongoing Major Research Projects and more than 60 research publications in last five years. The department also publishes an in-house bi-monthly newsletter "*Geographia*" and undertakes various activities through Geography Club "GLOBE (Geographers Loving Our Beautiful Environment)" and "AGES (Association of Geography Ex-Students)". The GLOBE organizes field trips, tours, students' events and works for the promotion of the subject, where as AGES provides financial and logistic assistance. Various scholarships have been instituted by the alumni.

The department has collaborations with Goa Institute of Public Administration and Rural Development (GIPARD), Old Goa, (Goa), Gogate-Jogalekar College, Ratnagiri (Maharashtra), Parishkar College of Global Excellence, Jaipur (Rajasthan), S.M. Bapuji Salunkhe Mahavidyalaya, Miraj (Maharashtra) and Department of Geography, University of Rajasthan, Jaipur (Rajasthan). There are two universities, University of Sri Jayewardenepura and University of Kelaniya, Sri Lanka, with whom, the department has academic exchange programmes.

The departments commitment to the growth of the subject and expansion of geographical knowledge through teaching, research, consultancy and extension activities, has earned it, a stature of being one of the most eminent academic departments in the State of Goa.

Infrastructure

The Department has independent laboratories with adequate infrastructure supported by computer facility and Internet connection and air conditioning. A well-developed Geographical Information System (GIS) Lab, Remote Sensing Lab and Photogrammetry & Research Lab cater to the needs of the students and researchers. The department is enriched with toposheets (Indian and British), weather charts, maps, globe, models and specimens of rocks and minerals. The Department is proud to have an automatic weather station installed by ISRO (Indian Space Research Organization) that provides continuous weather report. The department also has GPS and Mapmaker package.

Department Labs:

- 1. Geoinformatics Lab
- 2. P.G. Laboratory (Geomorphology Lab), which is currently being re-developed as Environmental Lab
- 3. Photogrammetry & Research Lab with tracing table
- 4. Remote Sensing Lab
- 5. General Lab
- 6. Mapping Room

Scholarships

The Department institutes three awards for the students of Geography.

- 1. **The Pratima Naik Memorial Award** is awarded to top scorer in the subject and girl student scoring highest marks in geography at undergraduate and postgraduate examinations respectively.
- 2. The M.S. Honrao and Dr. S. S. Hiremath Scholarship is awarded to needy meritorious postgraduate students of first year and second year respectively.
- 3. The Late Afroz Sheik Memorial Scholarship is awarded to a postgraduate student scoring highest in Semester I & II and who is economically disadvantaged.
- 4. **Dr. N. N. Sawant and Dr. S. S. Hiremath Scholarship for GIS Study** is awarded to a postgraduate student scoring highest in Geoinformatics and who is economically disadvantaged.

Courses Offered

The Department of Geography is the only department in the State of Goa to provide higher education at third year graduation level and at postgraduate level.

Degree Courses:

- B.A. Geography
- B.Sc. Geography
- M.A. in Geography
- M.Sc. in Geoinformatics

Diploma Course:

• Postgraduate Diploma in Geoinformatics

Ph.D. Programme in Geography:

• The Department is recognized as Center for Research in Geography by the Goa University

EDUSAT based Distance Learning Programme:

• Basic and Advanced Remote Sensing, GIS and GPS sponsored by NNRMS and ISRO Short Term Courses in the field of GIS and Remote Sensing (Announced as per requirement)

Three Years Integrated Programme : Bachelors of Arts and Science in Geography

Geography is one of the most exciting subjects to study at any level. It is the study of places and the relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. Geography is unique in bridging the social sciences (human geography) with the natural sciences (physical geography). Geography asks the big questions — Where? How? Why? What if? — and gives you the perspective to answer them with advanced technology and a solid knowledge of the world in which we all live. "Geography is the only subject that asks you to look at the world and try to make sense of it. The field never stops being exciting because that's what geography is all about - trying to make sense of the world."(Peirce F. Lewis)

The department of Geography at Parvatibai Chowgule College offers an array of courses that lays a firm foundation in geography and also enables students to develop skills of field work, cartography, map reading, research and report writing.

The three years integrated programme has 120 academic and 10 non academic credits. It is divided into three components: Foundation courses, Core and Elective courses.

Semester	Single Major	Major-Minor (Major)	Double Major	Minor
Ι	2 Core Courses	2 Core Courses	2 Core Courses	1 Core Course
Π	2 Core Courses	2 Core Courses	2 Core Courses	1 Core Course
	1 Core Course	1 Core Course	1 Core Course	1 Coro Courso
III	3 Elective	1 Elective	1 Elective	I Cole Course
	Courses	Course*	Course*	
	1 Core Course	1 Core Course	1 Core Course	1 Core Course
IV	3 Elective	1 Elective	1 Elective	I Cole Course
	Courses	Course*	Course*	
	1 Core Course	1 Core Course	1 Core Course	1 Core Course
V	3 Elective	2 Elective	I COLE COUISE	I Cole Course
	Courses	Courses*		
	1 Core Course	1 Core Course	1 Core Course	1 Core Course
VI	3 Elective	2 Elective	I COLE COUISE	I Cole Course
	Courses	Courses*		
	8 Core Courses	8 Core Courses	8 Core Courses	6 Coro Coursos
Total	12 Elective	6 Elective	2 Elective	
	Courses	Courses	Courses	

Semester-wise Distribution of Courses for BA and BSc Geography

*Note: Number of Electives is irrespective of the Semesters in which they are opted

1. Foundation courses : These are compulsory courses that are offered in each semester. The total number of credits is 36.

- 1.1 Languages (English, Hindi, French, Portuguese, Marathi, Konkani)
- 1.2 Statistical methods (Advanced)
- 1.3 Academic Writing
- 1.4 Research writing
- 1.5 Interdisciplinary (Semester V and VI
- 1.6 Environmental Science
- 1.7 Cyber Security

2. Core Courses are offered for the students opting for Single Major, Major- Minor and Double Major. The department offers 8 core papers for Single Major and double Major students, while Major – Minor and Minor Students will offer six core papers.

Compulsory Core (BA Geography)	Single Major	Major- Minor	Double Major	Minor
Introduction To Geography	•	•	•	•
Fundamentals Of Physical Geography	•		•	-
Basics Of Human Geography	•	•	•	-

•	•	•	•
•	•	•	•
•	•	•	•
•	•	•	•
•	•	•	•
Single Major	Major- Minor	Minor	
•	•	•	
•		-	
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•	•	•	
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	• • • • • • • • • • • • • • • • • • •	Single Major- Major Minor	Single Major- Minor Major Minor

3. Electives: The department offers 16 electives in four semesters (III,IV, V & VI). Single major students have to choose 12 electives of the listed in odd and even semesters Where as major – minor students will choose 6 electives and double major students will choose 2 electives. The department offers no electives for students opting geography as a minor subject.

3.1 Electives offered in the odd semesters (B.A. Geography) (Semester III & V)

- E-1 Socio- Economic Survey
- E-2 Field Survey In Physical Geography
- E-3 Participatory Rapid Appraisal Techniques
- E-4 Application of Computer in Geography
- E-9 Basics of Climatology
- E-10 Basics of Oceanography
- E-11 Geography of Rural Settlements
- E-12 Geography of Urban Settlements

Pre requisite: For courses E-9, E-10, E-11 and E-12, a student must have successfully completed courses in physical geography and human geography.

3.2 Electives offered in the odd semesters (B.Sc. Geography) (Semester III & V)

- E-1 Spatial Analysis
- E-2 Raster and Vector Data Models in GIS
- E-3 Participatory GIS
- E-4 Applied GIS
- E-9 Geography of Soil Studies
- E-10 Agro-Meteorology: Principles and Applications
- E-11 Field Survey in Physical Geography
- E-12 Quantitative Techniques in Geography

Pre requisite: For courses E-1, E-2, E-3 and E-4, a student must have successfully completed courses in Basic GIS and Remote Sensing

3.3 Electives offered in the even semesters (B.A. Geography) (Semester IV & VI)

- E-5 Regional Geography of Goa
- E-6 Regional Geography of India
- E-7 Regional Geography of South Asia (Sri Lanka)
- E-8 Regional Geography of USA
- E-13 Regional Planning
- E-14 Economic Geography
- E-15 Geography of Tourism
- E-16 Quantitative Techniques in Human Geography

Pre requisite: For courses E-5, E-6, E-7 and E-8, a student must have a student must have successfully completed courses in Basics & Advanced Regional Geography.

3.4 Electives offered in the even semesters (B.Sc. Geography) (Semester IV & VI)

- E-5 Coastal Geomorphology
- E-6 Fluvial Geomorphology
- E-7 Watershed Management
- E-8 Biogeography
- E-13 Remote Sensing and Forest Ecology
- E-14 Applications of GIS in Coastal Processes
- E-15 Ecology of Marine Environment
- E-16 Landscape and Disaster Management

Pre requisite: For courses E-5 and E-6, a student must have a student must have successfully completed courses in Physical Geography and Basic Geomorphology. For Courses E+13 and E-14, a student must have a student must have successfully completed courses in Basic Remote Sensing and GIS.

Any student aspiring to earn extra credits should get due approval from the Head of the Department.

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Research and Consultancy

Research and Consultancy is one of the key strengths of the department. Over the last five years, the following research and consultancy activities have been carried out in the department:

• Major Research Projects

- i. Tourism and Socio- cultural Impacts: A study of selected Tourist Destinations of Salcete, Goa sponsored by ICSSR. (2012 2014); Chief Investigator: Dr. Nandkumar N. Sawant
- ii. "Goa: Socio-cultural Transformations and Adaptations in the Post Liberation Era" sponsored by UGC (2012-2014), Chief Investigator: Dr. Nandkumar N. Sawant
- iii. Development of GPS Collar for Wildlife Study, funded by Chowgule Education Society (2010 -12), Chief Investigator: Dr. Sanjay Gaikwad
- iv. Assessment of Carbon Stock and Carbon Sequestration Scenario through Land Use Change in the State of Goa, sponsored by University Grants Commission, New Delhi (2015-2017), Chief Investigator: Dr. Sanjay Gaikwad

• Minor Research Projects

i. Velips in Goa – their society, problems and prospects" funded by University Grants Commission, Chief Investigator: Mrs. Anagha Bicholcar

• Consultancy

- i. 2010-11: Study of Climate Change & Impact on rural Masses: Maharashtra, for Peaceful Society
- ii. 2014: Socio-Economic Survey (Impact of Mining in Goa) for Department of Town & Country Planning, Goa
- iii. 2016: Field Techniques and Village Survey for The IIS University, Jaipur, Rajasthan
- iv. 2011: GIS Software Training Programme on "Basic and Advanced Course in ArcGIS Desktop" under Hydrology Project Phase II for Water Resources Department, Ponda, Goa
- v. 2011: "Retrieving and Transferring data from MS-DOS to AutoCAD" for Department of Forest, Working Plan Division, Ponda, Government of Goa
- vi. 2012: Summer Training Programme in Geospatial technologies and Applications under NRDMS Programme in DST funded by Ministry of Science and Technology, New Delhi
- vii. 2012: "Village Information System" for Surla and Velgeum Village of Bicholim Tahsil, Goa funded by Goa Mineral Ore Exporter's Association, Panaji, Goa

- viii. 2012: "DGPS Survey and Digitization of Mining Leases" for SESA Goa Ltd., funded by Directorate of Mines and Geology, Government of Goa
- ix. 2012: "Plantation along the Mangroves at the Proposed site of Yacht Haven (Goa) Pvt. Ltd., along Zuari River near Sankavale site, Funded by Yacht Heaven Goa Pvt. Ltd, Goa
- x. 2013: Emergency Escape Route for Disaster Management for Parvatibai Chowgule College, Margao, Goa
- xi. 2014: Winter Training Programme in Geospatial Technology and Applications under NRDMS Programme in DST funded by Ministry of Science and Technology, New Delhi
- xii. 2015: Winter Training Programme in Geospatial Technology under NRDMS Programme in DST funded by Ministry of Science and Technology, New Delhi

Graduate Attributes in Geography

The curriculum uses Choice Based Credit System framework. It has Core Course, Skill Enhancement Course, Elective - Discipline Specific and Elective - Generic Courses. The core courses cover key areas of geography about which all students should have basic knowledge. These courses are grouped as follows:

- i) **Theory** These courses build up the theoretical and conceptual foundations of geography.
- ii) **Practical** Every course has a practical component which is equal to 1 credit (25 marks)
- iii) **Fieldwork and institutional visits** are an integral part of practical component in all the courses in Geography. It helps to strengthen the methodological and practical foundations of geography.
- iv) Regional Approach courses like Basics of Regional Geography, Participatory Rapid Appraisal Techniques, Regional Geography of India, Geography of Rural Settlements, Geography of Urban Settlements, Fundamentals of Economic Geography, Introduction to Regional Planning, Geography of Population Growth focus regional aspects.
- v) **Application Oriented** This includes Socio-Economic Survey, Field Survey in Physical Geography, Rapid Appraisal Techniques, Computer in Geography, Quantitative Techniques in Geography, Geography of Tourism.

At the end of the three year gradation, the students are expected to have the following attributes.

- a) Conceptual clarity in the subject.
- **b**) Ability to apply the conceptual knowledge to day to day activities/real time events
- c) Research and analytical aptitude
- d) Team work skill and team dynamics management skills
- e) Soft skills- oratory skills, public speaking skills, writing skills, personal grooming, mannerisms and work place etiquettes
- f) Ability to work independently

Qualification Descriptors for B.Sc. Programme in Geography

- a) The qualification descriptors for the B.Sc. programme in Geography shall have the learning attributes such as field knowledge, use of advance tools and techniques for better comprehension of space and society etc.
- b) It also involves awareness among the students regarding the issues of different regions and socio-cultural aspects.
- c) The main qualification descriptors for the geography B.Sc students are to develop the critical evaluation and understanding.
- d) Demonstrate systematically geographical knowledge and understanding the theoretical as well as practical applications with understanding of various aspects.
- e) Demonstrate the ability to understand the significance of geographical aspects in relation to development of the regions and minimizing regional inequalities.
- f) Demonstrate the ability and geographical thinking critically regarding rural and urban spaces and their day to day problems with the application of geographical knowledge.
- g) Students have to demonstrate their geographical knowledge acquired in the class and apply the same in real world.
- h) Recognise the scope of geography in terms of exploring the career opportunities.
- i) Employment and life-long engagement in teaching and utilise the knowledge for publication for the future academic endeavours.
- j) The students have to develop the ability through the theoretical and practical means for realising the Sustainable Development Goals (SDG) both in rural and urban spaces to minimize the inequalities in developmental aspects.



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Programme Learning Outcome (PLO)

Name of the Department : Bachelor of Science in Geography

Programme	Short Title of	Description of the	Mapping	
Outcomes	the PLOs	Programme Outcomes	(achievements	of outcome of the
(PLO)		Graduates will be able to :	curse)	
			Course Code	COs No
PLO-1	Problem	Think critically, identify,	GEG-I.C-1	CO1, CO5,
	Analysis and	analyze problems/ situations	GEG-I.C-2	CO1, CO4
	Solutions	and further attempt to	GEG-II.C-3	C01
		design/ develop solutions	GEG-II.C-4	CO3
		that meet the specified goals.	GEG-III.SC-	CO1,CO2
			5	
			GEG-SE-1	CO1
			GEG-SE-2	CO4
			GEG-SE-4	CO1,CO2
			GEG-IV.SC-	CO1,CO2
			6	
			GEG-SE-5	CO1,
			GEG-SE-6	CO1
			GEG-SE-7	CO1, CO2, CO5
			GEG-V.SC-7	C01,
			GEG-SE-9	CO1
			GEG-SE-11	CO1
			GEG-VI.SC-	CO1, CO5
			8	
			GEG-SE-14	CO2
			GEG-SE-15	CO1
PLO-2	Use of	Apply appropriate IT tools	GEG-I.C-1	CO3
	Technology	efficiently in their daily	GEG-III.SC-	CO3,CO4
		activities of communication	5	
		and academics.	GEG-SE-1	CO2,CO3
			GEG-SE-2	CO1,CO2,
			GEG-SE-5	CO4
			GEG-SE-6	CO3
			GEG-SE-7	CO3, CO4
			GEG-SE-9	CO3,CO4
			GEG-SE-11	CO2, CO3
			GEG-SE-12	CO1,CO4
			GEG-SE-13	CO1,CO2,CO3,CO4
			GEG-SE-14	CO1,
			GEG-SE-15	CO4

PLO-3	Environment	Analyze and attempt	GEG-I.C-1	CO2
	and	solutions to environmental	GEG-I.C-2	CO2,CO3
	Sustainability	issues and commit	GEG-II.C-4	CO1.
		themselves to sustainable	GEG-III.SC-	CO4
		development in the local/	5	
		national and global context.	GEG-IV.SC-	CO4
			6	
			GEG-SE-5	CO2
			GEG-SE-7	CO6
			GEG-V.SC-7	CO2,CO3 CO4
			GEG-SE-9	CO2
			GEG-VI-SC-	CO2,CO3,CO4
			8	
			GEG-SE-14	CO4
PLO-4	Ethics	Recognize and understand	GEG-II.C-3	CO2
		professional ethics /human		
		values and be responsible for		
		the same.		
PLO-5	Individual and	Function effectively at	GEG-SE4	CO3,CO4,CO5,
	Team work	various levels, capacities and	GEG-SE-14	CO3
		situations.		
PLO-6	Communication	Communicate proficiently	GEG-SE-11	CO4,CO5
		(oral and written) as a		
		responsible member of		
		society.		
PLO-7	Research	Understand general research	GEG-II.C3	CO3,CO4,CO5
	Aptitude	methods and be able to	GEG-II.C4	CO2,
		analyse, interpret and derive		CO4,CO6,CO7
		rational conclusions.	GEG-SE1	CO4, CO5
			GEG-SE2	CO3
			GEG-IV.SC6	CO3
			GEG-SE5	CO3
			GEG-SE6	CO2,CO4,CO5
			GEG-SE-12	CO2,CO3
			GEG-SE-15	CO2,CO3,
PLO-8	Life Skills	Recognize the need for, and	GEG-I.C1	CO4
		have the preparation and	GEG-II.C4	CO5
		ability to engage in	GEG-SE-12	CO5
		independent and life-long		
		learning in the broadest		
		context of domain specific		
		change.		

Parvatibai Chowgule College of Arts And Science (Autonomous) Department Of Geography Three Year B.Sc. Degree Course in Geography Course Structure Updated On 16th March 2020

SEMESTER	CORE COMPU	LSORY	CORE ELECTIVE			
Ι	GEG-I.SC1: Introduction to Geography	GEG-I.SC2: Fundamentals of Physical Geography				
II	GEG-II.SC3: Basics of Human Geography	GEG-II.SC4: Basics of Regional Geography				
III	GEG-III.SC5: Fundamentals of Remote Sensing and GIS		GEG-SE1: Spatial Analysis	GEG-SE2: Raster and Vector Data Models in GIS	GEG-SE3: Participatory GIS	GEG-SE4: Applied GIS
IV	GEG-IV.SC6: Fundamentals of Geomorphology		GEG-SE5: Coastal Geomorphology	GEG-SE6: Fluvial Geomorphology	GEG-SE7: Watershed Management	GEG-SE8: Biogeography
V	GEG-V.SC7: Introduction to Climatology		GEG-SE9: Geography of Soil Studies	GEG-SE10: Agro- Meteorology: Principles and Applications	GEG-SE11: Field Survey in Physical Geography	GEG-SE12: Quantitative Techniques in Geography
VI	GEG-VI.SC8: Ecology and Terrestrial Environment		GEG-SE13: Remote Sensing and Forest Ecology	GEG-SE14: Advanced Coastal Geomorphology	GEG-SE15: Ecology of Estuarine Environment	GEG-SE16: Disaster Management: Urban and Coastal

Course Description

Geography curriculum inculcates knowledge of essential concepts of physical and human geography together with appropriate techniques using lectures, tutorials, group discussions, presentations, assignment evaluation, lab work and field visits. Thus, pedagogy process includes:

- Identifying and explaining the physical and cultural characteristics globally and processes at varied spatio-temporal contexts.
- Acquire cartographic skills
- Critically analyze various processes that take place in lithosphere, hydrosphere, atmosphere
- Understand the regional dimensions and dynamics
- Understanding human-environment and nature-society interactions as well as various global environmental challenges.
- Responding towards the global and national challenges and initiatives.

Program specific Learning outcomes (PSLO)

Program Sprcific Learning	Short Title of PSLOs	Description of the program outcomes	Cours	se outcome mapping	TLE
outcome (PSLO)					
PSLO 1	Acquire Basic skills in Geographical domain	Understand Fundamental Concepts in different domains of Geography (Physical, Human,	CO1	GEG-I.SC1, GEG- I.SC2, GEG-II.SC3, GEG-III.SC5, GEG-IV.SC6, GEG- SE7, GEG-V.SC7, GEG-SE9, GEG- SE11, GEG-VI.SC8, GEG-SE5, GEG-	Classroom interaction discussion written test Assignment Model making worksheet/puz
		Regional)	CO2	SE6, GEG-SE15, GEG-SE7, GEGSE-	zies Online
			CO3	14, GEG-SE7, GEG- V SC7	open book
			CO4	GEG-I.SC1	Semester end
			CO5	GEG-VI.SC8	examination
			CO6		
			CO7		
PSLO2	Mapping Skills	Develop	CO1		Session wise
		and Computer	CO2	SE6, GEG-1.SC2, GEG-	assessment Base map
		skills	CO3	GEG-I.SC1, GEG- I.SC2, GEG-II.SC4, GEG-SE5,	preparation Selection of suitable
			CO4	GEG-II.SC3,	cartographic
			CO5		techniques
			CO6		based
					mapping Graphical representation of data Map Layout
PSLO3	Analytical and	Be able to do	CO1	GEG-SE9, GEG-	Field work
	problem solving skills	Spatial analysis, identification of suitable site, locational advantages and decision	CO2 CO3	SE14, GEG-SE12GEG-I.SC1, GEG-II.SC4, GEG-V.SC7, GEG-SE15,GEG-IV.SC6, GEG-VI.SC8, GEG-SE14,	Surveying Pre-field preparation Assignment Written test Field
		making	1CO4	GEG-LSC2 GEG-	verification

After successful completion of a Bachelor's Science degree in Geography, the student will:

				II.SC3, GEG-	and ground
				II.SC4, GEG-	truthing
				IV.SCS6, GEG-SE-	Error
				6,	identification
			CO5	GEG-SE6,	and
			CO6		rectification
			CO7		
PSLO4	Application of	Correlate	CO1	GEG-SE1, GEG-	Handling
	Geo-informatics	knowledge of		SE13,	software
		GIS in real	CO2	GEG-III.SC5, GEG-	Use of
		time issues.		SE1, GEG-SE11,	remotely
				GEG-SE13	sensed data
			CO3	GEG-III.SC5, GEG-	Handling
				SE1, GEG-SE13,	hardware
			CO4	GEG-III.SC5, GEG-	Data
				SE2, GEG-SE7,	collection
				GEG-SE15,	Using mobile
			CO5		technology
			CO6		Web
			CO7		application
					Use of open
					source
					software
PSLO5	Use & apply	Acquire	CO1	GEG-II.SC4, GEG-	sample
	geographical	knowledge and	GOO	SE2,	collection and
	knowledge in	technique to	CO2	GEG-II.SC3, GEG-	testing
	addressing man	solve the	000	SE5, GEG-SE12	S011
	interface	challenging	CO3	GEG-SE9, GEG-	w aler
	Interface	issues of man	<u>CO1</u>	SEII, GEG-SEIS,	Piodiversity
		relationships	C04	GEG-V.SC/	Conservation
		relationships.	COS	GEG-SE/,	Environmenta
			C06		l impact
			0/		assessment
					CRZ mapping
					and analysis
PSLO6	Develop	Develop a	CO1		Analysis of
	analytical	process-based	CO2	GEG-IV.SC6,	Land, water,
	ability for	understanding		GEG-VI.SC8,	forest, animal
	Resource	of resources		GEG-SE2,	biodiversity
	management	(water, soil,	CO3	GEG-SE2, GEG-	Environmenta
		flora and		SE12,	l impact
		fauna)	CO4	GEG-SE1, GEG-	assessment
				SE9, GEG-SE11,	Conservation
				GEG-SE13, GEG-	Reclamation
				SE14, GEG-SE12,	management
			CO5	GEG-SE11,	
			CO6	GEG-SE7,	

				CO7		
PSLO7	Hands of	n	Have an ability	CO1	GEG-SE4	GPS
	experience to	0	to	CO2	GEG-SE4,	DGPS
	use		independently	CO3	GEG-SE4	Digital
	geographical		handle field	CO4	GEG-SE4, GEG-	surveying
	tools &	k	and survey		SE5,	Mapping
	equipment		instruments	CO5	GEG-SE1, GEG-	Change
			and prepare		SE4, GEG-IV.SC6,	detection
			maps and field	CO6		Problem
			reports.	CO7		identification

10. (a) Teaching Learning Processes

Learning Outcomes based Curriculum Framework (LOCF) for geography incorporates dynamic processes including fundamental and modern techniques, contemporary paradigms such as global initiatives like Sustainable Development Goals (SDGs), Disaster Risk Reduction (DRR), Paris Climate Action and national initiatives like smart cities, food security, water security, energy security, biodiversity, disaster management, human health and wellbeing and livelihood security.

The approaches are to make geography more scientific and societal-need oriented that could be the panacea of India's development. Geography uses scientific knowledge with the present focus that includes spatio-temporal analysis, skill development, GIScience, sustainable development and human security.

Learning is a challenging, engaging, and enjoyable activity. Learners should be encouraged to engage in a rigorous process of learning and self-discovery by adopting a highly focused and yet flexible approach to education.

- Each day learners should be encouraged to focus on key areas of the course and spend time on learning the course fundamentals and their application in life and society.
- In teaching and learning pedagogy, there should be a shift from domain or conclusions based approach to the experiential or process based approach.

Geography curriculum inculcates knowledge of essential concepts of physical and human geography together with appropriate techniques using lectures, tutorials, group discussion, presentation, assignment evaluation, lab work and field visits. Thus, pedagogy process includes:

- Identifying and explaining the physical and cultural characteristics globally and processes at varied spatio-temporal contexts.
- Understanding human-environment and nature-society interactions as well as various global environmental challenges.
- Analysing geographic information by using geo-spatial technologies.
- Responding towards the global and national initiatives.

Broad framework for teaching in the class includes:

1. Theory courses should have 3 hours per week for courses carrying 4 credits.

2. Practical courses should have 2 hours per week.

In order to achieve its objective of focused process based learning and holistic development, the Institution/University may use a variety of knowledge delivery methods:

10 a(i). Lectures

Lectures are designed to provide the learners with interesting and fresh perspectives on the subject matter. Lectures are interactive in a way that students work with their teachers to get new insights in the subject area, on which they can build their own bridges to higher learning.

10 a(ii). Discussions

Discussions are critical components of learning, and are used as a platform for students to be creative and critical with old and new ideas. Besides developing critiquing skills, arriving at

consensus on various real life issues and discussion groups lead to innovative problem solving and, ultimately to success.

10 a(iii). Life Skills:

Life skills provide students opportunities to understand real life situations and scenarios (i.e. coping with disaster), and solve challenges in a controlled environment or make use of them in simulating cultural experiences by locating/transposing them in new (local, regional, national and international) situations.

10 a(iv). Case Studies:

Case studies, wherever possible, are encouraged in order to challenge students to find creative solutions to complex problems of individual, community, society and various aspects of knowledge domain concerned.

10 a(v). Team Work

Positive collaboration in the form of teamwork is critical in the classroom environment, for which it is necessary to transcend one's prejudices and predilections so as to achieve the desired outcomes. In the process of teamwork, learners will acquire the skills of managing knowledge acquisition and other collaborative learners, thereby understanding how to incorporate and balance personalities.

10 a(vi). Study Tours/Field Visits:

Study Tours/ Field trips provide opportunities to the learners to test their in-class learning in real life situations as well as to understand the functional diversity in the learning spaces. These include visits to sites of knowledge creation, preservation, dissemination and application.

10 a(vii). Academics-Industries Interface:

The course curriculum of B.Sc. encourages students for closer interaction with industries/corporate/research institutes, etc. for at least 120 hours (4 Credits) internship and training.

10 (b) Assessment Methods:

The assessment of students' achievement in geography is aligned with course/program learning outcomes and the academic and geographical skills that the program is designed to be developed. Different assessment methods that are appropriate within the discipline of geography are used. Learning outcomes are measured through continuous evaluation using the oral and written examinations, cartographic and computer based exercises (GIS), practical assignments, observations of practical skills, project and field work reports, seminar presentations and viva voce.

Activities of The Department

Students Activities

• Inter-collegiate Geography Event "Geographize"

'Geographize' is a unique one-day geography event in the state of Goa, organized to promote geography as a subject and encourage interaction between geography students of various colleges. Usually organized around September, Geographize is a platform for students to exhibit their geographical skills through various activities like treasure hunt using geographical instruments, Quiz competition, Poster making, Model making, skit, Documentary making, Map Jig-saw and many more. Colleges and Universities in and around Goa, participate in this event.











Academic Exchange Programme, Sri Lanka

The Academic Exchange Programme, which is open to students and faculty of social sciences, is organized in two phases: one, wherein, faculty and students from one or more Universities of Sri Lanka, visit our college or allied institutes, and, second, wherein, students and faculty from our college visit the Universities in Sri Lanka. The primary objective is to provide an opportunity to understand the socio-cultural life, tourism, rural development and other aspects in Sri Lanka and also to foster academic relationship between the two countries. One of the main highlights of the Exchange Programme is the Indo-Sri Lankan Conference, which provides a platform for the students and faculty to present their research papers at international level.







• Collaborative Research, Fieldwork and other Activities under MoU's with University of Rajasthan, Jaipur; Gogate Jogalekar College, Ratnagiri, Maharashtra, Mother Care Hospital, Margao, Goa, Goa Institute of Public Administration and Rural Development (GIPARD), Ela, Old Goa, University of Kelaniya, Sri Lanka, University of Sri Jayewardenepura, Sri Lanka

• World Population Day

World Population Day is observed every year on 11th July to create awareness about population growth and related issues. Various competitions and activities are organized as part of the event.

• Hiroshima-Nagasaki Day

Understanding the need to sensitize students to global and national issues and help them become responsible members of the society, Hiroshima-Nagasaki day is observed since 2002, every year in August, to bring forth the issue of human disaster that occurred in 1945 in Japan and subsequently the contemporary issues that are happening around us. The event is a tribute to the victims of Hiroshima and Nagasaki atomic bombings.



• "Geographia" – Department Newsletter

Department publishes an in-house bi-monthly newsletter which publishes articles about recent geographical events and reports departmental activities.

• AGES (Association of Geography Ex-students)

AGES is an effort to stay connected with our ex-students and their progress in their respective fields of career. Also, members of AGES contribute to the betterment of the department by instituting scholarships to the disadvantaged and meritorious students.

• Organization & Participation in various Seminars, Conferences, Workshops & training Programmes

Department of Geography organizes various Seminars, Conferences, Workshops & training Programmes at State, National and International levels for two main reasons: one is to interact with researchers worldwide. And second, to encourage students and faculty to exhibit their research and presentation skills and also to share views and

opinions on related themes. Similarly, training programmes and workshops help students to acquire and hone their knowledge about recent geographical domains.

• Special Lectures by Guest Faculties

Department invites academicians and experts from renowned institutes to conduct special lectures for Geography students.

• Activities conducted by Geography Club GLOBE (Geographers Loving our Beautiful Environment)

The Geography club organizes various activities for students to create awareness about environmental issues and help students to appreciate and care for the environment. Monsoon Trek is one such event that is organized on the first Sunday of August every year.

• Surveys, Field Trips and Study Tours

Geography is not just about classroom learning. An active Geographer is the one who learns to apply the geographical skills in real world. Surveys, Fieldtrips and Study Tours provide that opportunity and make learning geography, a fun-filled experience.

• Consultancies & Extension Activities

Consultancies and Extension services are offered by the department to help individuals or organizations to achieve innovation and objectives in related geographical fields.

Syllabus for Autonomous Courses In Geography Bachelor of Science Updated On 16th March 2020

Semester I CORE Course Title: Introduction to Geography (Theory) Course Code: GEG-I.SC1 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To acquaint the students with distinctiveness of Geography as a field of learning.
- 2. The philosophy of the subject is to be taught in order to develop a keen interest in the subject and to pursue it for higher studies.

Course outcomes: At the end of this course, students will be able to:

- CO1: Understand fundamental concepts and dichotomies in geography
- **CO2:** Analyze the interrelationships among fundamental concepts of geography
- **CO3:** Acquire Basic cartographical skills such as basic elements of map and map reading, area measurements, time calculation
- **CO4:** Differentiate and evaluate different domains of geography

Unit No.	Course Content	No. of hours
Ι	Introduction of Geography	
	Definition, Meaning, nature and scope of geography; Major divisions	1.5
	of geography	15
	Major themes in Geography - location, region, process, spatial	
	interaction and time.	
II	Introduction to Geosphere: I	
	Atmosphere: Meaning &Definitions-Composition& Structure of	
	Atmosphere, Elements of Weather & Climate and their inter-relation.	15
	Biosphere & Nanosphere	
	Major Natural regions of world	
	Introduction to Geosphere: II	
	Lithosphere: Evolution of Earth, Geological Time scale.	
111	Orders of Relief (I, II, III), oceans and continents, classification of	
	mountains, plateau and plains	15
	Hydrosphere: Hydrological Cycle	1.5
	Spatial distribution of water on earth.	
		45

References:

Mandatory:

1. Goh Cheng Leong (2003): Certificate Physical and Human Geography, Oxford university press, New Delhi

Supplementary:

- 1. Dikshit R.D (2004): The Arts, Science of Geography, Integrated Readings Prentice Hall of India, New Delhi
- 2. Lal. D. S. (2007): Climatology, Pushtak Mahal, Allahabad
- 3. Das Gupta and Kapoor (2013): Principles of Physical Geography, S. Chand & Company Pvt. Ltd.
- 4. Singh Savindra (2005): Environmental Geography, Prayag Pustak Bhavan, Allahabad

Web-based:

- 1. https://player.uacdn.net/lesson-raw/7B40WVPQTFRB0H1UF10H/pdf/7647790894.pdf
- 2. https://scied.ucar.edu/atmosphere-layers
- 3. https://d43fweuh3sg51.cloudfront.net/media/assets/wgbh/tdc02/tdc02_doc_biomesummar y/tdc02_doc_biomesummary.pdf
- 4. https://www.researchgate.net/publication/225491377_The_early_evolution_of_the_planet __earth_and_the_origin_of_life
- 5. https://www.nap.edu/resource/12161/origin_and_evolution_of_earth_final.pdf
- 6. https://www.researchgate.net/publication/315125743_THE_HYDROLOGIC_CYCLE

CORE Course Title: Measurement Systems in Geography (Practical) Course Code: GEG-I.SC1 Marks: 25 Credits: 01 Duration: 15 sessions of 2 hours each

Uni Title **Practical sessions** t I 1. Scales and its types: 10 a. Verbal Statement. b. Representative Fraction. 2. Linear scalea. Simple and comparativeb. time and distance 3. Identification of location and extension based on latitude and longitudes. 4. Grid reference system. 5. Finding directions. 6. Calculation of time based on longitude 7. Calculation of area by square method 8. Preparation of map - Title, Scale, Legend, Direction, Π 05 Signs and symbols, lettering and colour scheme. III Journal 15

References:

Mandatory:

1. Misra, R.P. and Ramesh, A., (2005): Fundamentals of Cartography, Concept Pub. Co., New Delhi

Supplementary:

- 1. Campbell, J.(2004) Introductory Cartography, Prentice Hall, Inc Englewood
- 2. Monkhouse, I.J. and Wilkinson, H.R., (2009): Maps and Diagram, B.I. Publication, New Delhi
- 3. R. P Mishra. (2014) Fundamentals of Cartography, Concept Pub. Co., New Delhi
- 4. Gopal Singh. (2014), : Map Work and Practical Geography, 4th Edition, Sterling Book House Mumbai

Web-based:

- 1. http://groundwater.fullerton.edu/Maps,_Scale,_GIS_and_GPS/Guide_to_Map_Scale.html
- 2. https://www.timeanddate.com/geography/longitude-latitude.html
- 3. https://www.youtube.com/watch?v=ei5FAinKXoY
- 4. https://www.mathopenref.com/squarearea.html
- 5. http://www.fao.org/economic/the-statistics-division-ess/world-census-of-agriculture/conducting-of-agricultural-censuses-and-surveys/chapter-5-cartographic-preparation/en/

CORE Course Title: Fundamentals of Physical Geography (Theory) Course Code: GEG-I.SC2 Marks: 75 Credits: 3 Duration:45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. The course aims to introduce fundamental concepts of physical geography.
- 2. The course focuses of various spheres of the earth and their related concepts.

Course Outcomes: At the end of this course, students will be able to:

- CO1: Understand fundamentals of physical geography
- **CO2:** Apply techniques to represent different relief features
- CO3: Interpret the characteristics and associate with other relief features
- CO4: Analyze and interpret climate data

Unit	Course Content	No. of hours
No.		
Ι	Concept and Nature: Introduction to physical geography	15
	Recent developments in physical geography.	
	Layers of the Earth: Lithospheric system: Interior of the	
	earth. Layering of the earth- Mechanical layering and	
	chemical layering. Weathering and mass movement, Rocks	
	and its types. Soil- definition and profile.	
II	Basic concepts of climatology: Definition and scope of	15
	climatology	
	Insolation, factors affecting Insolation and Heat budget.	
	Temperature, atmospheric pressure, wind, and humidity	
III	Introduction to oceanography- Definition, Development of	15
	oceanography as a discipline, Significance and scope of	
	oceanography	
		45

References:

Mandatory:

- 1. Bloom, Arthur L., 2008: Geomorphology A Systematic Analysis of Late Cenozoic Landforms, Prentice Hall, Engle Wood Cliff, New Jersey.
- 2. Dayal, P. (2nd edition) 2006: A Textbook of Geomorphology, Shukla Book Depot, Patna
- 3. Strahler, A.N., 2005: Physical Geography, 3rd Ed., Wiley Publications
- 4. Singh, S. 2005: Physical Geography, Prayag Pustak Bhawan, Allahabad
- 5. Lal, D.S , 2004: Oceanography, Prayag Pustak Bhavan, Allahabad

Supplementary:

- 1. Ahmed, E., 2005: Geomorphology, Kalyani Publishers, New Delhi
- 2. Sharma, V.K., 2006: Geomorphology, Earth Surface, Process and forms, Tata McGraw Hill, New York
- 3. Thornbury, W.D., 1969: Principles of Geomorphology, 2nd Ed., Wiley International Edition, Wiley Eastern Reprint, 2004
- 4. Wooldridge, S.W. and Morgan, R.S., 2008: The Physical Basis of Geography, Longman (First published in 1937)
- 5. Worcestor, P.G., 2005: A Textbook of Geomorphology, Van Nostrand, 2nd Ed., East West Edition, New Delhi.
- 6. Chorley, Richard J., 2002: Spatial Analysis in Geomorphology, Harper and Row Publishers, New York, London.
- 7. Sharma, H.S. (ed), 2002: Perspective in Geomorphology, Vol. I & IV, Concept, New Delhi.
- 8. Sharma, V.K., 2006: Geomorphology, Earth Surface Processes and Forms, Tata Mc. Graw Hill, New Delhi.
- 9. Sparks, B.W., 2000: Geomorphology, Longman, London, 2nd edition.

Web-based:

- 1. https://www.nationalgeographic.org/media/earths-interior/
- 2. https://www.nationalgeographic.org/encyclopedia/rock-cycle/
- 3. http://www.geo.hunter.cuny.edu/~fbuon/GEOL_231/Lectures/Weathering%20and%20M ass%20Wasting%20Part%202.pdf
- 4. http://ncert.nic.in/textbook/pdf/kegy209.pdf
- 5. https://www.ukessays.com/essays/geography/history-significance-oceanography-9589.php

CORE Course Title: Fundamentals of Physical Geography (Practical) Course Code: GEG-I.SC2 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical Sessions
Ι	1. Methods of Representation of Relief features	10
	a. Spot Heights,	
	b. Bench Marks.	
	c. Triangulation mark	
	2. Contours diagrams for slopes with cross sec	ctions-
	gentle slope, steep slope, concave and convex slo	ope,
	3. Contours diagrams for hills, plateaus, cliff,	
	4. Contours diagrams for V-shaped valley, wat	erfall,
	rapids, river terraces	
	5. Profile Drawing from contour diagram.	
	a. Serial	
	b. Superimposed	
	c. composite	
Π	6. Calculation of mean, average, range of temperate	ıre. 5
	7. Calculation of lapse rate and Relative Humidity.	
III	Journal	
		15

References:

Mandatory:

- 1. Chorley, Richard. J. (ed.), 2009: Water, Earth and Man, Methuen & Co., London
- 2. King, C.A.M., 2006: Techniques in Geomorphology, Edward Arnold, London
- 3. Monkhouse, F.J. and Wilkinson, H.R., 2009: Maps and Diagrams, B.I. Publications Pvt. Ltd., New Delhi
- 4. Singh, R.L. and Singh Rana P.B., 2008, Elements of Practical Geography, Kalyani Publishers, New Delhi

Supplementary:

- 1. Goudie, Andrew, et al. (eds), 2001: Geomorphological Technique, George Allen & Unwin, London
- 2. Gregory, K.J. and Walling, D.E., 2003: Drainage Basin Form and Process, Edward Arnold, London
- 3. Leopold, L.B, Wolman, M.G. and Miller, J.P., 2004: Fluvial Processes in Geomorphology, Freeman, San Francisco
- 4. Misra, R.P. and Ramesh, A., 2009: Fundamentals of Cartography, Concept Publishing Co., New Delhi

Web-based:

- 1. http://www.brainkart.com/article/Methods-of-Representing-Relief-Features_33844/
- 2. https://www.slideshare.net/gauravlath1997/contour-diagrams
- 3. https://geo.libretexts.org/Bookshelves/Ancillary_Materials/Laboratory/Book%3A_Labor atory_Manual_For_Introductory_Geology_(Deline%2C_Harris_and_Tefend)/03%3A_T opographic_Maps/3.6%3A_Drawing_Contour_Lines_and_Topographic_Profiles
- 4. https://sciencing.com/calculate-mean-annual-temperature-7236109.html
- 5. https://eesc.columbia.edu/courses/ees/climate/lectures/atm_phys.html

Semester II

CORE Course Title: Basics of Human Geography (Theory) Course Code: GEG-II.SC3 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. The course provides the basic conceptual framework of Human Geography.
- 2. It focuses on cultivating basic knowledge through understanding and analysis of the fundamental concepts in Human geography.

Courses Outcomes: At the end of this course, students will be able to:

- **CO1:** Understanding of fundamental concepts of Human Geography
- **CO2:** Understand and analyze human related issues in societies
- **CO3:** Develop an understanding of basic quantitative techniques used in Human geography
- **CO4:** Collect, process and analyze socio economic data
- **CO5:** Visually illustrate population data

Unit	Торіс	No. of hours
Ι	Concept and Nature: Meaning, Scope and Development of Human	
	Geography.	15
	Basic principles-Principle of Activity or Change, Principle of	
	Terrestrial Unity or whole. Approaches in human geography	
	(humanistic, scientific, welfare and behavioral)	
II	Society and Culture Evolution of man (Australopithecus, Homo	
	Erectus, Homo sapiens. Man's spread over the earth during the	15
	Pleistocene). Culture- meaning and components. Language and	
	religion. (Classification, distribution, issues and challenges.)	
	Contemporary social problems: Gender disparity and related issues	
	Ethnicity and the related issues. (Case study of India).	
III	Indicators of Development: L.D.C. and M.D.Csocial, economic	
	and demographic.	15
	(Distribution and Density. Concepts of under population, over	
	population, age and gender composition. Fertility, mortality,	
	migration, Ageing population.)	
	Demographic transition.	
		45

Note: The course should focus on basic conceptual aspects.

References: Mandatory:

- 1. Hussain, M. (2004) Human Geography. Rawat Publication. New Delhi.
- 2. H.J De Blij, Alexander B. Murphy, Erin H. Fouberg (2007) *Human Geography: People, Place and Culture.* John Wiley and sons. USA.

Supplementary:

- 1. Panigrahi P.K. (2011) *Human Geography-Landscape of Human Activities*. Murari Lala and sons. New Delhi.
- 2. Sharma Y.K. (2007) Human Geography. Lakshmi Narain Agrawal, Agra.
- 3. Rubenstein J M (2010) Contemporary Human Geography. PHI learning Pvt., New Delhi.
- 4. Chandna, R.C. (2006) Geography of Population. Kalyani Publishers. New Delhi
- 5. Hagget, P. (2002) Geography: A Modern Synthesis. Harper & Row, New York
- 6. De Blij, H.J., Human Geography, Culture, Society and Space, John Wiley, New York, 2006
- 7. Fellman, J.L. Human Geography-Landscapes of Human Activities, Brown and Bench man, Pub. U.S.A. 2007.
- 8. Arun Kumar Sharma, 2012: Principles of Human Geography, Rastogi Publications, Meerut

Web-based:

- 1. https://researchguides.dartmouth.edu/human_geography
- 2. https://freegeobook.files.wordpress.com/2009/01/0761942637.pdf
- 3. https://www.britannica.com/science/human-evolution
- 4. https://ourworldindata.org/economic-inequality-by-gender
- 5. https://pages.uwc.edu/keith.montgomery/Demotrans/demtran.htm

CORE Course Title: Basics of Human Geography (Practical) Course Code: GEG-II.SC3 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit. Title **Practical sessions** Ι Calculation and interpretation of: 8 1. Fertility measures: Crude Birth Rate, General Fertility Rate 2. Mortality measures: Crude Death Rate, Infant Mortality Rate. 3. Age data Analysis: Age and gender composition 4. Construction of Population Pyramid 5. Literacy measures: Crude Literacy Rate. Π 7 Gross Enrolment Ratio. **6.** Work Participation Ratio. 7. Per capita income 8. GDP III Journal and viva 15

References:

Mandatory:

- 1. Bose, Ashish et. al., 2004: Population in India's Development, Vikas Publishing House, New Delhi
- 2. Chandna, R.C. Geography of Population: Concept, Determinants and Patterns, Kalyani Publishers, New York 2000.

Supplementary:

- 1. Bogue, D. J., 2001: Principles in Demography, John Wiley, New York
- 2. Census of India, 2001, India: A State Profile
- 3. Crook, Nigel, 2007, Principles of Population and Development. Pergmon Press, New York.
- 4. Daugherty, Helen Gin, Kenneth C.W. Kammeryir (2008) An Introduction to Population (Second Edition). The Guilford Press, New York, London
- 5. Mitra, Asok, 2008, India's Population. Aspects of quality and Control Vol. I & II. Abhinar Publication. New Delhi.
- 6. Srinivsan, K. and M. Vlassoff, 2001. Population Development Nexus in India: Challenges for the New Millennium. Tata McGraw Hill, New Delhi.
- 7. Srinivasan, K. Basic Demographic Techniques and Applications Sage Publications, New Delhi 2008.
- 8. UNDP, 2000: Human Development Report Oxford University Press, Oxford.
- 9. United Nations, 2004, Methods for Projections of Urban and Rural Populations. No. VIII, New York.
10. Woods, R., 2009: Population Analysis in Geography, Longman, London.

11. Sawant & Athavale, 2005: Population Geography, Mehta Publishing House, Pune.

Web-based:

- 1. https://ourworldindata.org/fertility-rate
- 2. https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3130
- 3. https://censusindia.gov.in/census_and_you/gender_composition.aspx
- 4. https://www.britannica.com/topic/population-pyramid
- 5. https://censusindia.gov.in/Census_Data_2001/India_at_glance/workpart.aspx

CORE Course Title: Basics of Regional Geography (Theory) Course Code: GEG-II.SC4 Marks: 75 Credits: 3 Duration:45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. The course aims to develop a basic understanding of the regions and recognizing the significance of geography in shaping region.
- 2. It helps students to appreciate regional unique dimensions of regions.

Course Outcomes: At the end of this course, students will be able to:

- CO1: Understand Fundamental concepts of regional geography
- **CO2:** Apply techniques of regionalization
- **CO3:** Differentiate among different regions spatial organization and areal variation in human activities.
- **CO4:** Develop an understanding of basic quantitative techniques used in regional geography.
- **CO5:** Develop the skill of calculation of different indicators of development.
- **CO6:** Diagrammatically represent and interpret regional data
- **CO7:** Represent and interpret characteristics of various regions.

Unit	Title	No.	of
		hours	
Ι	Concept of Region in Geography: Definition and characteristic		
	The Regional Approach - area, region, space	15	
	Factors of regionalization		
	ii) Methods of Regionalization- methods of delineation of region, types		
	of regions,		
II	i.) Foundations of Region - Ecological, Economic, Social and		
	Cultural Dimensions	15	
	ii.) Federalism-center – state relationships.		
	iii.) Core – Periphery		
	iv.) Hierarchy of regions,		
	v.) Regional Consciousness and Identity.		
	vi.) The Regional issues. (Two case studies)		
III	Study of Regional Organization: Their evolution, functions and inter-		
	linkages.	15	
	Globalization and the New Territorial Order.		
		45	

References:

Mandatory:

- 1. Singh, R.L., 2001 (ed): India A Regional Geography, National Geographical Society, India
- 2. Paul Claval, 2003, An Introduction to Regional Geography, , Rawat Publication, Jaipur & Delhi

Supplementary:

- 1. Cole, J. 2000: A Geography of the World's Major Regions, Routledge, London
- 2. Israel, S. Johnson, D.I. and Wood, D., 2005: World Geography Today
- 3. Jackson, R.H. and Hudman, L.E, 2007: Regional Geography: Issues for Today.
- 4. Wheeler, J.H. Jr. and Kostbade, J.T., (1990): World Regional Geography, Holt Rinshort and Winston, Inc
- 5. Holier, G.P., 2008: Regional Development in Michael Pacione (ed), *The Geography of the 3rd World: Progress & Prospects*, Rutledge, London, New York.
- 6. Jackson, R.H. and Hudmar, L.E. 2004: Regional Geography: Issues for Today
- 7. Paul Claval (2008) An Introduction to Regional Geography, Wiley-Blackwell, ISBN 155786733X.

Web-based:

- 1. https://shodhganga.inflibnet.ac.in/bitstream/10603/39734/12/12_chapter%202.pdf
- 2. https://issuu.com/rengasamy/docs/regional_planning_part_ii_types_of_regions___regio
- 3. https://www.insightsonindia.com/2014/11/13/regionalism-dimensions-meaning-issues/
- 4. https://link.springer.com/chapter/10.1007/978-3-319-18971-0_7
- 5. https://www.longdom.org/open-access/from-globalization-to-regionalism-and-interregionalism-a-study-ofsaarc-2332-0761-1000279.pdf
- https://institutdelors.eu/wpcontent/uploads/2018/01/regionalism_globalgovernance_t.behrj.jokela_ne_july2011_01.pdf

CORE Course Title: Basics of Regional Geography (Practical) Course Code: GEG-II.SC4 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Торіс	Practical	Marks
		Sessions	
Ι	Methods of Regional Demarcation:	08	10
	1. Demarcation of agricultural regions (crop combination and		
	diversification)		
	2. Gravity model,		
	3. Breaking point Analysis,		
	4. Sphere of Urban Influence		
	5. Population potential surfaces		
II	6. Network Analysis	07	10
	7. Nearest Neighbor index,		
	8. Centro graphic analysis		
III	Journal and viva		05
		15	25

References:

Mandatory:

1. Hegget Peter, Cliff A.D. et. al. (2001) Locational Methods, Locational Analysis in Human Geography, Vol. II Arnold – Heinemann Pub. (India)

Supplementary:

- 1. Hegget Peter, Cliff A.D. et. al. (2000) Locational Models, Locational Analysis in Human Geography. Vol. I Arnold Heinemann Pub. (India)
- 2. Chandna R.C. (2003): Regional Planning: A Comprehensive Text, Kalyani Publishers, Ludhiana

Web-based:

- 1. https://www.thoughtco.com/reillys-law-of-retail-gravitation-1433438
- 2. https://www.geographyforyou.com/2019/09/maximum-positive-deviation-crop.html
- 3. http://www.fao.org/3/x6906e/x6906e06.htm
- 4. https://shodhganga.inflibnet.ac.in/bitstream/10603/10376/9/09_chapter%201.pdf
- 5. https://karnataka.pscnotes.com/main-notes/paper-iii-general-studies-ii/urban-spheres-of-influence-and-rural-urban-fringe/
- 6. https://transportgeography.org/?page_id=623
- 7. https://www.geoib.com/nearest-neighbor-index.html
- 8. https://rashidfaridi.com/2017/09/14/centrographic-techniques/
- 9. http://www.geodz.com/eng/d/population-potential/population-potential.htm

Semester III CORE Course Title: Fundamentals of Remote Sensing and GIS (Theory) Course Code: GEG-III.SC5 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce key concepts of Remote Sensing and GIS.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand the basic science of remote sensing
- **CO2:** Interpret and analyze remotely sensed data.
- **CO3:** Carry out photogrammetric observations and calculate area, height, depth and changes in the same.
- CO4: Understand interaction of EMR with Earth surface materials

Unit	Title	No. of hours
Ι	Concepts of Remote Sensing , Introduction to remote sensing	15
	system, stages-Electromagnetic Radiation, theories of radiation	
	and its components: Characteristics of Electromagnetic Spectrum	
	Energy	
	Types of Remote sensing	
	Introduction to Sensors and platforms	
II	Interactions with Earth's atmosphere and surface features;	15
	Spectral response of Earth's natural surface.	
	Resolution	
	Aerial Photography:- Types, Error In Flying, Geometry, Scale,	
	Relief Displacement, Stereoscopes Parallax	
III	Visual Interpretation of Satellite Images and Aerial	15
	Photographs :	
	Elements of Image interpretation, Interpretation of Multi-Spectral	
	Imagery, Identification of Earth Surface Features	
	Levels of interpretation	
		45

References:

Mandatory:

- 1. Lillesand T.M. and Kiefer R.W., (2002) Remote Sensing and Image Interpretation, John Wiley and Sons, New Delhi.
- 2. George Joseph (2005) Fundamentals of Remote Sensing, University press Private Ltd, Hyderabad.
- 3. J. R. Jensen, (2003) Remote Sensing of Environment, An Earth Resource Perspective, Pearson Education Pvt. Ltd., New Delhi.

Supplementary:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
- 3. Kang tsung Chang, (2002) Introduction to Geographical Information System, , McGraw Hill.
- 4. P. A. Burrough and R. A. McDonnell, (2000) Principles of Geographical Information System, , Oxford University Press.
- **5.** Paul A. Lonfley, et al.(2002), Introduction to Geographic Information Systems and Science, John Wiley and Sons Ltd

Web Based:

- 1. <u>https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/remote-sensing-tutorials/fundamentals-remote-sensing-introduction/9363</u>
- 2. https://nptel.ac.in/courses/105/108/105108077/
- 3. https://crisp.nus.edu.sg/~research/links/rs-tut.html
- 4. http://www2.geog.ucl.ac.uk/~mdisney/teaching/PPRS/
- 5. https://gisgeography.com/remote-sensing-of-the-environment/

CORE Course Title: Fundamentals of Remote Sensing and GIS (Practical) Course Code: GEG-III.SC5 Marks: 25 Credits: 01 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Determination of scale, coverage, area, distance and height.	07
	Determination of parallax using mirror stereoscope.	
	Interpretation of Aerial Photographs & Satellite images	
II	Visual interpretation of aerial photo and satellite imageries	08
	Identification of physical and cultural features using elements	
	of interpretation and their verification and ground truthing	
	Levels of interpretation-1 & 2	
III	Journal	
		15

References:

Mandatory:

- 1. Lillesand T.M. and Kiefer R.W., (2002) Remote Sensing and Image Interpretation, John Wiley and Sons, New Delhi.
- 2. George Joseph (2005) Fundamentals of Remote Sensing, University press Private Ltd, Hyderabad.
- 3. J. R. Jensen, (2003) Remote Sensing of Environment, An Earth Resource Perspective, Pearson Education Pvt. Ltd., New Delhi.

Supplementary:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
- 3. Kang tsung Chang, (2002) Introduction to Geographical Information System, , McGraw Hill.
- 4. P. A. Burrough and R. A. McDonnell, (2000) Principles of Geographical Information System, , Oxford University Press.
- 5. Paul A. Lonfley, et al.(2002), Introduction to Geographic Information Systems and Science, John Wiley and Sons Ltd

Web Based:

- 1. <u>https://www.nrcan.gc.ca/maps-tools-publications/satellite-imagery-air-photos/remote-sensing-tutorials/fundamentals-remote-sensing-introduction/9363</u>
- 2. https://nptel.ac.in/courses/105/108/105108077/
- 3. <u>https://crisp.nus.edu.sg/~research/links/rs-tut.html</u>
- 4. http://www2.geog.ucl.ac.uk/~mdisney/teaching/PPRS/
- 5. https://gisgeography.com/remote-sensing-of-the-environment/

ELECTIVE Course Title: Spatial Analysis (Theory) Course Code: GEG-SE1 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce the fundamentals of spatial analysis through pattern recognition, interpolation, locational and topographical analysis.

Course Outcomes:

At the end of this course, students will be able to:

- CO1: Differentiate between spatial and attribute data using GIS software
- CO2: Process raster data in raster processing software

- CO3: Process vector data in GIS
- CO4: Acquire the skills of spatial analysis
- CO5: Prepare topographic models and study morphometric properties of terrain

Unit	Торіс	No. of hours
Ι	Introduction to Spatial Analysis: concepts, functions of spatial	15
	analysis	
	Characteristics, importance of geo-data base	
	Topology and types	
	Concept and sources of Spatial and Non-Spatial Data	
II	Concept and methods of spatial Interpolation.	20
	Raster analysis.	
	Overlay analysis.	
III	Topographic Analysis: Digital Elevation Model, Slope, Aspect,	10
	Flow Accumulation, Flow Direction etc.	
		45

References:

Mandatory:

- Alias A. Rahman and Morakot Pilouk (2008) Spatial Data Modeling for 3D GIS, Springer New York
- 2. Thurston, J., Poiker, T.K. and J. Patrick Moore. (2003). Integrated Geospatial Technologies: A Guide to GPS, GIS, and Data Logging. Hoboken, New Jersey: Wiley.

Supplementary:

- 1. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005). Geographic Information Systems and Science. Chichester: Wiley. 2nd edition.
- 2. M Goodrich (2000). Data Structures and Algorithms in Java, 2nd Edition Wiley.
- 3. Malczewski, J. (1999). GIS and Multicriteria Decision Analysis. New York: John Wiley and Sons
- 4. Ott, T. and Swiaczny, F. (2001). Time-integrative GIS. Management and analysis of spatio-temporal data. Berlin / Heidelberg / New York: Springer.

- 1. https://www.usna.edu/Users/oceano/pguth/md_help/html/mapb38f5.htm
- 2. https://www.researchgate.net/publication/311953089_An_integrated_algorithm_to_evalu ate_flow_direction_and_flow_accumulation_in_flat_regions_of_hydrologically_correcte d_DEMs
- 3. https://www.slideshare.net/RohitKumar431/topology-in-gis
- 4. http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture07/concepts/ 07%20-%20Topology.htm
- 5. https://www.slideshare.net/SumantDiwakar/spatial-vs-non-spatial

ELECTIVE Course Title: Spatial Analysis (Practical) Course Code: GEG-SE1 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hour each

Unit	Торіс	Practical
		Sessions
Ι	Vector Operations (Single Layer): Dissolve, Buffer, Multi Ring	10
	Buffer. Vector Operations (Multi Layer): Clip, Erase, Merge,	
	Intersect.	
	Raster Operations: clip and mosaic (Extract By Mask).	
	Spatial Queries and Non-Spatial Queries based on locations	
II	Interpolation: Inverse Distance Weighted method	05
	Topo to Raster.	
	Overlay Operations (Point in Polygon, Line in Polygon, Polygon	
	in polygon).	
III	Journal	-
		15

References:

Mandatory:

- 1. Alias A. Rahman and Morakot Pilouk (2008) Spatial Data Modeling for 3D GIS, Springer New York
- 2. Thurston, J., Poiker, T.K. and J. Patrick Moore. (2003). Integrated Geospatial Technologies: A Guide to GPS, GIS, and Data Logging. Hoboken, New Jersey: Wiley.

Supplementary:

- 1. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005). Geographic Information Systems and Science. Chichester: Wiley. 2nd edition.
- 2. M Goodrich (2000). Data Structures and Algorithms in Java, 2nd Edition Wiley.
- 3. Malczewski, J. (1999). GIS and Multicriteria Decision Analysis. New York: John Wiley and Sons
- 4. Ott, T. and Swiaczny, F. (2001). Time-integrative GIS. Management and analysis of spatio-temporal data. Berlin / Heidelberg / New York: Springer.

Web Based:

- 1. https://mgimond.github.io/Spatial/spatial-operations-and-vector-overlays.html
- 2. https://onlinelibrary.wiley.com/doi/10.1002/9781118826171.ch9
- 3. http://webhelp.esri.com/arcgisdesktop/9.2/index.cfm?TopicName=How_Inverse_Distanc e_Weighted_(IDW)_interpolation_works
- 4. https://mgimond.github.io/Spatial/spatial-interpolation.html
- 5. https://webapps.fundp.ac.be/geotp/SIG/interpolating.pdf

ELECTIVE Course Title: Raster and Vector Data Models in GIS (Theory) Course Code: GEG-SE2 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To introduce basic concepts and principles of GIS and emphasize on the role of raster and vector data models.
- 2. To introduce students to data processing, transformation and visualization of data using various models.

Course Outcomes

At the end of this course, students will be able to:

- **CO1:** Integrate raster and vector data models and also appreciate the role of these models in visualizing graphical outputs through GIS.
- CO2: Process & interpolate using 2D and 3D raster and vector data.
- CO3: Perform network analysis and cluster analysis.
- CO4: Understand projections and use it for spatial data presentation in GIS

Unit	Title	No.	of
		hours	
Ι	GIS Concepts, Principles, Geospatial Data Models, Organization of GIS	15	
	Data and System Functionality, Map Projections, Coordinate Systems		
	and Transformations.		
II	Fundamentals of Raster data models, metadata and data exchange	15	
	2D and 3D raster data models		
	Fundamentals of raster maps, Raster data transformation		
III	Vector data	15	
	Basics of vector data and Generation of vector data, fundamentals of		
	Vector map queries and statistics,		
	Basics of Point analysis		
	Basics of Network analysis		
		45	

References:

Mandatory:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
- 3. Kang tsung Chang, (2002) Introduction to Geographical Information System, , McGraw Hill.
- 4. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005). Geographic Information Systems and Science. Chichester: Wiley. 2nd edition.

Supplementary

- 1. Markus Neteler and Helena Mitasova (2008) OPEN SOURCE GIS, A GRASS GIS Approach (Third Edition) Springer, USA
- 2. McCartney Taylor, Nik Freeman (2014) Getting Started With GIS Using QGIS (Kindle Edition) McCartney Taylor.

- 1. https://mgimond.github.io/Spatial/index.html
- 2. https://www.esri.com/content/dam/esrisites/en-us/media/pdf/teach-with-gis/raster-faster.pdf
- 3. https://gisgeography.com/spatial-data-types-vector-raster/
- 4. https://www.gislounge.com/geodatabases-explored-vector-and-raster-data/
- 5. https://support.pitneybowes.com/SearchArticles/VFP05_KnowledgeWithSidebarHowTo? id=kA18000000Cu9DCAS&popup=false&lang=en_US
- 6. https://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/what-is-raster-data.htm

ELECTIVE Course Title: Raster and Vector Data Models in GIS (Practical) Course Code: GEG-SE2 Marks: 25 Credits: 1 Duration: 15 Sessions of 2 hour each

Unit	Title	Practical sessions
Ι	Import of raster data,	8
	Coordinate transformation,	
	Raster map algebra	
	Raster data transformation and interpolation	
	Spatial analysis with raster data	
II	Vector Data generation	7
	Network Analysis	
	Cluster analysis	
	Transformations to Raster(vectorization - rasterization)	
	Spatial Interpolation.	
III	Journal	
		15

References:

Mandatory:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
- 3. Kang tsung Chang, (2002) Introduction to Geographical Information System, , McGraw Hill.
- 4. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005). Geographic Information Systems and Science. Chichester: Wiley. 2nd edition.

Supplementary

- 1. Markus Neteler and Helena Mitasova (2008) OPEN SOURCE GIS, A GRASS GIS Approach (Third Edition) Springer, USA
- 2. McCartney Taylor, Nik Freeman (2014) Getting Started With GIS Using QGIS (Kindle Edition) McCartney Taylor.

- 1. https://mgimond.github.io/Spatial/index.html
- 2. <u>https://www.esri.com/content/dam/esrisites/en-us/media/pdf/teach-with-gis/raster-faster.pdf</u>
- 3. https://gisgeography.com/spatial-data-types-vector-raster/
- 4. https://www.gislounge.com/geodatabases-explored-vector-and-raster-data/
- 5. <u>https://support.pitneybowes.com/SearchArticles/VFP05_KnowledgeWithSidebarHowTo?</u> <u>id=kA18000000Cu9DCAS&popup=false&lang=en_US</u>
- 6. https://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/what-is-raster-data.htm

ELECTIVE Course Title: Participatory GIS (Theory) Course Code: GEG-SE3 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To expose students to applications of GIS in the context of community and people's participation.
- 2. To enhance Geographical Information through shared knowledge and information.

Course Outcomes:

At the end of this course, students will be able to:

- CO1: Understand the concepts of PRA, P-GIS pGIS, Pgis
- **CO2:** Develop the skill of data management and community mapping
- **CO3:** Prepare a community resource inventory (any two case studies)
- **CO4:** Evaluate the role of local people in developing and maintaining the community resources

Unit	Title	No. of hours
Ι	Participatory Geographic Information Systems	15
	Concepts and Methods, History (PRA, P-GIS pGIS Pgis)	
	Ethics, Partnership, role and responsibility of the scientist.	
	Methodology for Pgis, implementation and limitations of the	
	participation	
	Methods, Techniques, advantages of community mapping.	
	Data management. Features of interest for socio-economic	
	analysis and social development skills and training requirements.	
	P-GIS and the livelihoods approach.	
II	Contribution of P-GIS through Community Mapping in Water	15
	Resource Inventory.	
	Urban and Peri-Urban Partnership and Community	
	Empowerment	
	Community Resource Mapping in Forest, Agriculture and Water	
	Resources Management:	
	Bridging the Divide between Community and Government	
	Voluntary Information and PGIS (VI & PGIS)	
III	Neo-geography and GIS/2 : value addition to P-GIS	15
	Needs of Participatory GIS.	
	Perspectives on Participatory mapping and PGIS	
		45

References

Mandatory:

- Abbot, J., Chambers, R., Dunn, C., Harris, T., Merode, E. d., Porter, G., Townsend, J.,Weiner, D., de Merode, E., (1998). 'Participatory GIS: opportunity or oxymoron?' PLA Notes33. IIED: Londo
- 2. Elwood, Sarah (2006) Participatory GIS and Community Planning: Restructuring Technologies, Social Processes, and Future Research in PPGIS Collaborative Geographic Information Systems edited by Shivanand Balram and Suzana Dragicevic, Idea Group Inc. University of Arizona, USA

Supplementary:

- 1. Elwood, Sarah (2006), Critical Issues in Participatory GIS: Deconstructions, Reconstructions, and New Research Directions Transactions in GIS, 10(5): 693–708
- McCall, Michael K. (2004) Can Participatory-GIS Strengthen Local-level Spatial Planning? Suggestions for Better Practice. Dept. of Urban & Regional Planning and GeoInformation Management ITC. Course prepared for: GISDECO 2004 Skudai, Johor, Malaysia, 10-12 May (2004)
- Quan, Julian, Oudwater, Nicoliene, Pender, Judith and Martin, Adrienne (2001)GIS And Participatory Approaches In Natural Resources Research. SOCIO-ECONOMIC METHODOLOGIES FOR NATURAL RESOURCES RESEARCH BEST PRACTICE GUIDELINES. Published by Natural Resources Institute, The University of Greenwich 2001
- 4. Minang, Peter A. and McCall, Michael K. (2006) Participatory GIS and local knowledge enhancement for community carbon forestry planning: an example from Cameroon. Participatory Learning and Action.

- 1. https://www.participatorymethods.org/method/participatory-geographical-informationsystems-pgis
- 2. https://vimeo.com/channels/pgis
- 3. http://www.ppgis.net/about-pgis/
- 4. <u>http://www.iapad.org/wp-</u> content/uploads/2015/07/ppgis_the_future_of_environmental_gis.pdf
- 5. <u>https://pages.uoregon.edu/schlossb/articles/schlossberg_brehm_PGIS_active_transportation2.pdf</u>
- 6. https://www.involve.org.uk/resources/methods/participatory-gis

ELECTIVE Course Title: Participatory GIS (Practical) Course Code: GEG-SE3 Marks: 25 Credits: 1 Duration: 15 Sessions of 2 hour each

Unit	Title	Practical Sessions
Ι	Data processing and computing indices	5
	Linear Model & Linear Combination Method (LCM)	
	Assessment Index (AI)	
	Employment index (M)	
	Education index (E)	
	Health index (S)	
	Housing index (H)	
	Infrastructure index	
	The Principal Component Analysis Method (PCAM)	
	Marginality Index (MI)	
	Human Development Index	
II	Case study of any one of the following (mini project)	10
	Water Resource Inventory	
	Urban and Peri-Urban Agriculture	
	Forest and Water Resources Management	
	Using software like GRASS (Geographic Resources	
	Analysis Support System) and ILWIS (Integrated Land and	
	Water Information System)	
III	Project report	
		15

References

Mandatory:

- Abbot, J., Chambers, R., Dunn, C., Harris, T., Merode, E. d., Porter, G., Townsend, J.,Weiner, D., de Merode, E., (1998). 'Participatory GIS: opportunity or oxymoron?' PLA Notes33. IIED: Londo
- 2. Elwood, Sarah (2006) Participatory GIS and Community Planning: Restructuring Technologies, Social Processes, and Future Research in PPGIS Collaborative Geographic Information Systems edited by ShivanandBalram and SuzanaDragicevic, Idea Group Inc. University of Arizona, USA
- 3. Françoise Orban-FeraugeV.Aguilar, E. Alarcon, A. Carmona, N. Daix, B. Denil, A. Ignacio, J. Martinez, M. McCall, G.Miscione, E. Olivarez, M. Pandan. G. Rambaldi, R. Teruel, J. Verplanke participatory geographic information systems and land planning life experiences for people empowerment and community transformation, Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA) Wageningen, The Netherlands

Supplementary:

- 1. Elwood, Sarah (2006), Critical Issues in Participatory GIS: Deconstructions, Reconstructions, and New Research Directions Transactions in GIS, 10(5): 693–708
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- 3. Quan, Julian, Oudwater, Nicoliene, Pender, Judith and Martin, Adrienne (2001)*GIS And Participatory Approaches In Natural Resources Research*. SOCIO-ECONOMIC METHODOLOGIES FOR NATURAL RESOURCES RESEARCH BEST PRACTICE GUIDELINES. Published by Natural Resources Institute, The University of Greenwich 2001
- 4. Minang, Peter A. and McCall, Michael K. (2006) Participatory GIS and local knowledge enhancement for community carbon forestry planning: an example from Cameroon. Participatory Learning and Action.

- 1. https://www.participatorymethods.org/method/participatory-geographical-informationsystems-pgis
- 2. https://vimeo.com/channels/pgis
- 3. http://www.ppgis.net/about-pgis/
- 4. <u>http://www.iapad.org/wp-</u> <u>content/uploads/2015/07/ppgis_the_future_of_environmental_gis.pdf</u>
- 5. <u>https://pages.uoregon.edu/schlossb/articles/schlossberg_brehm_PGIS_active_transportation2.pdf</u>
- 6. https://www.involve.org.uk/resources/methods/participatory-gis

ELECTIVE Course Title: Applied GIS (Theory) Course Code: GEG-SE4 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce various recent application of GIS in business, society, transportation and spatial planning.

Course Outcomes:

At the end of this course students will be able to:

- **CO1:** Correlate knowledge of GIS in business applications
- **CO2:** Understand the applications of GIS in socio-economic planning.
- **CO3:** Use GIS to address local problems and suggest realistic spatial solutions
- CO4: Understand applications of GIS in transport and network planning

CO5: Understand and apply spatial modeling to real time situations.

Unit	Title		of
		hours	
Ι	Geo-business	15	
	Retail Application of Spatial Modelling to Solve: Retail Location		
	Problems, Location Based Services for Mobile Applications		
	Mass Appraisal Model, Lifestyle Segmentation Profiles,		
	Neighbourhood Model, Housing Price Mass Appraisal Model.		
II	Social Application: Assessing Clusters of Deprivation in City	15	
	Regions, GIS for Joined up Government		
	Spatial Statistical Methods to the Detection of Geographical		
	Patterns of Crime		
	Transport and Location: Demand Responsive Passenger		
	Transport Services, Strategic Land Use / Transportation Model,		
	Relocation of Facilities.		
	Probability Based GIS Model.		
III	Spatial Planning	15	
	Modelling Migration, Modeling Regional Economic Growth,		
	Carrying Capacity, Planning Network of Site, Assessing Service		
	Provision,		
		45	

References:

Mandatory:

1. Stillwell, John and Clarke, Graham (2004) Applied GIS and Spatial Analysis (Ed). John Willy and Sons LTD England

Supplementary:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
- 3. Kang tsung Chang, (2002) Introduction to Geographical Information System, , McGraw Hill.
- 4. P. A. Burrough and R. A. McDonnell, (2000) Principles of Geographical Information System, , Oxford University Press.
- 5. Paul A. Lonfley, et al.(2002), Introduction to Geographic Information Systems and Science, John Wiley and Sons Ltd

- 1. https://www.esri.com/en-us/arcgis/products/arcgis-storymaps/albums/applied-gis
- 2. <u>https://mgimond.github.io/Spatial/introGIS.html</u>
- 3. <u>https://publishing.monash.edu/epress/ag/index.html</u>
- 4. <u>https://scholar.harvard.edu/files/dell/files/090110combined_gis_notes.pdf</u>
- 5. https://dash.harvard.edu/bitstream/handle/1/27007691/Applying%20GIS%20Methods.pdf ?sequence=3&isAllowed=y

ELECTIVE Course Title: Applied GIS (Practical) Course Code: GEG-SE4 Marks: 25 Credits: 1 Duration: 15 Sessions of 2 hour each

Unit	Title	Practical Sessions
Ι	Spatial Modelling: Land Use transformation model and	8
	Transportation Model, Neighboring Model (NNI)	
II	Spatial Statistic: Cluster Analysis, Crime Pattern Analysis,	7
	Mass Appraisal	
III	Journal	
		15

References:

Mandatory:

1. Stillwell, John and Clarke, Graham (2004) Applied GIS and Spatial Analysis (Ed). John Willy and Sons LTD England

Supplementary:

- 1. C.P. Lo and Albert K. W. Yeung, (2002) Concepts and Techniques of Geographic Information System, Prentice –Hall, India.
- 2. Heywood I. (2011) An Introduction to Geographical Information Systems, Pearson Education Pvt. Ltd., New Delhi.
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- 1. https://www.esri.com/en-us/arcgis/products/arcgis-storymaps/albums/applied-gis
- 2. https://mgimond.github.io/Spatial/introGIS.html
- 3. https://publishing.monash.edu/epress/ag/index.html
- 4. https://scholar.harvard.edu/files/dell/files/090110combined_gis_notes.pdf
- 5. https://dash.harvard.edu/bitstream/handle/1/27007691/Applying%20GIS%20Methods.pdf ?sequence=3&isAllowed=y

Semester IV

CORE Course Title: Fundamentals of Geomorphology (Theory) Course Code: GEG-IV.SC6 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To provide the fundamentals of geomorphology.
- 2. To focus on application of geomorphological knowledge to resolve the challenging issues of man environment relationships.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand fundamentals of geomorphology.
- CO2: Analyze soil properties.
- **CO3:** Understand the concepts and processes of geomorphic landforms.
- **CO4:** Develop the skill of comparative analysis of slope development and their effect on human activities.
- **CO5:** Understand application of geomorphology in various fields.

Unit	Title	No. of hours
Ι	Geomorphic concept : major geomorphic concept	18
II	Slope development theory. Davis and Penck.	
	Aeolian landforms: Erosional & Depositional.	12
	Glacial Landforms: Erosional and Depositions	
III	Application of Geomorphology:	
	• Mining	
	Hazard management	15
	• Agriculture	
	Environmental management	
		45

References:

Mandatory:

- 1. Bloom, Arthur L., 2008: Geomorphology A Systematic Analysis of Late Cenozoic Landforms, Prentice Hall, Engle Wood Cliff, New Jersey.
- 2. Dayal, P. (2nd edition) 2006: A Textbook of Geomorphology, Shukla Book Depot, Patna
- 3. Strahler, A.N., 2005: Physical Geography, 3rd Ed., Wiley Publications
- 4. Singh, S. 2005: Physical Geography, Prayag Pustak Bhawan, Allahabad
- 5. Chorley, Richard J., 2002: Spatial Analysis in Geomorphology, Harper and Row Publishers, New York, London.

Supplementary:

- 1. Ahmed, E., 2005 : Geomorphology , Kalyan Publishers, New Delhi
- 2. Cooke R. U. and Doornkamp J.C. (1989): Geomorphology in Environmental Management, 2nd Edition, Oxford : Clarendon Press
- 3. Sharma, H.S. (ed), 2002: Perspective in Geomorphology, Vol. I & Vol. IV, Concept, New Delhi.
- 4. Sharma, V.K., 2006 : Geomorphology, Earth Surface Processes and Forms, Tata Mc. Graw Hill, New Delhi
- 5. Sharma, V.K., 2006 : Geomorphology, Earth Surface, Process and forms, Tata McGraw Hill, New York
- 6. Sparks, B.W., 2000: Geomorphology, Longman, London, 2nd edition.
- 7. Thornbury W.D, 2001: Principles of Geomorphology, 2nd Ed., Wiley International edition, Wiley Eastern Reprint, 2001
- 8. Wooldridge, S.W. and Morgan, R.S., 2000: The Physical Basis of Geography, Longman.
- 9. Worcestor, P.G., 2005: A textbook of Geomorphology, Van Nostrand, 2nd Ed., East west Edition, New Delhi

- 1. http://shaileshchaure.com/Notes/GEOMCON.pdf
- 2. https://www.iasj.net/iasj?func=fulltext&aId=16936
- 3. https://www.nps.gov/subjects/geology/aeolian-landforms.htm
- 4. https://www.nps.gov/subjects/geology/glacial-landforms.htm
- 5. https://www.researchgate.net/publication/247773175_Geomorphology_Concepts_and_A pplications

CORE Course Title: Fundamentals of Geomorphology (Practical) Course Code: GEG-IV.SC6 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hour each

Unit	Title	Practical sessions
Ι	Identification of rocks and their properties	9
	Soil profile, Soil analysis	
II	Interpretation of geological map, structural landforms (aerial	6
	photo or geological maps): identifications of faults, lineaments,	
	dykes and sills, rock types	
	Identification of Aeolian and Glacial Landforms from toposheet	
III	Journal and viva voce	
		15

References:

Mandatory:

- 1. Bloom, Arthur L., 2008: Geomorphology A Systematic Analysis of Late Cenozoic Landforms, Prentice Hall, Engle Wood Cliff, New Jersey.
- 2. Dayal, P. (2nd edition) 2006: A Textbook of Geomorphology, Shukla Book Depot, Patna
- 3. Strahler, A.N., 2005: Physical Geography, 3rd Ed., Wiley Publications
- 4. Singh, S. 2005: Physical Geography, Prayag Pustak Bhawan, Allahabad
- 5. Chorley, Richard J., 2002: Spatial Analysis in Geomorphology, Harper and Row Publishers, New York, London.

Supplementary:

- 1. Ahmed, E., 2005 : Geomorphology , Kalyan Publishers, New Delhi
- 2. Cooke R. U. and Doornkamp J.C. (1989): Geomorphology in Environmental Management, 2nd Edition, Oxford : Clarendon Press
- 3. Sharma, H.S. (ed), 2002: Perspective in Geomorphology, Vol. I & Vol. IV, Concept, New Delhi.
- 4. Sharma, V.K., 2006 : Geomorphology, Earth Surface Processes and Forms, Tata Mc. Graw Hill, New Delhi
- 5. Sharma, V.K., 2006 : Geomorphology, Earth Surface, Process and forms, Tata McGraw Hill, New York
- 6. Sparks, B.W., 2000: Geomorphology, Longman, London, 2nd edition.
- 7. Thornbury W.D, 2001: Principles of Geomorphology, 2nd Ed., Wiley International edition, Wiley Eastern Reprint, 2001
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- 9. Worcestor, P.G., 2005: A textbook of Geomorphology, Van Nostrand, 2nd Ed., East west Edition, New Delhi

- 1. <u>http://earthsci.org/mineral/rockmin/identification/identification.html</u>
- 2. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308
- 3. https://study.com/academy/lesson/understanding-interpreting-a-geologic-map.html
- $4. \ https://www.nps.gov/subjects/geology/aeolian-landforms.htm$
- 5. https://www.nps.gov/subjects/geology/glacial-landforms.htm

ELECTIVE Course Title: Coastal Geomorphology (Theory) Course Code: GEG-SE5 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To familiarize students about the mechanism of landform development resulting from coastal processes.

Course Outcomes:

At the end of this course, students will be able to:

- CO1: Understand various processes and associated landforms in coastal region
- **CO2:** Learn the methods of coastal hazard management
- **CO3:** Prepare and interpret coastal landscape maps.
- **CO4:** Conduct beach profiling using survey instruments.

Unit	Title	No. of hours
Ι	Introduction to coastal Processes	15
	Waves: Formation, Drifts and Tides. Types of coastlines,	
	Coastal erosion and deposition. Coastal landforms.	
II	Beach Geomorphology: Types and Configuration of beaches	15
	Coastal wetlands.	
	Coral reefs and marine environment.	
III	Coastal Ecosystem Management. Coastal Hazard Management.	15
		45

References:

Mandatory:

- 1. Eric Bird: Coastal Geomorphology: An Introduction, John Wiley & Sons; 1 edition (November 7, 2000),
- 2. Kale, V. S. and Gupta, A. (Rep.2011): Introduction to Geomorphology, Orient Longman, Calcutta.
- 3. Karlekar, S. (2009): Coastal Processes and Landforms: Diamond Publications, Pune
- 4. Ahmed, E., 2005 : Geomorphology , Kalyan Publishers, New Delhi
- 5. Bloom, Arthur L., 2004: Geomorphology A systematic Analysis of Late Cenozoic Landforms, Prentice Hall, engle Wood Cliff, N.J

Supplementary:

- 1. Cooke R. U. and Doornkamp J.C. (1989): Geomorphology in Environmental Management, 2nd Edition, Oxford : Clarendon Press
- Gerhard Masselink , Michael Hughes : An Introduction to Coastal Processes and Geomorphology (Hodder Arnold Publication), ISBN-10: 0340764112 , ISBN-13: 978-0340764114

- 3. Richard Davis Jr., Duncan Fitzgerald : Beaches and Coasts, Wiley-Blackwell; 1st edition (July 15, 2004), ISBN-10: 0632043083, ISBN-13: 978-0632043088
- 4. Timothy Beatley , Anna K. Schwab , David Brower (2002):An Introduction to Coastal Zone Management, Island Press; REV edition

- 1. https://www.nature.com/scitable/knowledge/library/coastal-processes-and-beaches-26276621/
- 2. <u>https://www.marineinsight.com/environment/a-comprehensive-list-of-different-types-of-sea-waves/</u>
- 3. https://geography.name/types-of-coastlines/
- 4. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/coastal-wetland
- 5. <u>http://www.oas.org/cdcm_train/courses/course1/Chapter%204-</u> <u>Coastal%20Hazards%20and%20Vulnerability.pdf</u>

ELECTIVE Course Title: Coastal Geomorphology (Practical) Course Code: GEG-SE5 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Identification of coastal features and processes on SOI toposheet.	05
II	Beach profiling & identification of major and minor coastal	10
	features on beach.	
	Profile of various types of coast.	
	Geomorphic mapping of Coastal Areas.	
III	Journal and Viva	
		15

References:

Mandatory:

- 1. Misra, R.P. and Ramesh, A., 2005: Fundamentals of Cartography, Concept Pub. Co., New Delhi
- 2. Monkhouse, I.J. and Wilkinson, H.R., 2001: Maps and Diagram, B.I. Publication, New Delhi
- 3. Singh, R.L.: Elements of Practical Geography, Kalyani Publishers, New Delhi ,2000

Supplementary:

- 1. Bygot, J.: An Introduction to Map Work and Practical Geography, 2001
- 2. Campbell, J., 2004: Introductory Cartography, Printice Hall, Inc Englewood
- 3. Jackson, R.H. and Hudmar, L.E.: Regional Geography: Issues for today ,2001
- 4. Raisz, E.: General Cartography, McGraw Hills Co., London ,2005
- 5. Robinson, A.H., et al,: Elements of Cartography, John Wiley and Sons, New York, 2003
- 6. Singh, R ; Singh L.R., Mapworks in Practical Geography, Central book Depot, Allahabad,2001

- 1. https://www.nature.com/scitable/knowledge/library/coastal-processes-and-beaches-26276621/
- 2. https://www.brainkart.com/article/Profile-Diagram_33845/
- 3. http://www.jsu.edu/dept/geography/mhill/phylabtwo/lab6/profile.html
- 4. https://www.worldatlas.com/articles/how-many-types-of-beaches-are-there-based-on-composition.html
- 5. http://geomorphology.sbg.ac.at/research/map-symbols/

ELECTIVE Course Title: Fluvial Geomorphology (Theory) Course Code: GEG-SE6 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce students to fluvial landforms and processes.

Course Outcomes:

At the end of this course, students will be able to:

CO1: Understanding the fundamental concepts of river and its processes.

CO2: Prepare drainage map and interpret fluvial landscape.

- **CO3:** Conduct survey for river profiling using instruments.
- **CO4:** Carry out morphometric analysis of a river basin.
- **CO5:** Correlate drainage pattern with structural features.

Unit	Title	No. of hours
Ι	River basin and Drainage Network: River and Stream, Drainage basin	15
	and network characteristics, River Dynamics, Classification, Phases of	
	development, Patterns.	
II	Fluvial processes: Erosion, Transportation and Deposition.	15
	Fluvial cycle and Fluvial landforms.	
III	Applied fluvial geomorphology: Environmental changes and river	15
	metamorphosis.	
	Flood and its impact (case studies)	
		45

Reference Books:

Mandatory:

- 1. Kale, V. S. and Gupta, A. (Rep.2011): Introduction to Geomorphology, Orient Longman, Calcutta.
- 2. Singh, Savindra (Rep. 2011): Geomorphology, PrayagPustakBhawan, Allahabad
- 3. Strahler A. H and Strahler, A. N. (1992) : Modern Physical Geography, John Wiley, New York

Supplementary:

- 1. Chorley, R. J., Schumm, S. A. and Sugden, D. E. (1984): Geomorphology, Methuen, London.
- 2. Fairbridge, R. W. (1968): Encyclopedia of Geomorphology, Reinholdts, New York.
- 3. Goudie, Andrew, S. (2004), Encyclopedia of Geomorphology, 1& 2, Routledge, Taylor & Francis, New York
- 4. Luna Bergere Leopold, Markley Gordon Wolman, John P. Miller (1995): Fluvial Processes in Geomorphology. Dover Publications Inc., New York

- 5. R.J. Small (1989)Geomorphology and Hydrology (Longman modular geography series), Longman Publication, Harlow, Essex, England
- 6. Thomas, S.G. David, (2016) The Dictionary of Physical Geography, 4th Edition, Wiley-Blackwell, New Jersey, USA
- 7. Thornbury, W. D. (Rep.2011): Principles of Geomorphology, John Wiley and Sons, New York.

- 1. <u>https://www.tandfonline.com/doi/full/10.1080/24749508.2018.1525670</u>
- 2. <u>https://www.yourarticlelibrary.com/rivers/rivers-classification-stages-and-meandering/60873</u>
- https://books.google.co.in/books?id=FV3bDwAAQBAJ&pg=PA29&lpg=PA29&dq=gloc k+model+river+development&source=bl&ots=jR5C8fkDTJ&sig=ACfU3U31ZCqJuXhh5N24la5785drbb1IQ&hl=en&sa=X&ved=2ahUKEwiy_Im659PpAhWHYH0KHdzDMEQ6AEwAnoECAYQAQ#v=onepage&q=glock%20model%20river%20developme nt&f=false
- 4. http://www.physicalgeography.net/fundamentals/10z.html
- 5. <u>https://www.chiefscientist.qld.gov.au/publications/understanding-floods/flood-consequences</u>

ELECTIVE Course Title: Fluvial Geomorphology (Practical) Course Code: GEG-SE6 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Preparation of drainage map. Identification and Interpretation of	05
	fluvial landforms, Patterns and processes from SOI toposheet.	
	Slope analysis.	
II	Drainage basin morphometry: Morphometric analysis of drainage	10
	basin.	
	Field visit : river Profiling and to observe fluvial processes	
III	Journal and Viva	
		15

References:

Mandatory:

- 1. Singh, R ; Singh L.R., Mapworks in Practical Geography, Central book Depot, Allahabad, 2001
- 2. Misra, R.P. and Ramesh, A., 2005: Fundamentals of Cartography, Concept Pub. Co., New Delhi
- 3. Robinson, A.H., et al,: Elements of Cartography, John Wiley and Sons, New York, 2003

Supplementary:

- 1. Bygot, J.: An Introduction to Map Work and Practical Geography,2001
- 2. Campbell, J., 2004: Introductory Cartography, Printice Hall, Inc Englewood
- 3. Monkhouse, I.J. and Wilkinson, H.R., 2001: Maps and Diagram, B.I. Publication, New Delhi
- 4. Raisz, E.: General Cartography, McGraw Hills Co., London ,2005
- 5. Singh, R.L.: Elements of Practical Geography, Kalyani Publishers, New Delhi ,2000

- 1. <u>https://www.usgs.gov/special-topic/water-science-school/science/watersheds-and-drainage-basins?qt-science_center_objects=0#qt-science_center_objects</u>
- 2. https://www.tandfonline.com/doi/full/10.1080/24749508.2018.1525670
- 3. <u>https://www.yourarticlelibrary.com/rivers/rivers-classification-stages-and-</u> meandering/60873
- 4. https://www.ijsr.net/archive/v4i7/24071501.pdf
- 5. https://www.internetgeography.net/topics/cross-profiles-of-a-river/

ELECTIVE Course Title: Watershed Management (Theory) Course Code: GEG-SE7 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objective:

- 1. To acquaint students with basic concepts and importance of Watershed Management.
- 2. To help students in understanding various processes that take place and that are involved in a watershed.

Course Outcomes:

At the end of this course, students will be able to:

- CO1: Understand concepts of Watershed Management.
- **CO2:** Develop a process-based understanding of watershed.
- CO3: Understand the methods and techniques of watershed management.
- **CO4:** Relate watershed management using the different methods in GIS.
- **CO5:** Understand hydrological process in watershed
- CO6: Understand various techniques for conservation of watershed management.

Unit	Title	No. of hours
Ι	Introduction to Watershed Management : Definition, Principles, objectives, Need of Watershed Management, Identification of problems in Watershed Management Approaches watershed management	15
II	Characteristics of watershed Runoff, River discharge Sediment load	15
III	HydrologicalProcessinWatershed:EcologicalCharacteristics of the riverSoil management techniques in watershedWatershed Conservation methods.	15
		45

References:

Mandatory:

- 1. Heathcote. W. Isobel , 2009, Integrated Watershed Management : Principles and Practice, 2nd Edition, Hoboken, N.J. : John Wiley & Sons, New Jersey
- 2. Singh Rajvir, 2003, Watershed Planning and Management, 2nd Edition, Yash Publishing House, Bikaner, India

Supplementary:

- 1. Manual of water and soil conservation: Government of India, ICAR
- 2. Manuals of the USDA
- 3. DeBarry. A. Paul, 2004, Watersheds : Processes, Assessment, and Management, Hoboken, N.J. : John Wiley & Sons, New Jersey
- 4. National Watershed Program Manual, The U.S. Department of Agriculture (USDA), Washington, D.C, December, 2009
- 5. Narayana, V.V. Dhruva, 2002, Soil and water conservation research in India, Published by ICAR, New Delhi

- 1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=125296
- 2. https://www.geographynotes.com/watershed-management-2/drainage-basin/areal-aspectsof- drainage-basin-watershed-management-geography/6374
- 3. https://www.geographynotes.com/watershed-management-2/drainage-network/linear-aspects-of-drainage-network-3-aspects-watershed-management/6287
- 4. http://www.keralasoils.gov.in/index.php/2016-04-27-09-26-39/soil-water-conservation-techniques
- 5. https://www.yourarticlelibrary.com/watershed-management/watershed-managementmeaning-types-steps-and-programmes/77309

ELECTIVE Course Title: Watershed Management (Practical) Course Code: GEG-SE7 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical Sessions
Ι	Sediment load analysis	5
II	Measurement and Estimation of Soil Erosion – Revised Universal Soil Loss Equation (RUSLE). Field Visit and Report: visit to watershed (Identification of problems of watershed, soil and water management) Survey, Database Generation.	10
III	Journal and Viva-voce	
		15

References:

Mandatory:

- Heathcote. W. Isobel , 2009, Integrated Watershed Management : Principles and Practice, 2nd Edition, Hoboken, N.J. : John Wiley & Sons, New Jersey
- 2. Singh Rajvir, 2003, Watershed Planning and Management, 2nd Edition, Yash Publishing House, Bikaner, India

Supplementary:

- 1. DeBarry, A. Paul, 2004, Watersheds : Processes, Assessment, and Management, Hoboken, N.J. : John Wiley & Sons, New Jersey
- 2. National Watershed Program Manual, The U.S. Department of Agriculture (USDA), Washington, D.C, December, 2009
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- 1. https://www.geographynotes.com/watershed-management-2/drainage-network/linear-aspects-of-drainage-network-3-aspects-watershed-management/6287
- 2. https://www.yourarticlelibrary.com/watershed-management/watershed-managementmeaning-types-steps-and-programmes/77309
- 3. https://library.wmo.int/doc_num.php?explnum_id=1709s
- 4. https://www.researchgate.net/publication/305841586_Estimation_of_Soil_Erosion_Using _RUSLE_Model_and_GIS_Techniques_for_Conservation_Planning_from_Kulekhani_R eservoir_Catchment_Nepal
- 5. https://support.esri.com/en/technical-article/000012346

ELECTIVE Course Title: Biogeography (Theory) Course Code: GEG-SE8 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objective:

1. To acquaint students with spatial and temporal patterns of biological diversity and the factors that govern the distribution and abundance.

Course Outcomes:

At the end of this course, students will be able to:

- CO1: Understand the concept of biogeography and its evolution
- CO2: Evaluate the role of global organizations and partnerships in protecting biodiversity
- CO3: Analyze the characteristics of biodiversity hotspots (any two)
- CO4: Understand the traditional and modern method of biodiversity conservation
- CO5: Evaluate different social movements of biodiversity conservations in India

Unit	Title	No. of hours
Ι	Concept of Biogeography.	
	Historical evolution of Biogeography.	
	Global patterns of Biodiversity.	18
II	Niche.	
	Speciation and extinction.	
	Accident and invasion.	10
	Endemism, vicariance and conservation.	
	Island biogeography.	
	Zoogeography and its Environmental Relationship.	
	Palaeo botanical and Palaeo Climatological records of environmental	
	change.	
III	Biodiversity hotspots. Forest communities and their distribution.	17
	Conservation- laws and practices. Social Movements of conservation.	
		45

References:

Mandatory:

1. Bhattacharyya, N.N., 2018: Biogeography, Rajesh Publications, New Delhi. **ISBN** : 978-81-85891-50-7

Supplementary:

- 1. Richard John Huggett 2004: Fundamentals of Biogeography (Routledge Fundamentals of Physical Geography), Routledge; 2nd edition
- 2. Mark V. Lomolino, Brett R. Riddle, Robert J. Whittaker, James H. Brown 2010, Biogeography 4th Edition, Sinauer Associates, Oxford University Press
- 3. Glen MacDonald, 2001: Biogeography: Introduction to Space, Time, and Life 1st Edition, Wiley
- 4. Husain, M. (ed)., 1994: Biogeography(Part I & II), Anmol Publications, Pvt. Ltd., New Delhi.
- 5. Singh, Savindra, 2010: Biogeography, Prayag Pustak Bhawan, Allahabad.

- 1. http://www.nyu.edu/projects/fitch/courses/evolution/html/biogeography.html
- 2. https://www.sparknotes.com/biology/evolution/evidence/section2/
- 3. https://study.com/academy/lesson/biogeography-definitions-examples.html
- 4. https://evolution-outreach.biomedcentral.com/articles/10.1007/s12052-012-0421-2
- 5. https://www.geo.arizona.edu/Antevs/ecol438/lect02.html
- 6. http://faculty.washington.edu/timbillo/Readings%20and%20documents/global%20div%2 0patterns%20origins/Gaston%20Nature%20Global%20Biodiv%20patterns.pdf

ELECTIVE Course Title: Biogeography (Practical) Course Code: GEG-SE8 Marks: 25 Credits: 1 Duration: 15 Sessions of 2 hrs each

Unit	Title	Practical Sessions
Ι	Vegetation Map interpretation	
	Biodiversity indexing	
	Biomass analysis	07
	Canopy structure	
	Stock analysis	
II	NDVI	
	Density of tree	
	Plant tress analysis	08
	Disturbance analysis	
III	Journal and viva voce	
		15

References:

Mandatory:

1. Bhattacharyya, N.N., 2018: Biogeography, Rajesh Publications, New Delhi. **ISBN** : 978-81-85891-50-7

Supplementary:

- 1. Richard John Huggett 2004: Fundamentals of Biogeography (Routledge Fundamentals of Physical Geography), Routledge; 2nd edition
- 2. Mark V. Lomolino, Brett R. Riddle, Robert J. Whittaker, James H. Brown 2010, Biogeography 4th Edition, Sinauer Associates, Oxford University Press
- 3. Glen MacDonald, 2001: Biogeography: Introduction to Space, Time, and Life 1st Edition, Wiley
- 4. Husain, M. (ed)., 1994: Biogeography(Part I & II), Anmol Publications, Pvt. Ltd., New Delhi.
- 5. Singh, Savindra, 2010: Biogeography, Prayag Pustak Bhawan, Allahabad.

- 1. https://www.researchgate.net/publication/262061314_Vegetation_Analysis_with_Referen ce_to_Topographic_Variables_using_Remote_Sensing_Data
- 2. https://academic.oup.com/jpe/article/1/1/9/1132900
- 3. https://cyfar.org/sites/default/files/cyfar_research_docs/Biodiversity%20Index.pdf
- 4. <u>https://www.biologydiscussion.com/biodiversity/types/2-types-of-diversity-indices-of-biodiversity/8388</u>
- 5. <u>https://www.researchgate.net/publication/326898794_Biodiversity_Indexes_Value_and_Evaluation_Purposes</u>
- 6. https://www.amnh.org/learn-teach/curriculum-collections/biodiversity-counts/plant-ecology/how-to-calculate-a-biodiversity-index
- 7. https://cid-inc.com/blog/the-forest-canopy-structure-roles-measurement/

Semester V

CORE Course Title: Introduction to Climatology (Theory) Course Code: GEG-V.SC7 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce key concepts of climatology in general and Indian monsoon in details.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand and analyze climatological concepts.
- **CO2:** Interpret and analyze weather and climatic phenomena
- **CO3:** Understand the main patterns of the various types of Earth's climates and the main climate classification schemes
- CO4: Understand the relationships between climate and other forms of environmental changes

Unit	Title	No. of hours
Ι	Fundamental of Atmospheric circulation	15
	Primary, secondary and tertiary circulation	
II	Atmospheric disturbances:	15
	Thermodynamics	
	CAPE and CINE- cloud development and stability, thunderstorm	
	Cyclogenesis – T number (basics of cyclones)	
	Western disturbances, fog, cold waves	
	Koppens Classification of climate	
III	Indian Climatology: Monsoons	15
	Pre monsoon: Cyclone genesis, Cyclonic storms, frequency, intensity,	
	landfall and associated weather.	
	South West monsoon: Onset and advance of southwest monsoon, Semi-	
	permanent features of monsoon, active and break in monsoon. El-Nino	
	and La-Nina.	
	Post monsoon: withdrawal of southwest monsoon, Northeast monsoon,	
	cyclonic storms in the Indian seas, trends in cyclonic disturbances,	
	Easterly waves.	
		45

References:

Mandatory:

- 1. Critchfield, H.J, 1998 : General Climatology, Prentice-Hall
- 2. Lal, D.S., 2011: Climatology, Sharda Pustak Bhavan
Supplementary:

- 1. Barry R.G. and Chorley, R. J., 2009: Atmosphere, Weather and Climate, Routledge
- 2. Bunnett R.B., 1993: Physical geography in Diagrams, Longman
- 3. Monkhouse, F.J., 1975 Principles of Physical Geography, Hodder Murray Publishers
- 4. P. Birot, 1966: General Physical Geography, Longman, Green & Co
- 5. Strahler, A.H., 1983: Modern Physical Geography, John Wiley and Sons
- 6. Strahler A. M. and Strahler A.H., 1983: Elements of Physical Geography, John Wiley and Sons
- 7. Stringer, E.T., 1972: Foundation of Climatology: An Introduction to Physical, Dynamic, Synoptic, and Geographical Climatology, W.H. Freeman & Co. Ltd.
- 8. Tikka R.N., 1998 Physical Geography. KedarNath Ram Nath, Meerut
- 9. Trewartha, G.T., 1968: Introduction to Climate, McGraw-Hill

- 1. https://www.nationalgeographic.org/encyclopedia/climatology/
- 2. https://www.environmentalscience.org/climatology
- 3. <u>https://climate.ncsu.edu/edu/AtmosCirculation</u>
- 4. <u>http://shantashrimsl.yolasite.com/resources/T_5%20-</u>%20Atmospheric%20Disturbances.pdf
- 5. <u>http://www.imdpune.gov.in/</u>
- 6. https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter14_FINAL.pdf

CORE Course Title: Introduction to Climatology (Practical) Course Code: GEG-V.SC7 Marks: 25 Credits: 01 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Representation of weather phenomena using isolines Isohyets map Isotherm map Isobars Representation of wind data Evapotranspiration Determining atmospheric stability (Tephigram) Preparation of weather Station Model. Upper air chart, isotach (wind)	05
II	 Study of weather symbols and IMD weather charts. Interpretation of IMD weather charts (at least 1 map of three seasons) Visit to IMD for hands- on- training: handling of weather instruments, taking readings, temperature, pressure, sunshine chart interpretation and forecasting. 	10
III	Journal and Viva	
		15

References:

Mandatory:

- 1. Singh, R.L. and Singh Rana P.B.(2008), Elements of Practical Geography, Kalyani Publishers, New Delhi
- 2. Strahler, A.N., 2000: Physical Geography, 3rd Ed., Wiley.

Supplementary:

- 1. Campbell, J. (2004), Introductory Cartography, Prentice Hall, Inc Englewood
- 2. Chorley, Richard. J. (ed.), 2001: Water, Earth and Man, Methuen & Co., London
- 3. Khullar.D.R. (2007), Essentials of Practical Geography, New Academic Publishing Co., Jalandher
- 4. Misra, R.P. & Ramesh, A., 2009: Fundamentals of Cartography, Concept Publishing Co., New Delhi
- 5. Monkhouse, F.J. & Wilkinson, H.R., 2009: Maps and Diagrams, B.I. Publications Pvt. Ltd., New Delhi
- 6. Sarkar, Ashis (2000), Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata

- 1. https://www.weather.gov/media/epz/mesonet/CWOP-WMO8.pdf
- 2. <u>http://kejian1.cmatc.cn/vod/comet/mesoprim/tephigram/print_3.php.htm</u>
- 3. <u>https://sites.google.com/site/crisflopt/comunicaes/areas/intrep-sat-images?tmpl=%2Fsystem%2Fapp%2Ftemplates%2Fprint%2F&showPrintDialog=1</u>
- 4. <u>http://www.imdpune.gov.in/training/Observational%20system-IMTC.pdf</u>
- 5. <u>https://metnet.imd.gov.in/imdnews/ar2018.pdf</u>

ELECTIVE Course Title: Geography of Soil Studies (Theory) Course Code: GEG-SE9 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To understand the process of soil formation, development and distribution.
- 2. To equip students with basics of soil structure, composition, content and conservation practices.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Identify and differentiate between various soils profiles and types
- **CO2:** Understand different types of processes of soil formation, characteristics and importance in agricultural practices
- **CO3:** Test the soil properties and quality of collected soil samples using various instruments and prepare lab reports.
- **CO4:** Map various soil types in terms of physical and chemical properties.

Unit	Торіс	No. o	of
		hours	
Ι	Introduction to soil: Concept, soil formation	15	
	Soil water dynamic, Factors affecting soil formation.		
	Soil structure, composition		
	Soil profile, Texture		
II	Soil and organisms - Organic matter of soil, Sources of organic matter	15	
	– Biomass, Termites, worms, ants, algae, fungi, bacteria,		
	Carbon cycle – simple decomposition, Agricultural importance of soils		
	- Nitrogen fixation		
III	Soil Conservation and management	15	
	Soil erosion, degradation and pollution, its sources and impacts : Soil		
	conservation and management practices traditional and modern		
	Case studies		
		45	

References:

Mandatory:

1. Brady Nyle. (2002). The nature and properties of soil. MacMillan Publishing company, USA

Supplementary:

- 1. Foth Henry. (1984). Fundamentals of soil science. John Wiley & Sons, Inc. USA
- 2. Munns Donald and Singer Michael. (1996). Soils An introduction. Prentice-Hall Inc, New Jersey, USA
- 3. Lal R and Stewart B.A. (1990). Advances in soil sciences. Springer-Verlag New York.
- 4. White Robert. (2005). Principles and Practice of Soil Science: The Soil as a Natural Resource, 4th Edition. Wiley & Sons, Inc Blackwell. USA

- 1. <u>https://www.nature.com/scitable/knowledge/library/soil-water-dynamics-103089121/</u>
- 2. <u>http://www.fao.org/3/a0100e/a0100e0d.htm</u>
- 3. <u>https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-</u> Edition/Text-Version/The-Living-Soil/Soil-Microorganisms
- 4. https://www.britannica.com/science/soil-organism
- 5. https://www.soils4teachers.org/biology-life-soil
- 6. https://www.infonet-biovision.org/EnvironmentalHealth/Introduction-soil-conservation-measures

ELECTIVE Course Title: Geography of Soil Studies (Practical) Course Code: GEG-SE9 Marks: 25 Credits: 1 Duration: 15 Sessions of 2 hours each

Unit Topic **Practical sessions** I Field visit: pre field, fieldwork and post fieldwork 10 Sample preparation Soil Test (physical) 1. Moisture content calculation 2. Texture analysis 3. EC Π Soil Test (chemical) 05 1. Soil pH levels 2. Carbon testing Journal and Viva III 15

References:

Mandatory:

1. Brady Nyle. (2002). The nature and properties of soil. MacMillan Publishing company, USA

Supplementary:

- 1. Foth Henry. (1984). Fundamentals of soil science. John Wiley & Sons, Inc. USA
- 2. Munns Donald and Singer Michael. (1996). Soils An introduction. Prentice-Hall Inc, New Jersey, USA
- 3. Lal R and Stewart B.A. (1990). Advances in soil sciences. Springer-Verlag New York.
- 4. White Robert. (2005). Principles and Practice of Soil Science: The Soil as a Natural Resource, 4th Edition. Wiley & Sons, Inc Blackwell. USA

- 1. https://www.nature.com/scitable/knowledge/library/soil-water-dynamics-103089121/
- 2. http://www.fao.org/3/a0100e/a0100e0d.htm
- 3. <u>https://www.sare.org/Learning-Center/Books/Building-Soils-for-Better-Crops-3rd-</u> Edition/Text-Version/The-Living-Soil/Soil-Microorganisms
- 4. https://www.britannica.com/science/soil-organism
- 5. https://www.soils4teachers.org/biology-life-soil
- 6. https://www.infonet-biovision.org/EnvironmentalHealth/Introduction-soil-conservation-measures

ELECTIVE Course Title: Agrometeorology: Principles and Applications (Theory) Course Code: GEG-SE10 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To study agro-meteorology and its application in agriculture.
- 2. To develop an understanding of the physical and human interventions that affect agricultural systems and management practices.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Determine Photosynthetically Active Radiation (PAR) and Solar Radiation Use Efficiency
- **CO2:** Understand the effect of temperature on crop production
- **CO3:** Understand the methods of managing of farm water resources
- **CO4:** Monitor drought and prepare irrigation schedule
- **C05:** Use remote sensing technology in Agrometeorology

Unit	Title	No. of hours
Ι	Agrometeorology:	15
	Perspectives and Applications: Definition and scope and development.	
	Solar Radiation and Its Role in Plant Growth:	
	The Source of Energy, Laws of Radiation, Earth's Annual Global Mean	
	Radiative Energy Budget, Solar Radiation and Crop Plants, Solar	
	Radiation Interception by Plants, Photosynthetically Active Radiation	
	(PAR), Solar Radiation Use Efficiency	
	Environmental Temperature and Crop Production:	
	Soil and Air Temperature, Plant Injury Due to Sudden Changes in	
	Temperature, Frost: Damage and Control, Thermoperiodism,	
	Temperature As a Measure of Plant Growth and Development.	
II	Climatological Methods for Managing Farm Water Resources-	15
	Water for Crop Production, Making Effective Use of Rainfall,	
	Evaporation and Evapotranspiration, Water Use and Loss in Irrigation.	
	Climatological Information in Improving Water-Use Efficiency (WUE),	
	Reducing Water Losses from Reservoirs,	
	Drought Monitoring and Planning for Mitigation: water budgeting,	
	irrigation scheduling, Drought Monitoring and Planning for Mitigation.	
	Climate, Crop Pests:	
	Role of Weather and Climate, Some Important Insect Pests of Crop	
	Plant.	
III	Remote-Sensing Applications in Agrometeorology.	15
	Computer Models in Managing Agricultural Systems, Agro-	
	climatological Services, using Climate Information to improve	
	Agricultural Systems, Climate Change and Its Impact on Agriculture.	
		45

References:

Mandatory:

- 1. G. Kathiresan (2015) Agrometeorology: A Simplified Textbook. New India Publishing Agency
- 2. G.S. Mahi& P.K. Kingra (2014): Fundamentals of Agrometeorology. Kalyani Publishers
- 3. Mavi H S (2003): Introduction To Agrometeorology. Oxford & Ibh

Supplementary:

- 1. Grigg, David (2005) An Introduction to Agricultural Geography (2nd Ed), Routeledge, London and New York
- 2. Harpal S. Mavi and Graeme J., Tupper (2004), Agrometeorology Principles and Applications of Climate Studies in Agriculture. The Haworth Press, Inc., Binghamton, NY.
- 3. Rao and Prasada (2008) Agricultural Meteorology. PHI Learning PVT. LTD., New Delhi
- 4. Seemann, Jochen, Chirkov, Y. I., Lomas, J., Primault, B. (2012): Agrometeorology. Springer-Verlag Berlin and Heidelberg GmbH & Co. KG
- 5. SR Reddy & D.S. Reddy (2014) Agrometeorology. Kalyani Publishers
- 6. S. Venkatraman (2015): Principles and Practice of Agricultural Meterology. BS Publications.
- 7. WMO (2011), Agricultural Meteorology Guide to Climatological Practices World Meteorological Organization, Geneva.

- 1. http://articles.adsabs.harvard.edu//full/1979ESASP1020....3F/0000003.000.html
- 2. <u>http://www.fao.org/nr/climpag/pub/Workshop%20on%20radio%20broadcasting%202001</u> %20Gommes.pdf
- 3. http://www.wamis.org/agm/gamp/GAMP_Chap04.pdf
- 4. https://www.researchgate.net/publication/308749358_Role_of_Remote_Sensing_and_GI S_in_Agrometeorology
- 5. http://www.oecd.org/greengrowth/sustainable-agriculture/49040929.pdf
- 6. <u>http://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b6-water/chapter-b6-4/en/</u>
- 7. <u>https://drought.unl.edu/archive/Documents/NDMC/Workshops/136/Pres/Svoboda_Droug</u> <u>ht%20Plan%20Case%20Studies-US_Caribbean.pdf</u>
- 8. <u>http://www.wamis.org/tools/info/droughtplanning.pdf</u>
- 9. https://om.ciheam.org/om/pdf/a80/00800448.pdf
- 10. https://www.droughtmanagement.info/wp-content/uploads/2015/12/Session-5_Thematic-Presentation.pdf

ELECTIVE Course Title: Agrometeorology: Principles and Applications (Practical) Course Code: GEG-SE10 Marks: 25 Credits: 01 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Green leaf response to Electro Magnetic Radiation	07
	Photosynthetically Active Radiation (PAR)	
	Solar radiation use efficiency	
	Temperature and crop growth	
II	Measurement of effective rainfall (using Huggins and Kassam	08
	water balance approach)	
	Water balance,	
	Measurement of evaporation and calculation of evapotranspiration	
	irrigation scheduling for crops	
	Analyzing the water deficiency (drought), drought index	
	Use of thermal data in drought monitoring	
III	Journal and Viva	
		15

References:

Mandatory:

- 1. G. Kathiresan (2015) Agrometeorology: A Simplified Textbook. New India Publishing Agency
- 2. G.S. Mahi& P.K. Kingra (2014): Fundamentals of Agrometeorology. Kalyani Publishers
- 3. Mavi H S (2003): Introduction to Agrometeorology. Oxford &Ibh

Supplementary:

- 1. Don Ankerman; Richard Large (2013) Agronomy Handbook. Midwest Laboratories Inc., OMAHA, NE
- 2. Harpal S. Mavi and Graeme J. Tupper (2004), Agrometeorology Principles and Applications of Climate Studies in Agriculture, The Haworth Press, Inc., Binghamton, NY.
- 3. Indian Council of Agricultural Research (2011) Handbook of Agriculture, Indian Council of Agricultural Research
- 4. Rao and Prasada (2008) Agricultural Meteorology. PHI Learning PVT. LTD., New Delhi
- 5. WMO (2011), Agricultural Meteorology Guide to Climatological Practices World Meteorological Organization, Geneva.

- 1. <u>https://www.researchgate.net/publication/321363262_Effective_Rainfall_Calculation_Me</u> <u>thods_for_Field_Crops_An_Overview_Analysis_and_New_Formulation</u>
- 2. http://www.fao.org/3/x5560e/x5560e03.htm
- 3. https://iopscience.iop.org/article/10.1088/1755-1315/54/1/012067/pdf
- 4. <u>https://www.researchgate.net/publication/270555940_Radiation_Use_Efficiency_Evaluat</u> <u>ion_of_Cropping_and_Management_Systems</u>
- 5. <u>https://www.scielo.br/scielo.php?pid=S0100-204X2009001000001&script=sci_arttext</u>
- 6. http://www.fao.org/3/a-ai593e.pdf
- 7. https://www.unisdr.org/files/1871_VL102138.pdf

ELECTIVE Course Title: Field Survey in Physical Geography (Theory) Course Code: GEG-SE11 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To introduce various surveying instrument used in Physical Geography.
- 2. To provide exposure to operation and the application of the instruments and methods of surveying.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand the different survey techniques
- **CO2:** Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies.
- CO3: Independently handle survey instruments and prepare maps and field reports.
- **CO4:** Independently prepare Field Books for field surveys in physical geography
- **CO5:** Acquire knowledge about preparation of map layout.

Unit	Торіс	No.	of
		hours	
Ι	Significance and Methods of Survey; Classification of Surveying;		
	Fundamentals of Plane Table Survey:		
	a) Radiation Method b) Intersection Method		
	Pre survey work: Safety Measures, Field Book Preparation, Literature	15	
	Survey, Sharing Responsibilities and Plan of Action		
	Post field survey work: Data Processing Methods, Analysis, Mapping		
	and Report Writing.		
II	Dumpy level surveying : meaning, functioning elements, applications		
	and Methods(Rise-fall and Collimation method)	15	
	Profile drawing: Beach and River.		
	Beach and River Morphology.		
	Observation of slope, river and coastal morphology on toposheet.		
	Pre survey and Post survey tasks.		
III	GPS survey: Meaning, Space Segment, Ground Segment and GPS	15	
	Receivers, Applications.		
		45	

References: Mandatory:

- 1. Khullar, D.R. (2007), Essentials of Practical Geography, New Academic Publishing
- 2. Monkhouse, I.J. and Wilkinson, H.R. (2009), Maps and Diagram, B.I. Publication, New Delhi
- 3. Sarkar, Ashis (2000), Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata

Supplementary:

- 1. Campbell, J. (2004), Introductory Cartography, Prentice Hall, Inc Englewood
- 2. Co.,Jalandher
- 3. Misra, R.P. and Ramesh, A. (2005), Fundamentals of Cartography, Concept Pub. Co., New Delhi
- 4. Singh, R.L. and Singh Rana P.B.(2008), Elements of Practical Geography, Kalyani Publishers, New Delhi

Web-based:

- 1. https://explorable.com/types-of-survey
- 2. https://www.slideshare.net/gauravhtandon1/plane-table-survey-27614680
- 3. https://libguides.usc.edu/writingguide/fieldreport
- 4. <u>https://theconstructor.org/surveying/dumpy-level-surveying-components-procedure-advantages/20456/</u>
- 5. https://www.gps.gov/systems/gps/

ELECTIVE Course Title: Field Survey in Physical Geography (Practical) Course Code: GEG-SE11 Marks: 25 Credits:1 Duration: 15 Sessions of 2 hours each

Unit	Торіс	Practical sessions
Ι	Plane table survey:	07
	a) Radiation Method :2 Exercises	
	B) Intersection Method: 2 Exercises	
II	Dumpy Level Survey: Rise-Fall and Collimation Method	08
	GPS Survey: Use of GPS in Mapping And Location	
	Observation Of Slope, River and Coastal Morphology on Field	
III	Journal /Field report	
		15

References:

Mandatory:

- 1. Khullar, D.R. (2007), Essentials of Practical Geography, New Academic Publishing
- 2. Monkhouse, I.J. and Wilkinson, H.R. (2009), Maps and Diagram, B.I. Publication, New Delhi
- 3. Sarkar, Ashis (2000), Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata

Supplementary:

- 1. Campbell J. (2004), Introductory Cartography, Printice Hall, Inc Englewood
- 2. Misra, R.P. and Ramesh, A. (2005), Fundamentals of Cartography, Concept Pub. Co., New Delhi
- 3. Singh, R.L. and Singh Rana P.B.(2008), Elements of Practical Geography, Kalyani Publishers, New Delhi

Web-based:

- 1. https://explorable.com/types-of-survey
- 2. https://www.slideshare.net/gauravhtandon1/plane-table-survey-27614680
- 3. https://libguides.usc.edu/writingguide/fieldreport
- 4. <u>https://theconstructor.org/surveying/dumpy-level-surveying-components-procedure-advantages/20456/</u>
- 5. https://www.gps.gov/systems/gps/

ELECTIVE Course Title: Quantitative Techniques in Geography (Theory) Course Code: GEG-SE12 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To expose students to basic and advance statistical methods in geography in general.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Test various statistical tools applied in earth science.
- **CO2:** Understand various stochastic models and forecasting methods in the discipline of earth science.
- **CO3:** Test and analyze various statistical tools applied in geography.
- **CO4:** Formulate hypothesis and prove it applying various stochastic models and forecasting methods in the discipline of geography.

Unit	Title	No. of hours
Ι	Statistical Methods in Geography	15
	Basics of Sampling, Data Collection and Sample Design, Hypothesis	
	Quantification and Prediction / projection, The Concept of Variable,	
	Probability, Frequency Function.	
II	Frequency Analysis and Simulation, Measure of Central tendency,	15
	Dispersion, Skewness and Kurtosis, Correlation and Regression, Chi	
	Square(X ²)	
III	Stochastic Modelling (Time Series Analysis) and Forecasting Processes,	15
	Autocorrelation, Moving Average.Maximum Entropy Method	
		45

References:

Mandatory:

- 1. Ashis Sarkar (2013), Quantitative Geography: Techniques and Presentations, Orient Blackswan
- 2. Rogerson., P. A.(2001) : Statistical Methods for Geography. SAGE Pub. New Delhi

Supplementary:

- 1. Pal S. K., 1998: Statistics for Geoscientists: Techniques and Application, Concept, New Delhi.
- 2. Sharma, D.D. (2008): Geostatistics with Application in Earth Sciences, Springer, with Capital Publishing Company, New Delhi, India.
- 3. Spence, N. & Owens, A. (2011) :Methods of Geographical Analysis. University of London
- 4. Tomislav Hengl (2009): A Practical Guide to Geostatistical Mapping. The European Communities, Luxembourg

- 1. https://ajsmit.github.io/Basic_stats/descriptive-statistics-central-tendency-and-dispersion.html
- 2. https://www.skillsyouneed.com/learn/sampling-sample-design.html
- 3. https://www.researchgate.net/publication/322656396_DATA_COLLECTION_AND_ SAMPLING
- https://personal.utdallas.edu/~scniu/OPRE-6301/documents/Data_Collection_and_Sampling.pdf
- 5. https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/

ELECTIVE Course Title: Quantitative Techniques in Geography (Practical) Course Code: GEG-SE12 Marks: 25 Credits: 01 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Measure of Central tendency and Dispersion	07
	Mean (Z) Estimates for the Mean, Confidence Limits for the Mean	
	Skewness and Kurtosis	
	Correlation and Regression, Correlation Coefficient	
	Hypothesis testing : The Chi-square (X^2) Test,	
	Time Series Analysis and Forecasting	
II	Variogram and Estimation Variance	08
	Entropy Method,	
III	Journal and Viva	
		15

Note : Only physical geography data should be used.

References:

Mandatory:

- 1. Ashis Sarkar (2013), Quantitative Geography: Techniques and Presentations, Orient Blackswan
- 2. Rogerson., P. A.(2001) : Statistical Methods for Geography. SAGE Pub. New Delhi

Supplementary:

- 1. A. Stewart Fotheringham, Chris Brunsdon and Martin Charlton. (2000): Quantitative Geography Perspectives on Spatial Data Analysis. SAGE Publications Ltd
- 2. Rogerson, Peter A. (2015) Statistical Methods for Geography. (4th Ed) SAGE Publications Ltd
- 3. Sharma, D.D. (2008): Geostatistics with Application in Earth Sciences, Springer, with Capital Publishing Company, New Delhi, India.
- 4. Spence, N. & Owens, A. (2011) Methods of Geographical Analysis. University of London
- 5. Robert Hammond, Patrick McCullagh; (1974): Quantitative techniques in geography: an introduction. Clarendon Press,

- 1. https://ajsmit.github.io/Basic_stats/descriptive-statistics-central-tendency-and-dispersion.html
- 2. <u>https://www.skillsyouneed.com/learn/sampling-sample-design.html</u>
- 3. <u>https://www.researchgate.net/publication/322656396_DATA_COLLECTION_AND_SAMPLING</u>
- 4. https://personal.utdallas.edu/~scniu/OPRE-6301/documents/Data_Collection_and_Sampling.pdf
- 5. https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/

Semester VI

CORE Course Title: Ecology and Terrestrial Environment (Theory) Course Code: GEG-VI.SC8 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To introduce the concepts of terrestrial ecology which will help in sustainable management of the same.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand Biomes and ecological factors
- **CO2:** Analyze sustainable strategies for conservation of terrestrial ecology.
- CO3: Acquire skills of water and soil testing
- **CO4:** Understand the climatic factors controlling terrestrial ecosystem.
- CO5: Understand pattern of terrestrial Biomes.

Unit	Title	No. of hours
Ι	Biomes of the world:	15
	• Biogeography: Species distribution, Historic effect of plate tectonics-past and present pattern of Biogeography	
	 Terrestrial Biomes : Tropical Rain Forest, Savannah, Tundra, Desert 	
II	Physical factors controlling terrestrial ecosystem	15
	• Soil : soil as an ecological factor, texture,	
	• Water: Classification, properties of water as ecological factors: properties, composition, effect of rainfall and moisture on growth and distribution of plants and animals.	
III	Climatic factors controlling terrestrial ecosystem	15
	Temperature: ecological factor, range of temperature tolerance, effects on	
	plants and animals, Precipitating : Distribution , effects on plants and	
	animal	
		45

References:

Mandatory:

- 1. Monkhouse, F. J. and Wilkinson, H. R. (1971): Maps and Diagrams, Methuen and Co., London
- 2. Strahler, A. N. (1964): Quantitative Geomorphology of Drainage Basins and Channel Networks, McGraw-Hill, New York

Supplementary:

- 1. Dhaliwal GS, Sangha GS, Ralhan PK, 1996: Fundamentals of Environment Science, Kalyani Publishers New Delhi,
- 2. J.L Chapman and MJ Reiss, 1999: Ecology: Principles and Application, Second Edition, Cambridge University Press, UK
- 3. Kotpal RL, Bali NP, 1998: Concepts Of Ecology, Vishal Publication, Jalendhar
- 4. Purphit SS, Ranjan R, 2003: Ecology, Environment and Pollution, Agrobios (India) Publication, Jodhpur

- 1. https://science.umd.edu/classroom/bsci124/lec35short.html
- 2. https://evolution.berkeley.edu/evolibrary/article/0_0_0/history_18
- 3. https://www.environmentalpollution.in/environment/5-ecological-factors-that-constitute-the-environment-of-an-organism/178
- 4. https://www.researchgate.net/publication/322419790_Physical_Chemical_and_Biological _Characteristics_of_Water_e_Content_Module
- 5. https://www.nature.com/scitable/knowledge/library/causes-and-consequences-of-dispersal-in-plants-15927714/

CORE Course Title: Ecology and Terrestrial Environment (Practical) Course Code: GEG-VI.SC8 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

UnitTitlePractical sessionsIField Visit : visit to a forest ecosystem and Grassland ecosystem
mapping of biodiversity using quadrant method
Testing relationship of soil and water with forest ecology.08IIField report writing and Viva
Pre field preparations and post field analysis and report
generation07II15

References:

Mandatory:

- 1. Monkhouse, F. J. and Wilkinson, H. R. (1971): Maps and Diagrams, Methuen and Co., London
- 2. Strahler, A. N. (1964): Quantitative Geomorphology of Drainage Basins and Channel Networks, McGraw-Hill, New York

Supplementary:

- 1. Handbook of Applied Hydrology, VenTe Chow, Ed., Section 4-II, McGraw-Hill Book Company, New York
- 2. King, C. A. M. (1966): Techniques in Geomorphology, Edward Arnold Ltd., London
- 3. Miller, A. A. (1953): The Skin of the Earth, Methuen and Co. Ltd., London

- 1. <u>https://ag.tennessee.edu/fwf/craigharper/Documents/PB1441%20Terr%20Aqu%20Ecol.p</u> <u>df</u>
- 2. https://fire.biol.wwu.edu//hooper/204_14ecologyintro.pdf
- 3. <u>https://www.arrowenergy.com.au/_____data/assets/pdf_file/0004/28957/Section_17-_____Terrestrial-Ecology.pdf</u>
- 4. <u>https://www.fs.fed.us/rm/pubs_other/rmrs_2009_neary_d002.pdf</u>
- 5. <u>https://www.csus.edu/indiv/b/baxterj/bio%20221b/vegetation%20sampling%20quadrat.p</u> <u>df</u>
- 6. <u>https://www.youtube.com/watch?v=uBYqBNyojMQ</u>

ELECTIVE Course Title: Remote Sensing of Forest Ecology (Theory) Course Code: GEG-SE13 Marks: 75 Credits: 3 Duration: 45 sessions of 1 hour each

Prerequisite Courses: Nil

Course Objective:

1. To introduce the fundamental application of remote sensing in the forest ecology.

Course outcomes:

At the end of this course, students will be able to:

- **CO1:** Use remotely sensed data in forest applications
- **CO2:** Prepare forest map and interpret the forest dynamics.
- CO3: Utilize open source remotely sensed data for forest studies
- CO4: Process different techniques for land use studies in forest.

Unit	Title	No.	of
		hours	
Ι	Remote Sensing of Forest Environments	15	
	Spectral Response of Vegetation.		
	Measuring and monitoring: General Methods of Measuring Vegetation.		
II	Measurement of Vegetation: Biophysical Measure, Timing of	15	
	Measurements,		
	Forest Structure and Composition, Species richness and composition		
III	Modeling Forest Productivity Using Data Acquired Through Remote	15	
	Sensing		
	Understanding Forest Dynamics: spatial and temporal changes		
	Total	45	

References:

Mandatory:

1. Ned Horning, Julie A. Robinson, Eleanor J. Sterling, Woody Turner, and Sacha Spector (2010), Remote Sensing for Ecology and Conservation, A Handbook of Techniques. Oxford University Press, Oxford.

Supplementary:

- 2. Adrian Newton (2007) Forest Ecology and Conservation, A Handbook of Techniques in Ecology & Conservation. Oxford New York
- 3. Hamlyn G Jones and Robin A Vaughan (2010) Remote Sensing of Vegetation Principles, Techniques, and Applications. Oxford University Press, Oxford.
- 4. Michael Wulder and Steven E. Franklin (2003) Remote Sensing of Forest. Environments, Concepts and Case Studies. (Ed) Springer, US.
- 5. Roger M. McCoy (2005) Field Methods in Remote Sensing. The Guilford Press, New York London.
- 6. Van Der Valk, Arnold (2009) Forest Ecology Recent Advances in Plant Ecology. Springer.

- 1. gsp.humboldt.edu/OLM/Courses/GSP_216_Online/lesson2-1/vegetation.htm
- 2. https://www.e-education.psu.edu/natureofgeoinfo/c8_p5.html
- 3. https://www.webpages.uidaho.edu/veg_measure/Modules/Lessons/Module%204(Range% 20Health)/4_3_ForestInventory.htm
- 4. https://www.sciencedirect.com/science/article/pii/S1470160X15001454
- 5. https://grindgis.com/remote-sensing/vegetation-spectral-signature-cheat-sheet

ELECTIVE Course Title: Remote Sensing of Forest Ecology (Practical) Course Code: GEG-SE13 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit Title **Practical sessions** I **Measurement of Forest Canopy** 10 Accuracy Assessment of forest map Sub-Pixel Analysis of Forest Structure Extracting Individual Tree Information Tree Canopy structure Fragmentation Analysis using Entropy approach Π **Vegetation indices** 5 • NDVI Mapping forest disturbances • 15

References:

Mandatory:

1. Ned Horning, Julie A. Robinson, Eleanor J. Sterling, Woody Turner, and Sacha Spector (2010)

Remote Sensing for Ecology and Conservation, A Handbook of Techniques. Oxford University Press, Oxford.

2. Roger M. McCoy (2005) Field Methods in Remote Sensing. The Guilford Press, New York London.

Supplementary:

- 3. Adrian Newton (2007) Forest Ecology and Conservation, A Handbook of Techniques Techniques in Ecology & Conservation. Oxford New York
- 4. Hamlyn G Jones and Robin A Vaughan (2010) Remote Sensing of Vegetation Principles, Techniques, and Applications. Oxford University Press, Oxford.
- 5. Michael Wulder and Steven E. Franklin (2003) Remote Sensing of Forest. Environments, Concepts and Case Studies. (Ed) Springer, US.
- 6. Van Der Valk, Arnold (2009) Forest Ecology Recent Advances in Plant Ecology. Springer.

- 1. <u>https://cid-inc.com/blog/forest-plant-canopy-analysis-tools-methods/</u>
- 2. http://www.fao.org/3/a-i5601e.pdf
- 3. https://pdfs.semanticscholar.org/38aa/3621437d3dcc8895584cb2e56992a8310a1c.pdf
- 4. <u>https://www.researchgate.net/publication/251494059_Detection_of_subpixel_treefall_ga_ps_with_Landsat_imagery_in_Central_Amazon_forests</u>
- 5. https://www.sciencedirect.com/science/article/pii/S0895717711006765
- 6. http://web.pdx.edu/~nauna/resources/8-2012_lecture1-vegetationindicies.pdf
- 7. https://www.hindawi.com/journals/js/2017/1353691/

ELECTIVE Course Title: Advanced Coastal Geomorphology (Theory) Course Code: GEG-SE14 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

- 1. To introduce the process of coastal formation and coastal geomorphology of India.
- 2. To introduce the application of geo-spatial data which will help in understanding coastal processes.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Acquire skills to develop models on coastal processes by using GIS tools and methods.
- **CO2:** Understand coastal systems and processes which shape the coastlines.
- **CO3:** Identify and differentiate between different coastal geomorphological features on the East and West coast of India using map & images.
- **CO4:** Identify recent coastal issues (Goan coastal zone (CRZ)).

Unit	Title	No. of hours
Ι	Tectonic and coast	15
	• Structural factors -Tectonic Coasts, Orientation of coastal tectonic movement, rates of coastal tectonic movement	
	Formation of coast	
	 Structurally controlled coasts- Bold and Low coast 	
	Coastal Process and sea-level fluctuations	
II	Coastal Geomorphology of India:	15
	• Indian coast- Extent & Topography Geology & structure of	
	coastal zone, Evidence of emergence and submergence,	
	• Shore features-Beach, Bar, Lagoons-lake, Delta, Estuaries, Coral	
	reefs and islands	
	Classification of Indian coast	
III	CRZ	15
	CRZ : Meaning, zones and provision	
	Case study of Goa	
		45

References:

Mandatory:

- 1. Gerhard Masselink , Michael Hughes :An Introduction to Coastal Processes and Geomorphology (Hodder Arnold Publication), ISBN-10: 0340764112 , ISBN-13: 978-0340764114
- 2. Eric Bird (2000): Coastal Geomorphology: An Introduction, 1 edition, John Wiley & Sons
- 3. Ahamad.E (1972) Coastal geomorphology of India, Orient Longman Delhi.

Supplementary:

- 1. Bloom. L. Arthur (2012):Geomorphology, Rawat Publication Delhi.
- 2. Cooke R. U. and Doornkamp J.C. (1989): Geomorphology in Environmental Management, 2nd Edition, Oxford : Clarendon Press
- 3. Kale, V. S. and Gupta, A. (Rep.2011): Introduction to Geomorphology, Orient Longman, Calcutta.
- 4. Karlekar, S. (2009): Coastal Processes and Landforms: Diamond Publications, Pune
- 5. Pethick J. (1995): Introduction to Coastal Geomorphology, John Wiley & Sons Inc.
- 6. Richard Davis Jr., Duncan Fitzgerald : Beaches and Coasts, Wiley-Blackwell; 1st edition (July 15, 2004), ISBN-10: 0632043083, ISBN-13: 978-0632043088
- 7. Timothy Beatley , Anna K. Schwab , David Brower (2002): An Introduction to Coastal Zone Management, Island Press; REV edition

- 1. https://www.nap.edu/read/2249/chapter/7#74
- 2. http://keralaczma.gov.in/pdfs/Coastal_Zones_of_India.pdf
- 3. http://www.geosocindia.org/index.php/bgsi/article/view/55966
- 4. <u>http://uregina.ca/~sauchyn/geog323/coastal.html</u>
- 5. http://www.dstegoa.gov.in/RSIReport-CRZ-Goa/GOAreport1.pdf

ELECTIVE Course Title: Advanced Coastal Geomorphology (Practical) Course Code: GEG-SE14 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	Demarcation of shoreline and tide level and coastal features	05
	using GIS software from satellite and SOI toposheet.	
II	Case study of any coastal problems: Field work and use of	10
	geospatial technology	
III	Journal and Viva	
		15

References:

Mandatory:

- 1. Gerhard Masselink , Michael Hughes :An Introduction to Coastal Processes and Geomorphology (Hodder Arnold Publication), ISBN-10: 0340764112 , ISBN-13: 978-0340764114
- 2. Eric Bird (2000): Coastal Geomorphology: An Introduction, 1 edition, John Wiley & Sons
- 3. Ahamad.E (1972) Coastal geomorphology of India, Orient Longman Delhi.

Supplementary:

- 1. Bloom. L. Arthur (2012):Geomorphology, Rawat Publication Delhi.
- 2. Cooke R. U. and Doornkamp J.C. (1989): Geomorphology in Environmental Management, 2nd Edition, Oxford : Clarendon Press
- 3. Kale, V. S. and Gupta, A. (Rep.2011): Introduction to Geomorphology, Orient Longman, Calcutta.
- 4. Karlekar, S. (2009): Coastal Processes and Landforms: Diamond Publications, Pune
- 5. Pethick J. (1995): Introduction to Coastal Geomorphology, John Wiley & Sons Inc.
- 6. Richard Davis Jr., Duncan Fitzgerald : Beaches and Coasts, Wiley-Blackwell; 1st edition (July 15, 2004), ISBN-10: 0632043083, ISBN-13: 978-0632043088
- 7. Timothy Beatley , Anna K. Schwab , David Brower (2002):An Introduction to Coastal Zone Management, Island Press; REV edition

- 1. <u>https://www.researchgate.net/publication/326096173_Methods_of_Shoreline_Demarcation_n_and_Validation_using_Remote_Sensing_and_GIS_</u>
- 2. <u>http://environmentclearance.nic.in/writereaddata/online/EC/06052015M3QUWAT6Dema</u> <u>rcationofHtide&LtideforHazira.pdf</u>
- 3. http://ncscm.res.in/cms/more/pdf/reports/htl_manual.pdf
- 4. http://www.ijitee.org/wp-content/uploads/papers/v2i4/D0545032413.pdf
- 5. https://www.omicsonline.org/open-access/coastal-erosion-and-shoreline-change-in-ganjam-coast-along-east-coast-of-india-2157-7617-1000467-100842.html

ELECTIVE Course Title: Ecology of Estuarine Environment (Theory) Course Code: GEG-SE15 Marks: 75 Credit: 03 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course objectives:

- 1. To study estuaries and their unique ecosystems.
- 2. To explore the features of estuarine ecosystem and analyze the effects of anthropogenic activities on estuaries.

Course Outcomes:

At the end of this course, students will be able to:

- **CO1:** Understand the estuarine processes, anthropogenic effects on estuaries.
- CO2: Test and analyze various parameters associated with estuarine ecology
- **CO3:** Suggest remedial measures for the protection of the same.
- **CO4:** Map estuaries and detect the changes using satellite data and topographical sheets.

Unit	Contents	No. of hours
Ι	Physical attributes of Estuaries	15
	Concept and Significance.	
	Physical characteristics of estuaries	
	Classification of estuaries.	
	• Environment in estuaries: mudflats, salt marsh, mangroves,	
	salt pans	
	• Sediment source, transportation and deposition in estuaries.	
II	Estuarine dynamics	15
	 Tides and tidal currents in estuaries 	
	• Estuarine circulation and mixing.	
	• Estuaries as sources of food for marine organisms and	
	nurseries for marine organisms.	
III	Anthropogenic Effects on estuaries and mitigation	15
	Agricultural runoff.	
	• Fishing	
	• Urban development and Reclamation of land for	
	development.	
	Recreational activities.	
	Ports and harbors	
		45

References: Mandatory:

1. Dronker J and Leussen W.V (1988) Physical Processes In Estuaries, Springer Verlag Publishers. London

Supplementary:

- 1. Dyer. K.R (1997) Estuaries- Physical Introduction, 2nd edition John Wiley and Sons, New York
- 2. Gade, Edward and Svendson(1982) Coastal Oceanography, Plenum Press London.
- 3. Nair N. B. and Thampy, D.M.: (1989), Textbook of Marine Ecology. Macmillan Publishers
- 4. Tait, R.V- (1982), Elements of Marine Ecology: An Introductory Course, 3rd Edition, Butterworth-Heinemann

- 1. https://cerm.mandela.ac.za/About-Estuaries/Physical-Characteristics
- 2. http://www.waterencyclopedia.com/En-Ge/Estuaries.html
- 3. https://www.nationalgeographic.org/encyclopedia/estuary/
- 4. <u>https://oceanservice.noaa.gov/education/tutorial_currents/02tidal1.html</u>
- 5. <u>http://marinespecies.org/introduced/wiki/Morphology_of_estuaries</u>
- 6. https://www.sciencelearn.org.nz/resources/1231-human-impact-on-estuaries

ELECTIVE Course Title: Ecology of Estuarine Environment (Practical) Course Code: GEG-SE15 Marks: 25 Credit: 01 Duration: 15 sessions of 2 hours each

Unit No	Contents	Practical sessions
Ι	Mapping of estuaries from Indian coasts using SOI	6
	toposneets (any 5)	
II	Mapping of estuaries in Goa:	9
	 Change detection using satellite data and topographical sheet Estuarine channel profiling, bank erosion, associated landforms (using GPS and current meter) 	
III	Journal and Viva	
		15

References:

Mandatory:

1. Dronker J and Leussen W.V (1988) Physical Processes In Estuaries, Springer Verlag Publishers. London

Supplementary:

- 1. Dyer. K.R (1997) Estuaries- Physical Introduction, 2nd edition John Wiley and Sons, New York
- 2. Gade, Edward and Svendson(1982) Coastal Oceanography, Plenum Press London.
- 3. Nair N. B. and Thampy, D.M.: (1989), Textbook of Marine Ecology. Macmillan Publishers
- 4. Tait, R.V- (1982), Elements of Marine Ecology: An Introductory Course, 3rd Edition, Butterworth-Heinemann

- 1. https://www.isprs.org/proceedings/XXXVI/part4/RS-GEO-18.pdf
- 2. https://www.google.com/intl/en_in/earth/
- 3. <u>https://library.wmo.int/doc_num.php?explnum_id=1709</u>
- 4. http://www.ipublishing.co.in/jggsvol1no12010/EIJGGS1006.pdf
- 5. https://icaci.org/files/documents/ICC_proceedings/ICC2001/icc2001/file/f11062.pdf

ELECTIVE Course Title: Disaster Management: Urban and Coastal (Theory) Course Code: GEG-SE16 Marks: 75 Credits: 3 Duration: 45 lectures of 1 hour each

Prerequisite Courses: Nil

Course Objectives:

1. To provide insights of basics and applications of landscape and disaster management.

Course Outcomes:

At the end of this course, students will be able to:

CO1: Be familiar with the concepts of disaster management

CO2: Understand the causes and effects of different natural hazards

CO3: Assess the risks of urban hazards (any one case study)

CO4: Evaluate coastal hazard risks and their management (any two local case studies)

CO5: Prepare hazard management and mitigation plan for any one local site.

Uni	Title	No. of hours
t		
Ι	Introduction to Disaster Management:	15
	• Definition, Types, Concepts of Disaster Management	
	Importance of Disaster Management	
	Introduction to mitigation methods	
	Disaster Management Cycle	
	Indian Scenario	
	Natural Hazards & Landscapes:	
	• Types of landscapes & natural hazards	
	Distribution Pattern	
	• Consequences	
	Mitigation measures	
II	Urban Landscape & Disaster Management:	15
	 Understanding Risk of Urban hazard 	
	• Case study	
III	Coastal Landscape & Disaster Management:	15
	 Understanding Risk of coastal hazards 	
	• Coastal risk, mitigation and planning.	
	Case study	
		45

References:

Mandatory:

- 1. Ban Wisner, (2005), At Risk: Natural Hazards, People's Vulnerability and Disasters, Routledge
- 2. Chowdhury Emdadul. Haque, (2005), Mitigation of Natural Hazards And Disasters: International Perspectives, Springer
- 3. FitzGerald. M. Duncan, (2003), Beaches and Coasts, Blackwell Publishing

Supplementary:

- 1. Asian Development Bank, (2016), Reducing Disaster Risk by managing Urban Landuse-Guidance notes for planners, Metro Manila, Philippines
- 2. Natural Hazards and Disaster Management, (2006), A Supplementary Textbook in Geography for Class XI on Unit 11: Natural Hazards and Disasters, Published by: The Secretary, Central Board of Secondary Education, 2, Community Centre, PreetVihar, Delhi-110092
- 3. Vernberg. F. John, Vernberg. Winona B, (2001), The Coastal Zone: Past, Present, and Future, University of South Carolina Press

- 1. https://www.academia.edu/8610063/An_Introduction_to_Disaster_Management_Concep t_and_Meaning
- 2. https://www.researchgate.net/publication/320126456_Concepts_and_Practices_of_Disas ter_Management_Concepts_and_Practices_of_Disaster_Management
- 3. https://www.adrc.asia/publications/LWR/LWR_abridged/definitions.pdf
- 4. http://www.nzdl.org/gsdlmod?e=d-00000-00---off-0aedl--00-0---0-10-0---Odirect-10---4-----0-11--11-en-50---20-about---00-0-1-00-0-0-11-1-0utfZz-8-10&cl=CL1.4&d=HASHcd2bae0c8381ef0542840a.2>=1
- 5. https://www.samhsa.gov/find-help/disaster-distress-helpline/disaster-types
- 6. https://www.linkedin.com/pulse/disaster-management-definition-process-various-phases-chatterjee
- 7. https://www.uu.nl/en/research/department-of-physical-geography/research/landscape-functioning-and-natural-hazards
- 8. https://www.intechopen.com/books/sea-level-rise-and-coastal-infrastructure/revealinglandscape-planning-strategies-for-disaster-prone-coastal-urban-environments-the-caseof-is
- 9. https://penniur.upenn.edu/initiatives/disaster-in-urban-landscapes-preparedness-response-and-recovery
- 10. https://www.iitk.ac.in/nicee/wcee/article/14_S08-032.PDF
- 11. https://www.sutori.com/story/how-do-natural-hazards-affect-landforms-and-landscapes--ZsqHdntyog8jiGrgAZDi212d
- 12. http://www.fao.org/3/AG127E10.htm
- 13. https://www.orfonline.org/research/making-indias-coastal-infrastructure-climate-resilient-challenges-and-opportunities-54330/

ELECTIVE Course Title: Disaster Management: Urban and Coastal (Practical) Course Code: GEG-SE16 Marks: 25 Credits: 1 Duration: 15 sessions of 2 hours each

Unit	Title	Practical sessions
Ι	1. Mapping Flood risk area	07
	2. Mapping Landslide and Erosion prone sites	
	3. Mapping Rock fall prone sites	
II	4. Mapping the urban land surface temperature (Urban Heat	8
	Islands)	
	5. Risk sensitive land use map	
	6. Calculating permissible density of hazards.	
III	Journal	
		15

References

Mandatory:

- 1. Ban Wisner, (2005), At Risk: Natural Hazards, People's Vulnerability and Disasters, Routledge
- 2. Chowdhury Emdadul. Haque, (2005), Mitigation of Natural Hazards And Disasters: International Perspectives, Springer

Supplementary:

- 1. Asian Development Bank, (2016), Reducing Disaster Risk by managing Urban Landuse-Guidance notes for planners, Metro Manila, Philippines
- 2. FitzGerald. M. Duncan, (2003), Beaches and Coasts, Blackwell Publishing
- 3. Natural Hazards and Disaster Management, (2006), A Supplementary Textbook in Geography for Class XI on Unit 11: Natural Hazards and Disasters, Published by: The Secretary, Central Board of Secondary Education, 2, Community Centre, PreetVihar, Delhi-110092
- 4. Vernberg. F. John, Vernberg. Winona B, (2001), The Coastal Zone: Past, Present, and Future, University of South Carolina Press

- 1. https://www.hindawi.com/journals/amete/2016/4891015/
- 2. https://www.sciencedirect.com/science/article/pii/S1110982314000209
- 3. http://www.oas.org/dsd/publications/unit/oea66e/ch10.htm
- 4. https://www.preventionweb.net/files/65868_f222odhiambolandslidessouthafrica[1].pdf
- 5. https://journals.openedition.org/geomorphologie/12778
- 6. https://www.sciencedirect.com/science/article/pii/S2226585619300445
- 7. https://www.sciencedirect.com/science/article/pii/S1110982317301114
- http://dpnet.org.np/public/uploads/files/Learning%20Document%20Issue%207%20-%20Risk%20Sensitive%20Land%20Use%20Planning%20for%20Urban%20Risk%20M anagement%20(002)%202019-05-16%2010-15-42.pdf
- 9. https://ngs.org.np/demo/wp-content/uploads/2019/09/Geo-disaster-and-risk-sensitive-land-use-planning-in-Nepal-Thapa-2018.pdf

Course Learning Outcomes

Sr. No	Course	Course Title	Course Learning Outcomes
1	GEG-I.SC1	Introduction to Geography	 At the end of this course, students will be able to: CO5: Understand fundamental concepts and dichotomies in geography CO6: Analyze the interrelationships among fundamental concepts of geography CO7: Acquire Basic cartographical skills such as basic elements of map and map reading, area measurements, time calculation CO8: Differentiate and evaluate different domains of geography
2	GEG-I.SC2	Fundamentals of Physical Geography	 At the end of this course, students will be able to: CO5: Understand fundamentals of physical geography CO6: Apply techniques to represent different relief features CO7: Interpret the characteristics and associate with other relief features CO8: Analyze and interpret climate data
3	GEG-II.SC3	Basics of Human Geography	 At the end of this course, students will be able to: CO6: Understanding of fundamental concepts of Human Geography CO7: Understand and analyze human related issues in societies CO8: Develop an understanding of basic quantitative techniques used in Human geography CO9: Collect, process and analyse socio economic data CO10: Visually illustrate population data
4	GEG-II.SC4	Basics of Regional Geography	 At the end of this course, students will be able to: CO8: Understand Fundamental concepts of regional geography CO9: Apply techniques of regionalization CO10: Differentiate among different regions spatial organization and areal variation in human activities. CO11: Develop an understanding of basic quantitative techniques used in regional geography. CO12: Develop the skill of calculation of different indicators of development. CO13: Diagrammatically represent and interpret regional data CO14: Represent and interpret characteristics of various regions.
5	GEG-III.SC5	Fundamentals of	At the end of this course, students will be able to:

		Remote Sensing	CO5:	Understand the basic science of remote
		and GIS		sensing
			CO6:	Interpret and analyze remotely sensed data.
			CO7:	Carry out photogrammetric observations
				and calculate area, height, depth and
				changes in the same.
			CO8:	Understand interaction of EMR with Earth
				surface materials
6	GEG-SE1	Spatial Analysis	At the	end of this course, students will be able to:
			CO6:	Differentiate between spatial and attribute
			0.05	data using GIS software
			CO/:	Process raster data in raster processing
			COP.	Software
			CO0	A service the shills of anoticl analysis
			CO9:	Acquire the skills of spatial analysis
			CO10:	prepare topographic models and study
7	CEC SE2	Destan and Vester	<u> </u>	morphometric properties of terrain
/	GEG-SE2	Raster and vector	At the	end of this course, students will be able to:
		Data Models in	005:	integrate raster and vector data models and
		GIS		visualizing graphical outputs through CIS
			C06.	Process and interpolate using 2D and 3D
			C00:	raster and vector data
			C07.	Perform network analysis and cluster
				analysis.
			CO8:	Understand projections and use it for spatial
				data presentation in GIS
8	GEG-SE4	Participatory GIS	At the	end of this course, students will be able to:
			CO5:	Understand the concepts of PRA, P-GIS
				pGIS, Pgis
			CO6:	Develop the skill of data management and
				community mapping
			CO7:	Prepare a community resource inventory
				(any two case studies)
			CO8:	Evaluate the role of local people in
				developing and maintaining the community
-				resources
9			At the	end of this course, students will be able to:
			CO6:	Correlate knowledge of GIS in business
			~~-	applications
			CO 7:	Understand the applications of GIS in socio-
			COP.	economic planning.
	GEG-SE4	Applied GIS	008:	Use GIS to address local problems and
			CO0.	Understand applications of CIS in transport
			0.09:	and network planning
			CO10-	Understand and apply spatial modeling to
			010:	real time situations
10	GEG-IV SC6	Fundamentals of	At the	end of this course students will be able to:
10		Geomorphology	COA	Understand fundamentale of
1	1	2201101p110106J	0.000	charlound fundamentals 01

			geomorphology.
			CO7: Analyze soil properties.
			CO8: Understand the concepts and processes of
			geomorphic landforms.
			CO9: Develop the skill of comparative analysis of
			slope development and their effect on
			human activities.
			CO10: Understand application of geomorphology
			in various fields.
11	GEG-SE5	Coastal	At the end of this course, students will be able to:
		Geomorphology	CO5: Understand various processes and
			associated landforms in coastal region
			CO6: Learn the methods of coastal hazard
			management
			CO7: Prepare and interpret coastal landscape
			maps.
			CO8: Conduct beach profiling using survey
			instruments.
12	GEG-SE6	Fluvial	At the end of this course, students will be able to:
		Geomorphology	CO6: Understanding the fundamental concepts of
			river and its processes.
			CO7: Prepare drainage map and interpret fluvial
			landscape.
			CO8: Conduct survey for river profiling using
			instruments.
			CO9: Carry out morphometric analysis of a river
			basin.
			CO10: Correlate drainage pattern with structural
10		XX 7 . 1 1	features.
13	GEG-SE/	Watershed	At the end of this course, students will be able to:
		Management	CO7: Understand concepts of Watershed
			Management.
			CO8: Develop a process-based understanding of
			watershed.
			CO9: Understand the methods and techniques of
			watershed management.
			COI0: Relate watershed management using the
			different methods in GIS.
			COII: Understand hydrological process in
			watershed
			CO12: Understand Various techniques for
1.4		D'	conservation of watersned management.
14	GEG-SE8	вюдеодгарну	At the end of this course, students will be able to:
			and its evolution
			and its evolution CO7. Evolute the role of clobal propriorities
			and portnorshing in protecting highlighters
			and participations in protecting biodiversity
			botepote (any two)
			notspots (any two)
1			Understand the traditional and modern

			method of biodiversity conservation
			CO10: Evaluate different social movements of
			biodiversity conservations in India
15	GEG-V.SC7	Introduction to	At the end of this course, students will be able to:
-		Climatology	CO5: Understand and analyze climatological
			concepts.
			CO6: Interpret and analyze weather and climatic
			phenomena
			CO7: Understand the main patterns of the various
			types of Earth's climates and the main
			climate classification schemes
			CO8: Understand the relationships between
			climate and other forms of environmental
			changes
16	GEG-SE9	Geography of Soil	At the end of this course, students will be able to:
		Studies	CO5: Identify and differentiate between various
			soils profiles and types
			CO6: Understand different types of processes of
			soil formation, characteristics and
			importance in agricultural practices
			CO : lest the soil properties and quality of
			collected soll samples using various
			CO2. Mon various soil types in terms of physical
			and chemical properties
17	GEG-SE10	Agrometeorology:	At the end of this course, students will be able to:
17	OEO-SEIO	Principles and	C06: Determine Photosynthetically Active
		Applications	Radiation (PAR) and Solar Radiation Use
		ripplications	Efficiency
			COT Understand the offerst of termineters
			LU : Understand the effect of temperature on
			cop production
			CO7: Understand the effect of temperature on crop productionCO8: Understand the methods of managing of
			CO7: Understand the effect of temperature on crop productionCO8: Understand the methods of managing of farm water resources
			 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation
			 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule
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18			 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of
18			 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Device of the construction of the construction
18		Field Survey in	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based
18	GEG-SE11	Field Survey in Physical	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies.
18	GEG-SE11	Field Survey in Physical Geography	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies. CO8: Independently handle survey instruments
18	GEG-SE11	Field Survey in Physical Geography	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies. CO8: Independently handle survey instruments and prepare maps and field reports.
18	GEG-SE11	Field Survey in Physical Geography	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies. CO8: Independently handle survey instruments and prepare maps and field reports. CO9: Independently prepare Field Books for field and prepare in physical survey instruments.
18	GEG-SE11	Field Survey in Physical Geography	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies. CO8: Independently handle survey instruments and prepare maps and field reports. CO9: Independently prepare Field Books for field surveys in physical geography
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18	GEG-SE11	Field Survey in Physical Geography	 CO7: Understand the effect of temperature on crop production CO8: Understand the methods of managing of farm water resources CO9: Monitor drought and prepare irrigation schedule CO10: Use remote sensing technology in Agrometeorology At the end of this course, students will be able to: CO6: Understand the different survey techniques CO7: Understand functions and applications of dumpy level, Plane table and Global Positioning Systems (GPS) in field based studies. CO8: Independently handle survey instruments and prepare maps and field reports. CO9: Independently prepare Field Books for field surveys in physical geography CO10: Acquire knowledge about preparation of map layout.

		Techniques in	CO5:	Test various statistical tools applied in earth			
		Geography		science.			
			CO6:	Understand various stochastic models and			
				forecasting methods in the discipline of			
				earth science.			
			CO7:	Test and analyze various statistical tools			
				applied in geography.			
			CO8:	Formulate hypothesis and prove it applying			
				various stochastic models and forecasting			
				methods in the discipline of geography.			
20	GEG-VI.SC8	Ecology and	At the	end of this course, students will be able to:			
		Terrestrial	CO6:	Understand Biomes and ecological factors			
		Environment	CO7:	Analyze sustainable strategies for			
				conservation of terrestrial ecology.			
			CO8:	Acquire skills of water and soil testing			
			CO9:	Understand the climatic factors controlling			
				terrestrial ecosystem.			
			CO10	: Understand pattern of terrestrial Biomes.			
21	GEG-SE13	Remote Sensing	At the	end of this course, students will be able to:			
		and Forest	CO5:	Use remotely sensed data in forest			
		Ecology		applications			
			CO6:	Prepare forest map and interpret the forest			
				dynamics.			
			CO7:	Utilize open source remotely sensed data for			
				forest studies			
			CO8:	Process different techniques for land use			
			1	studies in forest.			
22	GEG-SE14	Advanced Coastal	At the	end of this course, students will be able to:			
		Geomorphology	C05:	Acquire skills to develop models on coastal			
			COC	processes by using GIS tools and methods.			
			CU6:	Understand coastal systems and processes			
			C07.	which shape the coastlines.			
			07:	Identify and differentiate between different			
				coastal geomorphological features on the			
				East and west coast of mora using map &			
			COP.	Initiages.			
				identify recent coastal issues (Goan coastal			
22	GEG SE15	Ecology of	At the	and of this course, students will be able to:			
25	GEG-SE15	Ecology 01 Estuarine	CO5.	Understand the estuarine processes			
		Estuarine	005.	anthropogenic effects on estuaries			
		Linvironment	COG	Test and analyze various parameters			
			0.00	associated with estuarine ecology			
			C07.	Suggest remedial measures for the			
				protection of the same			
			C08·	Man estuaries and detect the changes using			
				satellite data and tonographical sheets			
24	GEG-SE16	Disaster	At the	end of this course, students will be able to:			
		Management:	CO6:	Be familiar with the concepts of disaster			
		Urban and Coastal		management			
		crown and coustai					
	CO7:	Understand	d the	causes	and	effects	s of
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		different na	atural h	azards			
	CO8:	Assess the risks of urban hazards (any one					
		case study))				
	CO9:	Evaluate	coastal	hazard	risks	and	their
		manageme	nt (any	two loca	l case	studies	;)
	CO10:	Prepare hazard management and mitigation					
		plan for an	y one l	ocal site.			