

## APPLIED BOTANY CENTRE (ABC)

### DEPARTMENT OF BOTANY, UNIVERSITY SCHOOL OF SCIENCES, GUJARAT UNIVERSITY, AHMEDABAD-380 009 SYLLABUS: M. Sc. CLIMATE CHANGE IMPACTS MANAGEMENT

#### Effective from August 2015

1. Four papers (Three hour duration) and two practical (Six hour duration) of hundred marks at the semester examination.
2. Field visit is essential for understanding natural systems. There shall be at least one such visit every year. Tour report including observations and learnings will be given due weight age.
3. Candidates shall be required to submit at the time of practical examination at the end of each semester. The laboratory journal, assignment, project work and diary of field work (field visit report) duly signed by the teachers concerned also need to be submitted.

CLI-401: Basics of Climate science

CLI-402: Climate and climate change

CLI-403: Global warming and climate change

CLI-404: Observed climate change and international responses

CLI 405PR: Practical – I: Based on topics covered in CLI 401 and 402

CLI 406PR: Practical – II: Based on topics covered in CLI 403 and 404

CLI- 407: Effects of climate change

CLI-408: Tools and techniques for impacts assessment

CLI -409: Policy and legislation: national and international scenarios

CLI -410: Future climate scenarios

CLI 411PR: Practical – III: Based on topics covered in CLI 407 and 408

CLI 412PR: Practical – IV: Based on topics covered in CLI 409 and 410

CLI-501: Climate change adaptation

CLI-502Climate change mitigation

CLI-503: Issues need attention

CLI-504:International Response and Individual Responsibility

CLI 505PR: Practical – V: Based on topics covered in CLI 501 and 502

CLI 506PR: Practical – VI: Based on topics covered in CLI 503 and 504

CLI-507: Project

#### Climate Change Impacts Management

Department Name: Climate Change Impacts management. School of Sciences			Semester 1				
Course		Name of the Course	No of Hours Per Week				
No.	Type		Lectures	Others	Practical	Total	Credit
CLI 401	Core	Intro to Climate &CC	3	1	—	4	4
CLI 402	Core	Climate Science	3	1	—	4	4
CLI 403	Core	Global Warming &CC	3	1	—	4	4
CLI 404	Core	Observed CC & its Intl Responses	3	1	—	4	4

CLI 405	Core	Practical 1	_	1	3	4	4
CLI 406	Core	Practical 2	_	1	3	4	4
		Total	12	6	6	24	24
			Semester 2				
Course		Name of the Course	No of Hours Per Week				
No.	Type		Lectures	Others	Practical	Total	Credit
CLI 407	Core	Effects of CC	3	1	—	4	4
CLI 408	Core	Tools & Tech. for Impacts Assmnt.	3	1	—	4	4
CLI 409	Core	P&L: Ntnl.& Intl. Scenarios	3	1	—	4	4
CLI 410	Core	Future Climate Scenarios	3	1	—	4	4
CLI 411	Core	Practical 3	_	1	3	4	4
CLI 412	Core	Practical 4	_	1	3	4	4
		Total	12	6	6	24	24
			Semester 3				
Course		Name of the Course	No of Hours Per Week				
No.	Type		Lectures	Others	Practical	Total	Credit
CLI 501	Core	CCAdaptation	3	1	—	4	4
CLI 502	Core	CCMitigation	3	1	—	4	4
CLI 503	Core	Issues Need Attention	3	1	—	4	4
CLI 504	Core	Intl Response & Intl Responsibility	3	1	—	4	4
CLI 505	Core	Practical 5	_	1	3	4	4
CLI 506	Core	Practical 6		1	3	4	4
		Total	12	6	6	24	24
CLI 507		Dissertation	Semester 4				24

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#### SYLLABUS: M. Sc. CLIMATE CHANGE IMPACTS MANAGEMENT

##### SEMESTER – I

##### CLI- 401: BASICS OF CLIMATE SCIENCE

##### Unit-1: Atmosphere and Hydrosphere

- Formation, composition of Earth's atmosphere, mass and layering of atmosphere, electromagnetic radiation, solar and terrestrial radiation, variation with latitudes and seasons, Adiabatic temperature changes, air stability and instability, Ozone layer, Temperature measurements and controls, Dry and Wet adiabatic lapse rate, inversion of temperature.
- Atmospheric pressure and winds, Pressure measurements and distribution, Wind observations, Factors affecting wind, Gradient and Geostrophic winds, local winds and Jet streams.
- Natural and man-made water bodies-types, significance and constraints, humidity, condensation, cloud formation, precipitation and fog, Acid rain, evaporation and transpiration, infiltration
- Soil water storage, surface runoff and hydrologic cycle, Surface and subsurface ocean currents, ocean tides and currents

## **Unit-2: Lithosphere and pedosphere**

- Structure of earth, Geological Timescales, Big bang theory and Continental Drift theory and plate tectonics, Earthquake and volcanic activity - Theories, occurrences, physical processes and types
- Types of rocks and soils, composition of rocks and soils, role of climate in soil formation,
- Soil classification, erosion, deposition and conservation,
- Physical and chemical properties of soil, degradation and reclamation

## **Unit-3: Biosphere**

- Biological classification of organisms, Species diversity and biodiversity
- Ecosystems, nutrients in ecosystem, food chain and food web, Biodiversity- in various ecosystems, Ecosystems, nutrients in ecosystem, food chain and food web. Carbon cycle, nitrogen cycle, sulfur cycle and other mineralization processes
- Principles of Conservation Biology including Planning, Legislation and Implementation of Conservation programmes
- Biomes- terrestrial and aquatic, classification, maps of biomes, anthropogenic biomes, Flora-fauna, status, *in-situ* and *ex-situ* conservation, RET species

## **Unit-4: Techniques and methods**

- Principle and use of tools to study atmosphere and hydrosphere
- Principles and Methods to study physicochemical properties of soil and water
- Documentation of biodiversity and methods to study ecosystems
- Techniques to enumerate RET species

## **CLI-402: CLIMATE AND CLIMATE CHANGE**

### **Unit-1: Climate and Weather**

- Definition of weather and climate, meteorology and climatology, elements, types of classification systems- empirical, applied and genetic systems, Koeppen classification system, three basic climate groups: low latitude, mid-latitude, high latitude
- Aridity index, drought, Holdridge life zones system: global bioclimatic scheme for the classification of land areas.
- Weather and climate change, Geological time scale, ice ages, record of past 1000 years, human influences,
- Internal forcing mechanisms and external forcing mechanisms, The Milankovitch Cycle theory, Solar variation,

### **Unit-2: Atmospheric chemistry**

- Measures of atmospheric composition: Mixing ratio, number density and partial pressure
- Atmospheric transport: Geostrophic flow, General circulation, Vertical transport, turbulence
- Atmospheric lifetime and time-scales: Definition, Box models, Source and Sinks mechanism, Atmospheric lifetime of Kyoto gases and sink mechanisms.
- Observations, Trends and Budget: Non CO<sub>2</sub> Kyoto gases, Montreal protocol gases

### **Unit-3: Physical evidences of climate change**

- Introduction to Paleoclimatology : Major events : Oceanic Anoxic Events , Holocene climatic optimum , Paleocene–Eocene Thermal Maximum , Younger Dryas/The Big Freeze, Little ice age and Faint young Sun paradox.
- Tree ring analysis, Palynology and Sclerochronology : Principles , Applications and Drawbacks.
- Polar ice, Isotopes, Ice melting and Ice core analysis, glaciers and arctic sea loss
- Sea level changes and Shore line changes ( Strand lines) and Temperature changes

### **Unit-4: Climate indices and extreme events**

- Measurement of various climate indices, aridity index,
- Seismic activity, Remote sensing data for temperature and precipitation

- Formation, structure, types and impacts of Cyclone , Thunderstorms, winterstorms, summer storms,Tornadoes and Hurricanes
- Formation, structure, types and impacts of Floods , droughts, precipitation, El nino and arctic circulation, Heat waves, Wild fires, Health effects, Heinrich events and Daansgard-Oeschger (D-O) events

### **CLI 403: GLOBAL WARMING AND CLIMATE CHANGE**

#### **Unit-1: Greenhouse gases and Global warming**

- Greenhouse gases and its sources
- Enhanced greenhouse gas effect
- Global warming and Greenhouse gases policy issue
- Effects and causes of global warming

#### **Unit-2: Aerosols**

- Sources of aerosols,Direct and indirect effects
- Production mechanisms of aerosolsTrends in aerosols
- Radiative forcing and GHGs-Definition, concept and processes
- Forcing –response relationship, Radiative forcing by tropospheric ozone, Radiative forcing of tropospheric aerosols

#### **Unit-3: Indian industry and global warming**

- Role of Indian industry in production of CFC products
- Role of plants
- Innovative approaches
- Biological modulation

#### **Unit 4: Measurement and procedures to assess global warming**

- GHG,aerosols,Anaesthetic gases-desflurane, isoflurane and sevoflurane
- Portfolio manager,CRIS, NOAA
- Photoacoustic spectroscopy ,mass spectrometer,
- AGAGE,ADS GC-MS, MEDUSA GC-MS

### **CLI-404: OBSERVED CLIMATE CHANGE AND INTERNATIONAL RESPONSES**

#### **Unit-1: Observed climate variability and change**

- Evidences of warming and change in atmosphere/ ocean circulations
- Climate extremes,Cyclones, thunderstorms, Tornadoes, Heat waves
- Energy balance of the earth,Human induced climate variations
- Sea level rising, Ice melting, temperature rising,Floods and droughts

#### **Unit-2: Human ecology of climate change**

- Anthropogenic activities responsible for climate change: Source activities (Burning of fossil fuel, Industrial activity, Urbanization, Agriculture, transportation, waste generation) Removals of Sinks and LULUCF
- Population and its environmental impact: Population, Population growth, Variation among nations, Population explosion, Family welfare programs, Environment and human health risk.
- Climate change and food security: Food systems(Agriculture, Animal husbandry, Fisheries), impacts of Climate Change on Food systems, Population and food security
- Energy supply: History of energy, Role of energy in development of human civilization, Energy Production, Emissions from energy generation. Role of energy in current climate change.

#### **Unit-3: International response to climate change**

- History of IPCC and UNFCCC
- The climate change convention
- National and local government responses
- Adaptive response and mitigation activity

#### **Unit-4: Physical climate processes and feedbacks**

- Atmospheric processes and feedbacks: Physics of the Water vapor and cloud feedbacks: cloud processes, precipitation processes, radiative processes, stratospheric dynamics and atmospheric circulation regimes, convection processes
- Ocean processes and feedbacks: Surface Mixed Layer, Convection, Interior Ocean Mixing, Mesoscale Eddies, Horizontal Circulation and Boundary Currents
- Land surface processes and feedbacks: land surface change, Land hydrology, runoff and surface atmosphere exchange
- Cryosphere processes and feedbacks: Snow cover and permafrost, sea ice, land ice

#### **Proposed Reference material**

1. Anonymous:[http://unfccc.int/resource/docs/publications/infokit\\_2002\\_en.pdf](http://unfccc.int/resource/docs/publications/infokit_2002_en.pdf)
2. J. Oliver and J. Hidore (2001): *Climatology-An Atmospheric Science* (second edition).
3. M. Maslin (2004): *Global Warming- A very short introduction*, Oxford publication.
4. Climate Change: What it means for us, our children and our grandchildren by Joseph F.C. DiMento and Pamela Doughman, MIT press
5. IPCC Third Assessment Report (2001)
6. Climate and Global Environmental Change by L.D. Danny Harvey, Prentice Hall publication
7. Climate Change- An Indian Perspective by S.K.Das , Foundation books
8. Global Warming- A very short introduction by Mark Maslin, Oxford publication
9. <http://www.physicalgeography.net/fundamentals/contents.html>
10. *Climatology-An Atmospheric Science* (second edition) by John Oliver & John Hidore– Indian edition
11. Climate and Global Environmental Change by L.D. Danny Harvey, Prentice Hall publication
12. *Global Warming: the complete briefing* by John Theodore Houghton
13. Climate change: Biological and Human aspects by Jonathan Cowie

#### **CLI 405PR: PRACTICAL – I: ASSIGNMENT/FIELD EXERCISES BASED ON TOPICS COVERED IN THEORY PAPERS**

#### **CLI 406PR: PRACTICAL – II: LABORATORY EXERCISES ESSENTIAL TO UNDERSTAND THE TOPICS COVERED IN THEORY PAPERS**

## SEMESTER-II

### CLI- 407: EFFECTS OF CLIMATE CHANGE

#### **Unit-1: Climate change impacts on water**

- Impacts on Water Cycle and Water Demand
- Impacts on Water Supply
- Impacts on Water Quality
- Impacts of Changes in Water Resources on Other Sectors
- Climate Ready Estuaries, Climate Ready Water Utilities, Green Infrastructure, Healthy Watersheds, Sustainable Infrastructure in Water sense

#### **UNIT -2:Climate change impacts on agriculture and health**

- Impacts on Crops, crop cycles, soil quality and soil organic carbon
- Impacts on Livestock, fodder production and availability, livestock crisis management
- Impacts on Fisheries, fishing cycles and local community impacts due to change in fishing cycles
- Financial mechanisms for crop/livestock/fisheries loss insurances, state government policies and aids, central government policies and aids

#### **Unit-3:Climatechange impacts on forests and transportation**

- Forest dispersion and shifting, Forest fires
- Ecophysiological Responses, Tree Responses to Temperature and Water Availability
- Tree Responses to Increased CO<sub>2</sub>Concentration, Carbon Storage and Nutrient Availability
- Species Distributions, Transient Responses in Species Compositions, Potential Biome Distributions, Past and Future Species Migration Rates
- Biodiversity and related Adaptation mechanisms and strategies

#### **UNIT -4: Climate change impacts on energy and socioeconomic issues, methods of evaluation and/or assessment**

- Climate and Energy Systems and its relevance to various stakeholders in the energy sector
- The effects of climate change on power & heat plants – assessing the risks and opportunities
- Renewable sources, production mechanisms, project planning for solar pv, wind generation farms
- Forest biomass for fuel production – potentials, management and risks under warmer climate

### CLI-408: TOOLS AND TECHNIQUES FOR IMPACTS ASSESSMENT

#### **Unit-1: Methods of impacts and vulnerability assessment**

- Approaches: sensitivity, adaptability and vulnerability
- Key determinants of impacts: magnitude of change, rate of change, transient scenarios, climate variability and extreme events, thresholds
- Effect of complexities of analysis: climate uncertainties, socio-economic Uncertainties, low-probability catastrophic events, risk and uncertainties, valuation methods- monetary measures, discounting, validation
- Anticipating effects of climate change: scale of analysis for impact assessment, the Baseline for Comparison, how should Integrated Scenarios of Climatic and Socioeconomic Change be used? What are the Prospects for assessing the impacts of Climatic Extremes and variability?

#### **Unit-2: GIS & Remote Sensing**

- Introduction to Remote Sensing and GIS techniques : Satellites , Sensors, Platforms and Resolutions, Infrared and Microwave Remote Sensing : Principles and Applications, Interpreting Optical Remote Sensing Images
- Projection of climate change scenarios and Tools for mapping and monitoring
- GIS applications based on models outputs and GIS databases
- Remote sensing technologies to monitor climate change processes (vegetation biomass, monitoring flooding, soil moisture and depth, surface micro topography etc.)

- Remote sensing datasets and satellite based monitoring systems, parameters of oceanography

### **Unit-3: Climate Modeling**

- History of climate modeling
- Types and theory of models and Global climate models and energy Balance models.
- Emission scenarios, baseline scenarios
- Projections of global warming under different scenarios

### **Unit-4: Statistical Tools and Techniques for Impact Prediction**

- Definitions of future characterization
- Artificial experiments
- Sensitivity analysis
- Analogues, storylines, scenarios
- Social science research methodologies

## **CLI -409: POLICY AND LEGISLATION: NATIONAL AND INTERNATIONAL SCENARIOS**

### **Unit-1: UNFCCC and Montreal Protocol (MULTILATERAL ENVIRONMENTAL AGREEMENTS –MEA)**

- United Nations Conference on the Human Environment and United Nations Conference on Environment and Development (UNCED)
- Scientific and implementation bodies, actors in negotiation process
- Decisions of COP and MOP
- Subsidiary bodies of CDM (Designated National Authority, CDM-EB Executive board)
- Status of ratification and Links with Montreal Protocol and Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

### **Unit 2: The Kyoto mechanisms**

- Kyoto protocol: Objective , Status of Ratification, Flexible mechanisms
- Economic potential: Economics of market mechanisms : CDM , JI and ET
- Environmental problems
- Political barriers and Amendments to the Kyoto Protocol

### **Unit-3: Other national, regional and international legislative framework**

- National action plans of countries
- Reporting systems
- GHG reduction initiatives
- Clean energy and energy efficiency related regulations and Forestry regulations

### **Unit-4: Climate Change Policy**

- Climate change policy of countries
- Uncertainty and climate change policy
- Policy implications
- Cost-benefit analysis in the context of climate change

## **CLI -410: FUTURE CLIMATE SCENARIOS**

### **Unit-1: Decisions based on emissions**

- Integrated Assessment Modeling- Country-wise Case studies ( Example of Case study of Acid rain, Canada)
- Decision making processes: Three methods (eco-efficiency, environmental priority strategy (EPS) system, and certified emission reduction (CER) price, Considering cost and CO<sub>2</sub> emission
- Policy makers : Speculators
- Analysis and decision support tools in mitigation of Climate change.

### **Unit-2: Load sharing**

- Burden
- Equity
- Developed vs developing country
- Sandbag, Case study of Poland in Load sharing

### **Unit -3: Ethics**

- The perfect moral storm and its relevance on Climate Change (S. Gardiner)
- Skepticisms, past emissions, future emissions
- Environmental risk, impacts and direct interventions
- Collaborative Program on the Ethical Dimensions of Climate Change ,Climate Justice.

### **Unit-3: Sustainable Development**

- Concept: Definition, Pillars of sustainability. Sustainable development and Ecosystem, Agriculture, forestry and others sectors
- Stake holder: Defining stake holders, stake holder engagement and role of stake holders
- Ecological foot-print: Concept, definition, methodology and case studies.
- Indicators/Determinants: population dynamics and SD, integrative vs sectorial perspective of SD

### **Proposed Reference material**

- a. Climate change policy – A survey by Stephen Schneider, Armin Rosencranz and John Neils
- b. Climate change policy by Dieter helm, Oxford
- c. UNFCCC Handbook
- d. IPCC Third Assessment Report
- e. Climate Change: What it means for us, our children and our grand children by By Joseph F. DiMento, Pamela Doughman
- f. IPCC Technical Guidelines for Assessing Climate change Impacts and Adaptations
- g. An Introduction to Simple Climate Models used in the IPCC Second Assessment Report – IPCC Technical paper II
- h. Climate change: Causes, Effects and Solutions by John T. Hardy. Willey publication
- i. Climate change and technological options: basic facts, evaluation and practical solutions by Konrad Soyez and HartmutGabi, SpringerWien New York publication
- j. The complete guide to climate change by Brian Dawson and Matt Spanngle

### **CLI 411PR: Practical – III: Based on topics covered in CLI 407 and 408**

### **CLI 412PR: Practical – IV: Based on topics covered in CLI 409 and 410**



## SEMESTER –III

### CLI-501: CLIMATE CHANGE ADAPTATION

#### **Unit-1: Concepts and strategies**

- Definition and issues: Definition, Types of adaptation (Anticipator, reactive, human, natural), Systems, Scales, and Actors
- Methods of adaptation:
- Vulnerability and resilience: Concept, definition, methodology and case studies
- Sector –wise adaptation strategy (agriculture, forests, water resources, coastal resources, fisheries, human health), adaptation potential and challenges

#### **Unit-2: Costs and Benefits**

- Framework for estimating benefits and cost to adaptation
- Linking variability to climate changes
- Case examples
- Economic and policy instruments to promote adaptation

#### **Unit-3: Adaptive Capacity**

- Introduction to Adaptive Capacity: Definition, concept and issues
- Determinants of adaptive capacity: Economic resources, Technology, Information and skills, Infrastructure, Equity and Institution.
- Methods of enhancing adaptive capacity in sectors: Agriculture, Forestry
- Methods of enhancing adaptive capacity in sectors: Social, Rural, Urban, Coastal.

#### **Unit-4: Adaptation and Development**

- Tools to address climate risks in development activities
- Tools and approaches to incorporate vulnerability and adaptation in development projects
- NAPAs, CBA, ALM, APF,SEA,CC-DARE
- Disaster risk reduction-policy and plans

### CLI-502: CLIMATE CHANGE MITIGATION

#### **Unit-1: Mitigation strategies and options for various sectors**

- Basic concepts , methodology and Structure of mitigation assessment
- Improved energy efficiency, fuel substitution, hydropower, carbon capture and sequestration, land based carbon sinks
- General and technology specific barriers and The rebound effect
- Equity and sustainability issues, issues of biodiversity
- Assessment of mitigation costs and benefits

#### **Unit-2: Emission trends and mitigation policies**

- Sector-wise measures and instruments to mitigate climate change : Short term and Long term Mitigation action
- New and clean technologies
- Emission standards : Vehicle emission performance standard : CARB, EURO and Bharat Stage
- Sustainable development and climate change mitigation

#### **Unit-3: Carbon Market**

- Carbon Markets :Emission trading ,Carbon accounting, Carbon Offsets, Tradable Permits and Leakage
- Structure of international carbon market ,allowance and project based markets : Chicago Climate Exchange, European Climate Exchange, European Energy Exchange, NASDAQ OMX Commodities Europe , Power Next, Commodity Exchange Bratislava,
- Pricing structures and Formulation : Fixed, Floating, Combination of the two ,Buyers and sellers of carbon assets

- Transactions and trends and Voluntary carbon market

#### **Unit-4: Renewable and alternative energy technologies**

- Technology options: Biomass, Solar, Hydro, Geothermal and Wind.
- Technology transfer, Current Transfer of Climate Change Mitigation Technology, Methodological and Technological Issues in Technology Transfer, Barriers to Technology Transfer.
- Stakeholders and pathways for energy supply technology transfer
- Case examples : Transfer of technologies between countries , Programmes and Policies for Technology Transfer between Countries.

### **CLI-503: ISSUES NEED ATTENTION**

#### **Unit-1: Sustainable forest management**

- Present area
- Reduction
- Strategies
- Adaptation

#### **Unit-2: Coastal zone management**

- Notification
- Ocean development
- Mangrove ecosystem
- Initiative and mitigation of coastal hazards

#### **Unit-3: Land use and cover management**

- Change
- Degradation
- Socio- ecological system
- Impacts

#### **Unit-4: Public awareness**

- Methods and ecology, economics and ethics: the missing links
- Life cycle analysis
- Role environmentalist
- Interface of science and policy

### **CLI-504 INTERNATIONAL RESPONSE AND INDIVIDUAL RESPONSIBILITY**

#### **Unit-1: Environmental Risk Assessment**

- Concept hazard identification, dose-response evaluation, exposure assessment, risk characterization
- Risk evaluation
- Public perception of risk
- Risk communication

#### **Unit-2: Environmental Impact Assessment**

- Concept
- Screening, scoping, prediction and mitigation, management and monitoring
- Preparing an Environmental Statement, Making a planning application and consultation
- Projects considered within the town and country planning regime. Local planning authorities

#### **Unit-3: Environmental Audit**

- Overall environmental management
- Procurement policy, Energy management, Materials management, Water and wastewater management, Waste management, Noise monitoring and control, Air quality monitoring and control, Emergency response procedures

- Transportation and travelling, Staff awareness and training, Publicity of environmental information, Response to public enquiries and complaints, Setting, process and carrying out an audit, Benefits of environmental audit
- Environmental audit programme in India

#### **Unit-4:Individual responses**

- Footprint and Handprint concept
- Awareness programs
- Case studies
- Youth participation and engagement activities, youth organization and membership opportunities, interventions and conferences and guideline development for regular participation

#### **Proposed References Material**

- a. The Earthscan reader on adaptation to climate change By Lisa Schipper, Ian Burton
- b. Climate change, adaptive capacity and development by Joel B. Smith, Richard J. T. Klein, SaleemulHuq, Potsdam-InstitutfürKlimafolgenforschung
- c. Mainstreaming Adaptation to Climate Change in Least Developed Countries (Ldcs) by SaleemulHuq, Atiq Rahman, International Institute for Environment and Development
- d. Climate Change and India: Vulnerability Assessment and Adaptation by P.R Shukla, Subodh Sharma, N.H. Ravindranath , Amit Garg and Sumana Bhattacharya
- e. Technologies, policies and measures for mitigating climate change- IPCC Technical paper I
- f. Climate change and sustainable development By Anil Markandya, Kirsten Halsnaes
- g. Climate change and carbon markets - A Handbook of emission reduction mechanisms By FarhanaYamin
- h. Voluntary Carbon Markets By Ricardo Bayon, Amanda Hawn, Katherine Hamilto
- i. State and Trends of the Carbon market- 2004, World Bank working paper no.44
- j. Carbon markets- an international business guide By Nick Eyre, Arnaud Brohé, Nicholas Howarth
- k. Handbook of Climate change mitigation options- USAID
- l. Climate change and developing countries by N.H.Ravindranath and Jayant Sathaye
- m. Primer on Climate change and Sustainable Development: Facts, policy analysis and applications by Mohan Munasinghe and Rob Swart
- n. New and Renewable technologies for sustainable development by NaimHamdiaAfgan and Maria da GracaCarvalho
- o. Renewable energy: Technology, Economics and Environment by Martin Kaltschmitt, Wolfgang Streicher, Andreas Wiese

#### **CLI 505PR: Practical – V: Based on topics covered in CLI 501 and 502**

#### **CLI 506PR: Practical – VI: Based on topics covered in CLI 503 and 504**

#### **SEMESTER-IV**

##### **Dissertation**

The dissertation is an independent research work relating to the cutting edge of climate change and management research. It develops skills in formulating research questions, and analysis/evaluation of results using appropriate techniques.