



**DARBARI SETH BLOCK, INDIA HABITAT CENTRE,  
LODHI ROAD, NEW DELHI**

**SUB: TWELFTH MEETING OF THE ACADEMIC COUNCIL  
AGENDA NOTES**

Date : 27 July 2005  
Venue : Conference Room, TERI  
Time : 10.00 am

<b>Item No.</b>	<b>Particulars</b>
Item No. 1	To confirm the minutes of the eleventh meeting of the Academic Council held on 7 <sup>th</sup> March 2005
Item No. 2	Matters for information
Item No. 3	To report the decisions taken by the Executive Committee of the Academic Council on behalf on the Academic Council.
Item No. 4	To consider and approve the revised structure for the M.Sc Environmental Studies and Natural Resources programme.
Item No. 5	To consider and approve M.Sc Environmental Studies and Natural Resources programme courses.
Item No. 6	Courses in the pre Ph.D. programme of the School
Item No. 7	Creating the post of Lecturer.
Item No. 8	Any other item with the permission of the Chair.

**Item No. 1 To confirm the minutes of the eleventh meeting of the Academic Council held on 7<sup>th</sup> March 2005**

The minutes of the eleventh meeting of the Academic Council held on 7<sup>th</sup> March 2005 were circulated to the members. No comments have been received so far.

The Academic Council may, therefore, consider confirming the minutes, as circulated.

**Item No. 2 Matters for information**

- (i) Two Ph.D. students from the Centre for Bioresources and Biotechnology, Mr Vanit Kathuria and Ms Vaishali Sabharwal successfully defended their Ph.D. theses on 2 April 2005 and 6 June 2005 respectively.
- (ii) The following faculty members have joined the School with effect from the dates indicated against their names:
- |                    |                     |             |
|--------------------|---------------------|-------------|
| Dr Arabinda Mishra | Associate Professor | 11 May 2005 |
| Dr Surender Kumar  | Associate Professor | 12 May 2005 |
| Dr Ram Karan Singh | Associate Professor | 26 May 2005 |
- (iii) The final designs for the new campus at Vasant Kunj have been cleared by the concerned agencies and construction has commenced at the site. The campus is expected to be operational by July 2006.
- (iv) The first batch of 17 students have successfully completed the M.Sc programmes in Environmental Studies and Natural Resources. 2 students have been placed with Development Alternatives 1 with World Wide Fund for Nature (WWF) and 1 with Shree Cements. 3 students have joined Ph.D programmes at IIT, Delhi & at TERI School and 1 student has joined an M.Phil programme at IIFM. The Placement Cell continues to make efforts to place the remaining.
- (v) 4 students in the M.A. (Regulatory Studies) programme have completed one year of course work and will now move to the research phase of the programme.
- (vi) The M.A (Public Policy and Sustainable Development) programme will commence from 2<sup>nd</sup> January 2006. This programme is being sponsored by Department of Personnel and Training. The last date for receipt of applications is 15 September 2005.

presentation by students

presentation to FOER - need to educate them

Send info to Govt. Council members

1/2 page of readings

VR Mehra / Look into placements

**Item No. 3 To report the decisions taken by the Executive Committee of the Academic Council on behalf on the Academic Council.**

**(i) Academic Chairs at the TERI School of Advanced Studies**

A draft policy for Academic Chairs at the TERI School of Advanced Studies was recommended by the Executive Committee on behalf of the Academic Council. The draft policy is placed at Annexure 3.1. The Academic Council is requested to concur with the recommendation.

**(ii) Appointment of NTPC Chair Professor**

NTPC has given an endorsement to TERI School of Advanced Studies for a Chair in the Department of Policy Studies for the programme leading to the award of M.A (Regulatory Studies) degree. The Executive Committee, on behalf of the Academic Council, had recommended the name of Mr S Sundar for appointment to the Chair. Mr S Sundar has made important contributions in the field of regulation and to the TERI School of Advanced Studies in the Department of Policy Studies. The Academic Council is requested to concur with this recommendation.

**(iii) Eligibility criteria for Ph.D. admission**

As per the existing rules, the minimum qualifications for admissions to the Ph.D. programme in the Faculty of Policy and Planning read as follows:

- (a) M.A. or M.Phil in economics, statistics, mathematics, operations research or any allied field
- (b) Master's degree in science or bachelor's degree in engineering or technology

The Executive Committee on behalf of the Academic Council, approved an amendment in the minimum qualifications to read as follows:

- (a) M.Sc./M.A./M.Phil in a relevant field or equivalent
- (b) Bachelor's degree in engineering/ technology or equivalent

The Academic Council is requested to concur

**Item No. 4 To consider and approve a revised structure for the M.Sc Environmental Studies and Natural Resources programme.**

Based on the experience gained in the last 2 years of the M.Sc programmes and on the feedback received from the students and prospective employers, a revised structure has been developed for the two programmes. The existing structure is placed at Annexure 4.1 and the revised structure is placed at Annexure 4.2. The major changes proposed include a revision of the minimum credit requirement for the award of the degree from 88 to 95, deletion of 1 minor project and inclusion of the second minor project in the summer semester between the first and second years of the programmes, introduction of the elementary maths in the syllabus and restructuring of the elective courses offered in the III semester. The Academic Council is requested to consider and approve the revised structure of the programmes.

*MA prog  
shud extend  
to  
PhD prog*

*integrated  
programme*

*change of  
name  
approved*



**Item No. 5 To consider and approve M.Sc Environmental Studies and Natural Resources programme courses.**

The course outlines for the courses which have been revised based on the revised structure of the programmes are placed at Annexure 5.1. These have been approved by the Board of Studies in its meeting held on 13 July 2005 of the Department of Natural Resources. The Academic Council is requested to consider and approve the course outlines.

**Item No. 6 Courses in the pre Ph.D. programme of the School**

The rules of the School require the students undergoing the Ph.D. programme to complete a minimum number of credits before they are formally admitted to the candidature of the Ph.D. degree. The course requirements are determined by the DRC/CRC on the recommendation of the SRCs, after due consideration to the background of the student in relation to the proposed topic of research.

Pre-Ph.D. courses are offered by Centres and Departments. In addition to these, it is proposed to enable SRCs to recommend approved M.Sc/MA courses for Ph.D. students. Credits earned through these courses would count towards the credit requirements decided by the DRC/CRC. This would give a wider scope to the courses studied by the student before starting his /her research. The Academic Council is requested to consider and approve.

*ok*

**Item No. 7 Creating the post of Lecturer.**

The development plan of the School envisages the posts of Professors/ Associate Professors/ Assistant Professors. This was keeping in mind that TERI School is a post graduate university and faculty members would be required to guide Ph.D. scholars in their research. It is now felt that in some areas of specialization it might not be possible to get a Ph.D. qualified candidate. In such cases it is proposed to employ candidates as lecturers. The Academic Council, is requested to discuss and recommend creation of posts of lecturers with the following pay scale and eligibility criteria.

Pay Scale: 10,000-325-15,200

Eligibility Criteria: Masters degree with a first class or equivalent (in terms of grades etc.) in the appropriate subject with a very good academic record throughout.

**Item No. 8 Any other item with the permission of the Chair.**

*Change of name to HSE (NR mgmt)*

*Notes in  
participatory nature of the institution  
ultimately → marketability is the benchmark  
Placement  
Nathaniel Brain Research Institute  
Scientific Advisory Board Committee*

*newsletter  
Presentation by students  
at A C*

*Quality - benchmarking*





## Policy on Academic Chairs

This policy lays down the modalities for establishment and designation of Chairs and the responsibilities that go along with the Chair.

### Criterion for Chairs

The principle criterion governing the establishment of chairs at the TERI School of Advanced Studies is that they advance the School's academic goals and objectives. The Chairs would also be an opportunity for the School to recognize a benefactor or to honour a scholar. The academic chairs would recognize and support faculty members of exceptional academic distinction.

### Selection to the Chair

A Chair will be attached to a Department or Centre of the School. The appointment to the Chair would be done by the Board of Management of the School on the recommendation of the Academic Council. The criteria for selection of the Chair will be that the individual have made an important contribution to the School, society or to a particular field of study.

### Desirable Qualifications

The incumbent to the Chair shall demonstrate the following knowledge, skills, abilities and experience:

- Knowledge of curricula development, evaluation and revision
- Knowledge of trends and developments in the related areas.
- Leadership skills.
- Ability to maintain effective interpersonal relations in dealing with students, staff of the department, of other departments and management.

- Ability to analyse data and information, reason logically and develop, evaluate and present alternative solutions effectively.
- Ability to evaluate, advise and assist in the development and improvement of courses.
- Creative, independent judgement

### **Naming of the Chair**

Naming of the Chair will be decided jointly by the donor and the School. This will be subject to approval by the Board of Management of the School. //

### **Terms and Conditions**

The academic appointment to an endowed Chair will normally be full-time, with tenure, at the rank of a professor. The Chair, subject to the conditions of the endowment, may be renewed at the end of the tenure, subject to periodic review and subject to the policies of appointment at the School. The terms and conditions of appointment will be the same as those for a full-time professor of the School.

### **Role of the Chair**

It is intended that the holder of the Chair will contribute to the growth of the School and in particular to the area in which the Chair has been established. The chair is expected to work closely with the Dean to shape academic vision and serve as a key link between the Dean and the department.

The following are some of the key responsibilities of the chair:

- Provide academic leadership and vision for the department.
- Aid in publicizing and generating interest in the programmes of the department.
- Assist in building the various courses and in the approval processes.
- Stimulate the department by generating ideas and initiatives.
- Take classes and contribute to relevant courses in that area.
- Initiate and contribute to research in that area.
- Generate interest and contribute towards publishing in the area.
- Contribute to academic planning.
- Develop links with industry and academia.
- Enhance the resources of the department through proposal writing and fund-raising initiatives.
- Help in managing departmental resources.
- Communicate news/ latest developments in relevant subjects in the area.
- Promote faculty development by mentoring or providing mentors to junior faculty.
- Foster leadership experience for appropriate faculty.
- Foster a climate of collegiality and respect.

- Safeguard the interests of the students.
- Assist in faculty searches

The Chair is expected to contribute to the School, in general, by being a role model.

### **Disestablishment**

In the event that the funding no longer supports a Chair, it may either be disestablished by mutual agreement between the School and the donor, or the Chair may be converted to a faculty appointment as a professor.

### **Funding**

The principle revenue for a designated Chair may be in the following forms:

1. A perpetual Chair, which will be sustained from the interest on an endowment.
2. A tenure Chair that will be sustained for the period of the tenure through annual or one-time payment. The capital and investment revenue will be expended over the stipulated period of time, at the end of which, the designated Chair will be terminated.

Funding is expected to be sufficient to provide the cost of the Chair. It is expected to cover the salary and allowances of the incumbent and an appropriate amount for research. The funding may be secured from a benefactor, from a funding agency or from any organization/trust. The funding amount will be such that the School does not require to provide funds from its own budget, unless so decided in advance. The financial resources, and their use, will be reported in the annual financial statement of the School.

In certain cases, a Joint Chair may be established on terms jointly agreed to by both the parties and the School.

### **Fund Management**

Funds towards the Chair and expenses on the Chair will be shown separately in the statement of accounts of the School. The endowment money given to the School for a Chair will be merged with the corpus of the School and will be managed by the Director of the School.





teri school of  
advanced studies

Darbari Seth Block, India Habitat Centre,  
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*Courses in Semester I*

NRS 121 (Ecology)	Credits: 4
NRS 131 (Environmental chemistry)	Credits: 4
NRS 111 (Introductory statistics)	Credits: 3
BBT 151 (Environmental biotechnology)	Credits: 4
NRS 101 (Communication skills)	Credits: 4
NRS 141 (Basic course in environmental and resource economics)	Credits: 4

*Courses in Semester II*

NRS 172 (Geomatics for natural resource management)	Credits: 4
NRS 142 (Environmental law and policy)	Credits: 4
NRS 122 (Silviculture & forest measurements)	Credits: 4
NRS 162 (Basics of watershed science)	Credits: 4
NRS 132 (Environmental pollution and control)	Credits: 4
NRS 104 (Minor Project-I)	Credits: 4

*Courses in Semester - III (Elective Courses)*

*Environmental Studies*

NRS 187 (Solid and hazardous waste management)	Credits: 3
BBT 153 (Environmental bioremediation)	Credits: 3
NRS 133 (Environmental pollution monitoring and auditing)	Credits: 3
NRS 147 (Environmental economics)	Credits: 3
NRS 145 (Integrated impact assessment: environment, health and social impacts)	Credits: 3

*Natural Resources*

NRS 183 (Soil conservation and land management)	Credits: 3
NRS 171 (Environmental modelling)	Credits: 3
NRS 185 (Water conservation)	Credits: 3
NRS 123 (Biodiversity conservation)	Credits: 3
NRS 125 (Forest protection)	Credits: 3
NRS 143 (Resource economics)	Credits: 3
NRS 181 (Sustainable resources management)	Credits: 3

*Courses common for both the streams*

NRS 149 (Governance and management of natural resources)	Credits: 3
NRS (Impacts of climate on ecosystems and society)	Credits: 3
NRS 103 (Environment journalism and media relations)	Credits: 2
NRS 173 (Research methods)	Credits: 2
NRS 105 (Minor Project-II)	Credits: 4

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*Semester – IV*

NRS 102 (Major project)	Credits: 18
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Department of natural Resources  
Darbari Seth Block, India Habitat Centre,  
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## MSc Program

### *Courses in Semester I*

1. Ecology	Credits: 4
2. Environmental chemistry	Credits: 4
3. Introductory statistics and mathematics -I	Credits: 4
4. Cultural Ecology and Development	Credits: 3
5. Environmental law and policy	Credits: 4
6. Environmental Biotechnology	Credits: 3
7. Communication Skills	Credits: 2

Total **Credits: 24**

### *Courses in Semester II*

1. Introductory statistics and mathematics -II	Credits: 3
2. Geomatics for natural resource management	Credits: 4
3. Environmental pollution and control	Credits: 4
4. Biodiversity Assessment and Conservation	Credits: 4
5. Basic course in environmental and resource economics	Credits: 4
6. Basics of Watershed Science	Credits: 4

Total **Credits: 23**



**Summer Semester**

Minor Project-I (Area of specialization with an interdisciplinary approach) Credits: 4  
 Courses in Semester - III (Concentration areas) **Total credits=24**

SN	Environmental Studies	Natural Resource Management
2	<p>Electives (any 6 courses)</p> <ol style="list-style-type: none"> <li>1. Research Methodology</li> <li>2. Env. Pollution monitoring and auditing (Complementing course: <i>Environmental modelling</i>)</li> <li>3. Solid and hazardous waste management (Complementing course: <i>Environmental bioremediation</i>)</li> <li>4. Environmental Modelling</li> <li>5. Integrated Impact Assessment (Complementing course: <i>Environmental modelling</i>)</li> <li>6. Climate Change (Complementing course: <i>Environmental modelling</i>)</li> <li>7. Environmental Economics</li> <li>8. Environmental bioremediation (Complementing course: <i>Solid and hazardous waste management</i>)</li> <li>9. <i>Minor Project 2 (compulsory)</i></li> </ol>	<ol style="list-style-type: none"> <li>1. Research Methodology</li> <li>2. Trees outside Forests</li> <li>3. Water conservation</li> <li>4. Soil conservation and Land management (Complementing course: <i>Water conservation</i>)</li> <li>5. Resource economics</li> <li>6. Integrated Impact Assessment (Complementing course: <i>Environmental modelling</i>)</li> <li>7. Governance and management of natural resources</li> <li>8. Policy analysis for Sustainable resource management</li> <li>9. Environmental modelling</li> <li>10. Silviculture and Forest Measurements</li> <li>11. <i>Minor Project 2(compulsory)</i></li> </ol>

**IV Semester (Major project)**

Credits:20

Students will be required to work on a research problem, using appropriate methodology, with an interdisciplinary approach. The thematic area of the major project should be related to their respective stream of specialization

Course No.: NRS 111

Course title: **Statistics and Mathematics-1**

Number of credits: 4 (3-1-0)

No. Of lectures-tutorial-practical: 42-14-0

Faculty: Prof.A.N.Nankan

**Objective: The course is designed to serve as a foundation course in order to meet the requirement of mathematical knowledge in various subsequent courses offered in the master's program of Environmental studies and Natural resources.**

**Evaluation procedure:**

Tutorials/assignment: 10%

2 minor tests: 40%

1 major test (end semester): 50%

**Detailed course out line and lecture plan:**

No	Topic	Allotted time (hours)		
		Lectures	Tutorials	Practical
1.	<b>Statistics</b>			
	Introduction, role of statistics in learning and decision makings	1		
	Types of data: primary and secondary data	1/2		
	Data reliability different sources of primary and secondary data collection	1/2		
2.	<b>Summarization of data</b>			
	Graphical representation of data using different methods	2	1	
	Frequency distribution, histogram, frequency curve, frequency polygon cumulative frequency curves and their interpretations.	2		
	Measures of center tendency/positioning; mean for ungrouped and grouped data, weighted mean, geometric mean, harmonic mean, median, and mode and their properties and comparison	1	1	
	Measures of dispersion: dispersion, range, variance, standard Deviation, coefficient of variance, quartile and percentile values, skew ness and related properties	2	2	
3.	<b>Probability</b>			
	Concepts, meaning, different methods for calculating, laws of addition and multiplication of probability, independent events joint probability and marginal probability, probability of compound events	3	1	

	Conditional probability, Bayes theorem, Concept of random variable, discrete and continuous random variables, expected value, variance	1	2	
4.	<b>Probability Distributions</b>			
	Binomial distribution, Poisson and normal distribution and Applications	2		
5.	<b>Sampling theory &amp; Distributions</b>			
	Types of sampling, sampling techniques, introduction to sampling distributions, standard error	2		
	Sampling from normal distributions, sampling distribution of mean, t-distribution, chi –squared distribution and F - distribution, central limit theorem	2	1	
6.	<b>Sets</b> Sets and their representation Finite and Infinite Sets Empty Sets, Equal Sets, Subsets, Power Sets, Universal Sets, Venn Diagrams, Complements of a set, Operations and Applications of Sets	2		
7.	<b>Relations and Functions</b> Ordered Pairs, Cartesian Product of Sets, Relations, domain, co-domain and range, Functions – into and onto, Constant function, identity function, Composition of functions, Invertible functions, Binary operations	3	1	
8.	<b>Logarithms</b> Meaning of logarithm to a base a, Laws of logarithms, characteristic and mantissa, antilogarithms, tables, applications	2	1	
9.	<b>Complex Numbers</b> Representation of Complex numbers in rectangular and polar coordinates, graphical representation, Algebra of complex numbers	2	1	
10.	<b>Linear equations</b> Graphical representation, solution of linear equations in one and two variables	2		
11.	<b>Quadratic Equations</b> Solution of quadratic equations, relation between roots and coefficients, nature of roots, formation of quadratic equations with given roots, symmetric functions of roots, equations reducible to quadratic equations	3	1	



12.	<b>Functions, Limits and Continuity</b> Concept of a real function, Domain and Range, Types of functions and their graphs, Fundamental theorem of limits and proofs of standard limits, Limit at infinity and infinite limits, Continuity of a function (i) at a point (ii) over an open / closed interval, sum, product and quotient of continuous functions, continuity of special functions	9	2	
	<b>Total</b>	<b>42</b>	<b>14</b>	

**Basic textbooks (around 3-4)**

Mathematical Statistics by Freund and Walpole.

Biostatistical Analysis by Jerrold. H. Zar, Prentice Hall of India.

Regression Analysis by Draper and Smith.

Sampling Methods by M.N. Murthy.

**Other suggested readings**

Statistics with Application in Biology and Geology by Preben Blaesild and Jorgen Granfeldt, Chapman and Hall.

Statistical Methods in Bioinformatics by Warren J. Ewens, Gregory R. Grant, Springer.

Course No.: NRS 112

Course title: **Statistics and Mathematics-2**

Number of credits: 3(2.5-0.5-0)

No. of lectures-tutorial-practical: 35-7-0

Faculty: Prof.A.N.Nankanan

**Objective:** This course is the extension of the *Statistics and Mathematics-1*. The main objective of this course is to supplement the additional material which is not being covered in previous course so that it can fulfill the need of mathematical knowledge required to work with the subsequent courses offered for master's program of *Environmental Studies and Natural resources*.

**Evaluation procedure:**

Tutorials/assignment: 10%

2 minor tests: 40%

1 major test (end semester): 50%

**Detailed Course Outline and Lecture Plan:**

		Lectures	Tutorials	Practical
1	<b>Statistical Process Control (SPC)</b>			
	Chance of Assignable Causes, Process Capability, US Tolerance Economics of Control Charts, Charts for attribute, variable of special SPC system	2	1	
2	<b>Sampling Inspections</b>			
	Sampling versus nonsampling errors, Economy of 100% versus sampling inspection, Lot inspection concepts and Sampling Plan(AQL,RQL, Suppliers and Consumers Risks)	2	1	
3	<b>Estimation</b>			
	Estimator, estimate, Criteria of good estimator, types of estimation, point estimation	1		
	Interval estimation of Population proportion, population mean and population standard deviation and sample size determination.	2	1	
4	<b>Tests of hypothesis</b>			
	Decision-making using data, concepts of hypothesis testing, types errors, level of significance, critical region, and steps for testing of hypothesis.	2		

	Testing for specified proportion, test for specified mean, variance based on one sample. Test for equality of two proportions, test for equality of two populations and variance	2		
	Contingency table and applications of Chi square distribution Equality of two or more proportion, test of dependence of traits	2	2	
	Types of relationships, Simple regression, scatter diagram	1		
	Method of least squares, correlation coefficient, coefficient of determination	2		
	Nonlinear regression, multiple regression analysis	1	2	
5	<b>Differentiation</b> Derivative of a function: its significance, Continuity and differentiability, Derivatives of sum, product and quotient of functions, derivatives of special functions – logarithmic, trigonometric, exponential, inverse trigonometric, implicit, Applications of derivatives, Roll's theorem, Mean Value Theorem	6		
6	<b>Indefinite Integrals</b> Properties of integrals, Solution by substitution, partial fractions etc., Solution of various types of integrals	6		
7	<b>Definite Integrals</b> Definition, Fundamental theorems of definite integrals and evaluation of definite integrals, Application of Definite Integrals	6		
		<b>35</b>	<b>7</b>	

**Basic textbooks (around 3-4)**

Mathematical Statistics by Freund and Walpole.

Biostatistical Analysis by Jerrold. H. Zar, Prentice Hall of India.

Regression Analysis by Draper and Smith.

Sampling Methods by M.N. Murthy.

**Other suggested readings**

Statistics with Application in Biology and Geology by Preben Blaesild and Jorgen Granfeldt, Chapman and Hall.

Statistical Methods in Bioinformatics by Warren J. Ewens, Gregory R. Grant, Springer.



## NRS 111: Communication Skills

### Objective

Students of science are rarely trained in writing or speaking but the fact is that sooner or later, they will have to present what they have learnt, either verbally or in an examination, and later, as they start working on real life situations. They are needed to communicate their point of view, respond to others', comprehend a range of styles of delivery, and have a sufficiently well-developed style of their own, with the assurance of their own communication abilities. Both, what they write and how they write it, are important and equally important are how and what they say, especially when they move out into jobs after obtaining their degrees.

In the realm of the social and life sciences, as in other areas, communication is specialized: there are special terms belonging to the subject that must be used to describe phenomena, behaviour, and experiences. Here, the significance of precision and clarity cannot be over-emphasized, but it must be recognised that clarity in writing is an outcome of clarity in thought. Students are often unable to think for themselves hampering the ability to write/express themselves clearly, despite having an adequate vocabulary.

Students are, all too often, unaware of the requirements of formal effective communication and its growing significance in today's era of globalization.

This course aims to fill in the gaps identified above. By the end of the semester, students ought to

- 1 Become aware of the importance of speaking and writing with precision, economy and clarity and be trained in ways of achieving these goals.
- 2 Analyse and structure information/data and understand its importance.
- 3 Get acquainted with the requirements of formal and scientific writing and use them.
- 4 Be able to produce a document/report that is sound in content as well as style.

### Syllabus

#### Module 1 Comprehension and analysis (28 lectures)

Topic	Number of hours
Reading, summarising books (prose)/substantial chunks of reading material of a relatively high level.	6
Designing small research tasks aimed at identifying the components of a piece of research – introduction, literature review, materials, methods, results, discussion, summary, conclusions.	6
Presenting one small presentation meeting all specified requirements (graphs, tables, figures, etc.)	8
Writing assignments to develop free thinking, presentation of opinions, judgements and analyses. Comments and critique given by other students.	6

Topic	Number of hours
Formulation of questions on different topics.	3
Discussions on a variety of random topics (group discussions). Repeated exposure to deficiencies in writing. Repeated exposure to well-written work. Exercises in contrasting the two.	3

Module 2: Communication techniques (to be taught in the form of a one- or two-day intensive workshop)

Purpose, audience, content, presentation
Alternatives to prose 1: lists
Alternatives to prose 2: tables
Alternatives to prose 3: illustrations
Scholarly communication: the process
Searching and retrieving information from the Internet
Mechanics of bibliographies and references
Communication for information: research papers, reports, articles
Communication for persuasion: proposals and CVs
Interpersonal communication through text: letters, faxes, e-mails
Presentations

*Core reference*

The following three books are the core reference books; the library may consider buying multiple copies of each.

- 1 Joshi Y. 2003  
*Communicating in Style*  
New Delhi: The Energy and Resources Institute. 250 pp.
- 2 Montgomery S L. 2002  
*The Chicago Guide to Communicating Science*  
Chicago, Illinois, USA: University of Chicago Press. 228 pp.  
[Chicago Guides to Writing, Editing, and Publishing]
- 3 Jones D and Lane K. 2002  
*Technical Communication: strategies for college and the workplace*  
New York: Longman. 782 pp.

*Supplementary reading*

The following 15 books are recommended as supplementary reading, with the most recent listed first. Every topic draws upon relevant sections from one or more of these, which makes specific page numbers redundant. Reference will also be made to relevant web sites and corresponding URLs supplied to students.

- 1 Few S. 2004  
*Show Me the Numbers: Designing tables and graphs to enlighten*  
Oakland, California: Analytics Press. 265 pp.
- 2 Atkinson M. 2004  
*Lend Me Your Ears: all you need to know about making speeches and presentations*  
London: Vermilion [Ebury Press, Random House]. 376 pp.
- 3 Leigh J. 2004  
*CVs and Job Applications*  
Oxford, UK: Oxford University Press. 144 pp.  
[One Step Ahead series]
- 4 Peters P. 2004  
*The Cambridge Guide to English Usage*  
Cambridge, UK: Cambridge University Press. 608 pp.
- 5 Miller JE. 2004  
*The Chicago Guide to Writing about Numbers*  
Chicago: University of Chicago Press. 312 pp.
- 6 Taylor S. 2004  
*Model Business Letters, E-mails & Other Business Documents, 6th edn*  
Singapore: Pearson Education (Singapore). 498 pp.
- 7 Alley M. 2003  
*The Craft of Scientific Presentations: critical steps to succeed and critical errors to avoid*  
New York: Springer-Verlag. 242 pp.
- 8 White J W. 2003  
*Editing by Design: for designers, art directors, and editors: the classic guide to winning readers*  
New York: Allworth Press. 248 pp.
- 9 Zelazany G. 2001  
*Say it With Charts: the executive's guide to visual communication*  
New York: McGraw-Hill. 226 pp.
- 10 Wurman R S. 2001  
*Information Anxiety 2*  
Indianapolis, Indiana, USA: Que. 308 pp.
- 11 Rushkoff D. 1999  
*Coercion: why we listen to what "they" say*  
New York: Riverhead Books. 294 pp.
- 12 Lutz W. 1997  
*The New Doublespeak: why no one knows what anyone's saying anymore*  
New York: HarperCollins. 256 pp.
- 13 Cutts M. 1995  
*The Plain English Guide: how to write clearly and communicate better*  
Oxford, UK: Oxford University Press. 162 pp.



- 14 Salant P and Dillman D A. 1994  
*How to Conduct Your Own Survey*  
New York: John Wiley. 232 pp.
- 15 Tannen D. 1992  
*You Just Don't Understand: women and men in conversation*  
London: Virago Press. 330 pp.

**Course Title: Cultural Ecology and Development**

Number of Credits: 3

Number of Lectures-Discussion and Review

Faculty Name: Avanish Kumar

**Course Outline**

The course intends to build ethno-scientific perspective of human-environment relationship. This course critically analyzes dynamic features of human societies and their use of natural resources, both in the historical and the contemporary situations. The course familiarizes students with community practices and their worldview on culture and environment. The course seeks to build different perspectives and understanding of the inter-relationships between cultural practices, environment and livelihoods in a socially relevant context.

Primary thrust of the course is to address relationship between culture and natural resource. For example, are natural resource management practices a consequence of or a cause of culture? Are these relationships similar at different times and in different places? Should any development in this context be regarded as a measure of evolutionary "success"? To organize the various answers to these questions, the course is divided into three parts (A) Theories and Concepts in Cultural Ecology (B) Community Resource Management and Culture, and (3) Control, Conflict and Development. To build scientific perspective, part A focuses on theories of various cultural ecologists, while part B expose students to extend their knowledge of different community based practices and part C exposes students on the challenges and constraints in development.

**Course Pedagogy**

The pedagogy would be interactive lectures and Review and discussion (book/case studies). These discussion and reviews focus on critical reading and understanding of literature and active participation of students in class discussion. The students will be evaluated on the quality of review. Each student will be responsible for leading at least two class discussions by preparing and sharing a short review (1000 words). The review should identify central concepts, critically evaluate them in relation to other issues/concerns in the course, and pose questions for discussion.

**Evaluation Procedure** (% of aggregate marks):

- Class discussion: 10 %
- Review (1000 words): 20 %
- 2 minor tests: 20 %
- 1 major test (end semester): 40 %

## Course Content

S. No	Topic	Allotted time (hours)	
		Lectures	Review/ Class Discussion
<b>Part A. Theories and Concepts</b>			
1	<i>Introduction to Cultural Ecology</i> Environmental Determinism, Positivism, Ecological Perspective, Population Ecology, Systems Ecology, Cultural Ecology, Ethno-Ecology	4	
2	<i>Human – Nature Interference</i> Levels of Adaptation, Behavioral Adaptation, Physiological Adaptation, Demographic Adaptation, Biological Evolution, Cultural Evolution, Mechanisms of Cultural Evolution.	2	
3	Approaches, Analogies and limitations in Cultural Ecology	4	1
<b>Part B. Community Resource Management and Culture</b>			
4	<i>Cultural Ecology and Community</i> Modes of production and Modes of Resource Use	3	2
5	<i>Cultural Ecology and Social Organization</i> Tribes and Caste	4	2
6	<i>Cultural Ecology and Religion</i> Sacred Grooves and community based resource management	4	2
<b>Part C. Control, Conflict and Development</b>			
7	Early Environment and Community Debate (forest and community)	4	2
8	Ecological Change, Development and Social Tension; Critical review of community based practices in India (Narmada and two other case studies)	6	2

### Required Texts:

Donald H. Hardesty. 1977. *Ecological Anthropology*. University of Nevada, Reno.

Julian Steward. 1955. 'The Concept and Method of Cultural Ecology' in *Theory of Culture Change*. Urbana: University of Illinois Press.

John W. Bennet. 1975. 'Ecosystem Analogies in Cultural Ecology' in Steven Polgar (ed.) *Population, Ecology and Social Evolution*. Mouton Publisher, The Hague 1975.



Roy A. Rappoport. 1973. 'The Sacred in Human Evolution' in Morton H. Fried (ed.) *Exploration in Anthropology: Readings in Culture, Man and Nature*. Thomas Y. Crowell Company, New York (pg.403-420).

Andrew P. Vadya . 1973. ' An Ecological Approach in Cultural Anthropology" in Morton H. Fried (ed.) *Exploration in Anthropology: Readings in Culture, Man and Nature*. Thomas Y. Crowell Company, New York (pg.249-253).

Madhav Gadgil and Ramchandra Guha. 1992. *This Fissured Land : An ecological History of India* . Oxford University Press, New Delhi.

Joan P. Mencher. 1994. Ecology and Social Structure: A comparative Analysis in Ramchandra Guha (ed.) *Social Ecology* . Oxford University Press, Delhi.

Madhav Gadgil and K.C.Malhotra 1994. The Ecological Significance of Caste in Ramchandra Guha (ed.) *Social Ecology* . Oxford University Press, Delhi.

B.K.Roy Burman. 1982. Transfer and Alienation of Tribal Land in Buddhadeb Chaudhuri (ed.) *Tribal Development in India: Problems and Prospects*. Inter-India Publications, New Delhi.

Marvin Harris. 1992. *The Cultural Ecology of India's Sacred Cattle*. Current Anthropology. 7:51-66.

Madhav Gadgil and V.D. Vartak. 1994. The Sacred Uses of Nature in Social Ecology by Ramchandra Guha , Oxford University Press, Delhi 1994.

Vandana Shiva et al. 1991. *Ecology and the Politics of Survival :Conflicts over Natural Resources in India*. United Nations University Press, Sage Publications, New Delhi.

Amita Baviskar. 2004. *In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley*. Oxford University Press, New Delhi.

Dataprasad Dabholkar. 1993. *Oh Mother Narmada : On the Hot Trail of a Controversy*. Willey Eastern Limited, New Delhi.

## Course Title: Research Methodology

Number of Credits: 4

Number of Lectures-Tutorial-Practical

Faculty Name: Avanish Kumar & Surrender Kumar

### Course Outline

The aim of the course is to build scientific perspective and attitude for scientific enquiry by creating knowledge and understanding of scientific explanation, elements of research design and quantitative and qualitative techniques. The course will provide a comprehension of principles and elements of research design to formulate research problems and research questions. It will introduce students to various tools and techniques related to quantitative and qualitative research methods– and will help in designing research study by combining both methods (qualitative & quantitative) for applied research. Fieldwork methods will help to understand and implement research ideas. It will discuss the limitations, benefits, appropriateness, and challenges of the qualitative and the quantitative techniques in the applied research.

The course is geared towards preparing students for carrying forward independent applied research. The course is divided into three main modules: Philosophy and Scientific Perspective, Elements of research design and Quantitative and Qualitative research methods. Overall, the course will build interest and perspective of students to develop and conduct independent scientific research in interdisciplinary applied studies.

Evaluation Procedure (% of aggregate marks):

- Class discussion: 20 %
- Tutorials/assignment: 20 %
- 2 minor tests: 20 %
- 1 major test (end semester): 40 %

### Details of course content & allotted time

No	Topic	Allotted time (hours)	
		Lectures	Tutorials/ Practical
<b>Philosophy of Research &amp; Scientific Explanation</b>		<b>5</b>	
1	Introduction to Research Methods, Relevance and Ambiguity in applied research,	1	
2	Ethics in Research	1	
3	Scientific Explanation and understanding in science, Characteristics of Scientific Research & Logic of Scientific Enquiry and notions of causality	1	
4	Introduction to Different Perspectives and types of research	2	
<b>Designing Research</b>		<b>9</b>	
5	Elements of research Design Meaning of Research Design; Need for Research Design; Features of a Good Design; Different types of Research Designs; Developing a Research Plan.	1	

6	Literature Review (including finding research gaps)	1	
7	Defining the Research Problem/ research questions and hypothesis: What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem;	1	
8	Hypotheses; types of hypotheses; Differences between hypothesis & research problem , Objectives and Result/Outputs	2	
9	Designing Questionnaire /Schedule, Questions, Constructing structured, Semi-structured and Non-structured questionnaire/interview, Closed Ended/Open types and relevance	2	
10	Developing Research Studies/Projects: Logical framework analysis and methods to plan resources and develop research studies	2	
<b>Quantitative Methods/Statistical Techniques</b>			<b>28</b>
11	Review of Matrix Algebra	2	
12	Multiple Regression Analysis: Introduction, assumptions and estimation	2	
13	Relaxing the Assumptions of the classical Model: heteroscedasticity, autocorrelation, multi-collinearity, errors in variable, dummy variables.	8	
14	Maximum Likelihood Estimation	2	
15	Simultaneous Equations: Introduction to simultaneous equation system, problem of identification, indirect least square method, two-stage least square method	8	
16	Analytical Hierarchal Process: An Introduction	2	
17	Operations Research: Linear Programming: Primal and Dual problems, Sensitivity Analysis	4	
<b>Qualitative methods and Techniques</b>			<b>14</b>
18	Character of Qualitative Research	2	
19	Qualitative Method Approach: Inclusive Notion, Frame and Terms of Reference, Deviation	1	
20	Fieldwork and Ethnography	2	
21	Application of Survey Research Methods	1	
22	Basic Principles and Art of Facilitating Participation and Interpretation	1	
23	Focus Group Discussion	2	
24	Extended Case Study/Case Study Method, genealogy methods	1	
25	Participatory Rural Appraisal tools, Techniques and methods	2	
26	Resource Assessment & Social Mapping/Planning, Social audit	2	



**Basic Reading Text:**

1. E. Nagel.1979. *The Structure of Science: Problems in the Logic of Scientific Explanation*. Macmillan India Ltd.
2. Ramkrishna Mukherjee.1989. *The Quality of Life: Valuation in Social Research*. Sage Publications, New Delhi
3. A. R.Singleton.Jr & C.B.Straits. 1999. *Approaches to Social Research*. Oxford University Press, New York.
4. White A Shirley. *The Art of Facilitating Participation: Realising the Power of Grassroots Communication*. Sage Publications, New Delhi.1999.
5. L.W.Neuman.1997. *Social Research Methods: Quantitative and Qualitative approaches*. Allyn & Bacon. 560 pp
6. Vinay Kumar Srivastava. 2004. (ed) *Methodology and Fieldwork*, Oxford University Press, New Delhi
7. D. Gujarati.2003. *Basic Econometrics*. McGraw Hills.
8. J. Johnston.2003. *Econometric Methods*. McGraw Hills.
9. Hamdy A. Taha. 1996. *Operations Research: An Introduction*. Prentice Hall.

## Biodiversity Assessment and Conservation

Number of credits: 4

Number of Lectures-Tutorial-Practicals: 35-14-14

Course coordinator: Dr. Neeraj Khera

### Course outline:

The course aims at providing students with detailed knowledge of the extent of the world's biodiversity and a critical awareness to the threat to biodiversity posed by human activities and current levels of extinction; an advanced level of knowledge of the biological principles underlying biodiversity assessment, conservation and management. The emphasis would be given to utilize analytical and communication skills of the students for analyzing and discussing real life problems related to biodiversity conservation.

### Evaluation procedure (Percentage of marks to be allotted to each type of test):

- 2 minor tests : 15 + 15
- Assignments/Presentations/Field visits : 15
- Practicals : 15
- 1 major test (end semester) : 40

### Details of course content & allotted time

No	Topic	Allotted time (hours)		
		L	T	P
1	<b>Introduction:</b> Defining biodiversity; Fundamental principles of genetic, species and ecosystem diversity; Introduction to taxonomic and systematic principles	2		
2	<b>Magnitude and Distribution of biodiversity</b> An overview of the variety of life forms; Global distribution of biodiversity, factors affecting species distribution, number of species worldwide, estimates and examples of recently discovered communities, abundance of species in different ecosystems of the world; concept of diversity Hot-spots; Biodiversity of India including medicinal plants and NTFPs	3	3	
3	<b>Assessment and monitoring of biodiversity</b> Methods of assessing and measuring biodiversity; Comparison of different sampling techniques; Diversity indices; tools for biodiversity data analysis; mapping distribution of species; techniques for monitoring plant, bird, insect, mammals, reptiles and fish biodiversity Use of Remote sensing and other advanced tools like GIS, GPS etc for biodiversity assessment  Genetic diversity	5	5	14
4	<b>Value of Biodiversity</b> Direct and indirect values; total economic value; ethical values; valuation techniques	2	2	

5	<p><b>Causes and consequences of biodiversity Loss:</b>  Estimates of extinction rates worldwide and in India; local extinctions, IUCN, National Red Data Books</p> <p>Vulnerability to extinction; Endemic species and island biogeography; rare and threatened species; Habitat destruction, fragmentation; overexploitation; Invasive species; Commercialization of agriculture and forestry; Impact of pollution and global climate change on biodiversity  <b>Consequences:</b> Food and economic security, livelihood</p>	4	3
6	<p><b>Conservation strategies:</b></p> <ul style="list-style-type: none"> <li>• <b>Theoretical background:</b> overview of genetic variability; population biology of endangered species; conservation genetics; wildlife biology <span style="float: right;">4</span></li> <li>• <b>Conservation of biodiversity within ecosystems-<i>In situ</i> conservation:</b> <span style="float: right;">5</span> <span style="float: right;">3</span>  Wild populations; community conservation; Gap analysis; Establishment of protected areas; Design and management of protected areas; Protected areas in India; Connectivity and corridors <span style="float: right;">1</span></li> <li>• <b>Ex-situ conservation:</b> Zoo; Gene bank; seed bank; aquaria; botanical gardens <span style="float: right;">2</span></li> <li>• Establishment of new populations, Captive breeding, reintroduction <span style="float: right;">2</span></li> <li>• <b>Conservation and society:</b> community involvement; indigenous knowledge system, restoration through peoples movement, sustainable resource use, Environment education and communication, biodiversity for livelihoods</li> </ul>		
8	<p><b>Legal and political scenario:</b>  Legislations; international agreements for the protection of species and habitats; Biodiversity act; Biodiversity register, Emerging International Policies</p>	1	
<b>Total</b>		35	14 14

**Practicals:**

1. Assessment of plant biodiversity in protected and unprotected forest (7 hours). (10%)
3. Assessment of bird diversity in a wetland (7 hours). (5%)

**Field Visits:**

1. Visit to a protected area to study Wildlife Census techniques. } 5%



2. Visit to a gene bank
3. Visit to a biodiversity information center

**Assignments and presentations:**

1. Herbarium/poster preparation (3%)
2. Presentation on the conservation status of any species/ecosystem. (3%)
3. Writing a newspaper article after critical analysis of a selected issue/ policy/ recent research in the field of biodiversity. (4%)

**Basic textbooks:**

1. Richard B. Primack. 1998. *Essentials of conservation biology* Sinauer Associates Inc., USA.
2. Hunter, M. L. 2001. *Fundamentals of conservation biology*, second edition. Blackwell Science, Cambridge, UK

**Other important Readings:**

**Books:**

1. Meffe, G. K. and Carroll, R. L. 1997. *Principles of conservation biology*. Second edition. Sinauer Associates Inc., USA.
2. Hunter, M. L. 1999. *Maintaining biodiversity in forest ecosystems*. Cambridge University Press. ISBN 0-521-63104-1.
3. Rodgers, W.A.1991. *Techniques for Wildlife Census in India: A Field Manual*. Wildlife Institute of India
4. Sutherlans, W, J. 2000. *The conservation handbook: Research, Management and Policy*. Blackwell Science, Oxford
5. Ildos and Bardelli. 2001. *The Great National Park of the World*. ISBN 81-87107-06-5. Om Book Service, New Delhi.
6. Singh and Singh. *A Pocketbook of Indian Pheasants*. Wildlife Institute of India, Dehradun.
7. V. B. Saharia. 1998. *Wildlife in India*. Natraj Publishers, Dehradun.
8. Salim Ali. 2002. *The Book of Indian Birds*. (13<sup>th</sup> edition). Bombay Natural History Society.
9. MacKinnon et al. 1996. *Managing Protected Areas in the Tropics*. Natraj Publishers, Dehradun.
10. David Black. 1981. *Animal Wonders of the World*. Orbis Publishing, London.
11. RLEK. *Community Forest Management In Protected Areas*. Natraj Publishers, Dehradun

**Papers:**

**Topic 2:**

1. Lauren F. Howard\*, Thomas D. Lee. Temporal patterns of vascular plant diversity in southeastern New Hampshire forests. *Forest Ecology and Management* 185 (2003) 5–20

**Topic 3:**

2. B. B. Salem. Application of GIS to biodiversity monitoring. *Journal of Arid Environments* (2003) 54: 91–114
3. Swamy, P S, Sundarapandian, SM, Chandrashekhar, P., and Chnadrashkharan, S (2000). Plant species diversity and tree population structure of a humid tropical forest in Tamil Nadu, India. *Biodiversity and Conservation*. 9: 1643-1669.

4. Khera, N, Kumar A, Jeet Ram and Tewari, A. (2001). Plant biodiversity assessment in relation to disturbances in mid-elevational forest of central Himalaya, India. *Tropical Ecology*, 42(1): 83-96

**Topic 5:**

5. Francisco Kelmo a,b, Martin J. Attrill a,\* , Rilza C.T. Gomes c, Malcolm B. Jones a. El Ni~no induced local extinction of coral reef bryozoan species from Northern Bahia, Brazil. *Biological Conservation* 118 (2004) 609–617
6. Nicholas Baxa,,Angela Williamsona, Max Aguerob,Exequiel Gonzalezb,Warren Geeves. Marine invasive alien species: a threat to global biodiversity. *Marine Policy* 27 (2003) 313–323

**Topic 6:**

7. L. G. Pearlstine, S. E. Smith, L. A. Brandt, C. R. Allen, W. M. Kitchens and J. Stenberg. Assessing state-wide biodiversity in the Florida Gap analysis project. *Journal of Environmental Management* (2002) 66, 127-144
8. *Designing Protected Areas: Wild Places for Wild Life*. Proceedings Summary of the Canadian Council on Ecological Areas (CCEA) and Circumpolar Protected Areas Network (CPAN) Workshop, September 9-10, 2003, Yellowknife, Northwest Territories ISBN 0-7708-0106-4

**Topic 8:**

9. A. DAMODARAN Conflict of Trade-Facilitating Environmental Regulations with Biodiversity Concerns: The Case of Coffee-Farming Units in India. *World Development* Vol. 30, No. 7, pp. 1123–1135, 2002

## Solid and hazardous waste management

Credits: 4

No. of lecture-tutorials-practical: 36-14-12

Pre-requisite for course: consent of teacher and attendance of course on environmental chemistry

The objectives of this elective course are:

- To expose the students to fundamental knowledge on different aspects of solid waste management by urban local bodies, healthcare units and industries
- To familiarize them with practices adopted in developed and developing countries for solid waste management

The course would cover - general introduction including definition of solid wastes – municipal waste, biomedical waste, hazardous waste, radioactive waste, e-waste; legal issues and requirements for solid waste management; sampling and characterization of solid waste; analysis of hazardous waste constituents including QA/QC issues; health and environmental issues related to solid waste management; steps in solid waste management - waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques (composting, vermi-composting, incineration, non-incineration thermal techniques, refuse derived fuels, land-filling); economics of the onsite vs. offsite waste management options (individual vs. common treatment/disposal practices, integrated waste management; and waste minimization and concepts of industrial symbiosis and industrial ecology. The course would comprise of 36 lectures, 14 hours of tutorials and 12 hours of laboratory work.

Topic	Allotted time		
	Lectures	Tutorials	Lab work
1. General introduction including definitions of solid waste including municipal, hospital and industrial solid waste; legal issues and requirements for solid waste management and health and environmental issues related to solid waste management.	3 hours		
2. Sampling and characterization of solid waste	3 hours		12 hours
3. Analysis of hazardous constituents in solid waste including QA/QC issues	3 hours	3 hours	
4. Health and environmental issues related to solid waste management	2 hours		
5. Waste reduction at source – municipal and industrial wastes	2 hours	2 hours	
6. Material and resource recovery/recycling from solid wastes (including local initiatives)	2 hours		
7. Methods of waste collection, collection techniques, waste container compatibility, waste storage requirements, transportation of solid wastes	2 hours	2 hours	



8. Treatment and disposal techniques for solid wastes – composting (centralized and decentralized), vermi-composting, autoclaving, microwaving, incineration, non-incineration thermal techniques, use of refuse derived fuels, land-filling	7 hours	3 hours	
9. Basics of management of radioactive wastes from – mining, power generation, other facilities	4 hours		
10. Economics of on-site vs. off-site waste treatment and disposal (individual vs. common disposal)	2 hours	2 hours	
11. Waste minimization and concept of industrial ecology and industrial symbiosis	3 hours	2 hours	
12. Integrated waste management practices	3 hours		
<b>Total</b>	<b>36 hours</b>	<b>14 hours</b>	<b>12 hours</b>

### Evaluation criteria

▪ Class participation and assignment	10%
▪ Performance in lab work	10%
▪ 2 minor tests	20%
▪ Performance in tutorials	10%
▪ Final examination	50%

### Books for Reference

Standard Handbook of Hazardous Waste Treatment and Disposal, Freeman, H. M. (Ed.), McGraw Hill Book Company, New York, 1988.

The safe disposal of hazardous wastes-the special needs and problems of developing countries, The World Bank Technical Paper No. 93, Volume I, II, and III, 1989. Authored by Barstone, R. Smith, J. E. (Jr.), and Wilson, D.

Manual on Municipal solid waste management, Central Public Health and Environmental Engineering Organisation (CPHEEO), New Delhi, 2000.

Safe management of wastes from health-care activities, A. Pruss, E. Giroult and P. Rushbrook, World Health Organisation, Geneva, 1999.

Solid waste engineering, P. A. Vesilind, W. A. Worrell and D.R. Reinhart, Thomson Books

Integrated Solid Waste Management, G. Tchobanoglous, H. Theisen and S.M. Vigil, Mc Graw Hills

SW-846, Test methods for evaluating solid wastes, USEPA.

### Faculty

1. Dr Suneel Pandey
2. Guest faculty

**Course title: Environmental pollution monitoring and auditing**

Number of credits:4 (3-0-0)

Number of lectures-tutorials-practicals : 38-14-0

Course coordinator: Dr Nandini Kumar

**Course outline:**

The course will introduce students to the techniques commonly used in chemical and biological monitoring of the environment. It will communicate why monitoring of the environment is important, and describe sampling and analytical methodologies while emphasizing good working practice in terms of quality assurance and safety procedures. The section on auditing is meant to describe the principles of the environmental auditing process. It aims to reveal the role of the environmental management system in managing the environmental effects of industrial activities. Case studies will be used extensively to illustrate these aspects.

**Evaluation procedure:**

- 2 minor tests : 15%+15%
- 1 major test (end semester) : 50%
- Assignments : 10%
- Term paper : 10%

**Details of course content & allotted time**

Topic	Allotted time (hours)		
	Lectures	Tutorials	Practicals
<b>Introduction to pollution monitoring and its objectives</b>	1	-	-
<b>Types of monitoring</b>	2	-	-
Source monitoring, ambient environment monitoring			
<b>Prerequisites for monitoring</b>	4		-
Monitoring protocol, meteorological data, source inventory, suitability of analytical techniques, environmental quality standard			
<b>Duration and extent of survey</b>	4	3	-
Duration of survey and frequency of sampling, methods of reducing sampling frequency, number of sampling sites			
<b>Sampling methods</b>	5		-
Air, water and soil, sediment sampling methods			
<b>Presentation of data</b>	2	2	-
<b>Environmental auditing</b>			
<b>Introduction to environmental auditing</b> The principles and practice of environmental auditing, objectives, procedures, benefits, environmental auditing as a management tool.	2	-	-

Topic	Allotted time (hours)		
	Lectures	Tutorials	Practicals
<b>Designing an audit programme</b>			
Identifying environmental effects, monitoring and performance indicators, sources of evidence, specialist audit skills, selecting auditing goals, defining the boundaries, designing a reporting process.	6	3	-
<b>Techniques of environmental auditing</b>			
Pre-audit activities and audit planning, protocols and questionnaires, field work, working papers and audit record keeping, evaluating findings and conducting exit interviews, audit reports.	6	-	-
Introduction to integrated environmental management systems, industrial ecology, the ISO 14000 series and environmental labelling, concepts of lifecycle and risk assessment.	6		-
Case studies		6	-
<b>Total</b>	<b>38</b>	<b>4</b>	<b>0</b>

#### Basic textbooks:

- 1 *Hazardous Waste Management*, M D LaGrega, P L Buckingham, J C Evans, McGraw-Hill International Edition (chapters on environmental audits, risk assessment)
- 2 *Environmental Chemistry* S E Manahan (chapter on industrial ecology, resources and energy)
- 3 *Understanding our environment: an introduction to environmental chemistry and pollution* R M Harrison (selected chapters), Royal Society of Chemistry
- 4 *Pollution: sources, effects and control*, edited by R M Harrison (selected chapters), Royal Society of Chemistry

#### Suggested readings:

- 1 *Environmental Auditing*, Humphrey N and Hadley M, Palladian Books
- 2 *Environmental Auditing: Fundamentals and Techniques*, J Ladd Greeno, G S Hedstrom, and M DiBerto, John Wiley and Sons
- 3 *Environmental auditing for the non-specialist* (The Chandos Series on the environment) by Chris Hoggart, Chandos Publishing, Oxford Ltd.
- 4 *Environmental monitoring* G Bruce Wiersma CRC Press 2004
- 5 *Basic concepts of environmental chemistry* Des W. Connell, Lewis Publishers
- 6 *Environmental analytical chemistry* edited by F W Fifield and P J Haines, Blackie Academic & Professional.



**Course Title: Environmental Modeling****Course code: NRS 171: Course Credit: 3 (35\*-7\*\*-0\*\*\*\*)****Faculty: Dr. Ram Karan Singh and Dr. T S Panwar****Course outline (Air pollution):**

Sources and effects of air pollutants, air quality standards, and emission inventory, meteorological aspects related to air pollution, air quality modeling and its application, trans-boundary air pollution.

**Evaluation Procedure:**

S.NO.	COMPONENT	MARKS (%)	REMARKS
1.	Test-1	15	
2.	Test-2	15	
3.	Surprise Quiz-1	10	Unannounced
4.	Seminars	15	
5.	Participation and Attendance	5	
6.	Comprehensive Examination	40	

**Special Remark:** Any open component will be announced later

**Course outline (Air pollution):**

Sources and effects of air pollutants, air quality standards, and emission inventory, meteorological aspects related to air pollution, air quality modeling and its application, trans-boundary air pollution.

**Detail course contents and lecture plan:**

TOPIC	ALLOTTED TIME (HOURS)		
	Lectures	Tutorials	Practical
Introduction to the course; Sources and effects of air pollutants, air quality standards/emission inventory	1	-	-
Meteorological aspects related to air pollution (wind circulation, lapse rate, stability conditions, turbulence, Richardson number, boundary layer structure, mixing height, plume behavior, heat island effect, wind rose)	5	-	-
Air Quality modeling and its application (Model classification, box model, Gaussian dispersion model, dispersion parameters, plume rise, removal mechanisms, point/line/area sources, long term and short term dispersion models)	6	3	-
Case studies and model applications	2	-	-
Trans-boundary air pollution	1	-	-
Total	15	3	0

**Detail course contents and lecture plan:**

TOPIC	ALLOTTED TIME (HOURS)		
	Lectures	Tutorials	Practical
Sources and effects of noise pollution, Noise standards	1	-	-
Basics of sound propagation, noise scales and rating methods	2	-	-
Noise modeling and its application	2	1	-
Total	5	1	0

**Course outline (Water pollution)**

Sources and effects of water pollutants, introduction to principles of water quality modeling, distribution of water quality in rivers, estuaries and lakes, contaminant transport in groundwater, water quality modeling applications and discussion of case studies.

**Details of course content and allotted time**

TOPIC	ALLOTTED TIME (HOURS)		
	Lectures	Tutorials	Practical
Sources and effects of water pollutants: Indian context	1	-	-
Principles of water quality modeling: River hydrology and derivation of stream equation; conservative and non conservative pollutants; physical laws	3	-	-
Distribution of water quality in rivers and estuaries; characteristics of lakes; evaluating and assessing BOD/DO in rivers; Eutrophication analysis and basic mechanisms of Eutrophication	4	1	-
Contaminant transport in groundwater; basics on fate and transport of pollutants; Hydrodynamic dispersion; Decay; Reactive processes; Site specific groundwater quality problems in Indian context	4	2	-
Water quality modelling and its applications: Model set-up, calibration, and validation procedures; Selection; Case studies and applications of water quality modeling	3	-	-
Ecological modeling	3	-	-
Total	18	3	0

**Reference Books:****Air and Noise pollution**

1. Boubel, R W, Fox, D L, Turner, D B (Ed.) and Stern, A C (Ed.) (1994) Fundamentals of Air Pollution, 3rd edition, Academic Press Inc.
2. Turner, D B (1994) Workbook of Atmospheric Dispersion Estimates: An introduction to dispersion modelling, 2nd edition, Lewis publishers.

3. Wark, K, Warner, C F, and Davis, W T (1997) Air Pollution- Its origin and control, Addison Wesley Longman, Inc.
4. Rao C S (1991), Environmental pollution controls engineering, New Age International (P) Ltd., Publishers, New Delhi.
5. Pasquill, F and Smith, F B (1983) Atmospheric Diffusion, Ellis Horwood Ltd., Chichester.
6. Heinsohn R J and Kabel R L (1999) Sources and control of air pollution, Prentice hall, NJ
7. Rau, J.G. (1980) Environmental Impact analysis handbook. McGraw Hill, New York

#### **Water pollution**

1. Chapra, S: Surface Water-quality modelling, Tata McGraw-Hill, 1997.
2. Thomann, Robert V., John A. Mueller. Principles of Surface Water Quality Modeling and Control.
3. HarperCollins Publisher Inc., New York, 1987
4. Bouwer, H. Groundwater hydrology. Mc-Graw Hill International Editions (Civil Engineering series), 1978
5. Todd, D.K. Groundwater hydrology. John Wiley and Sons, 1980
6. Freeze, A., Cherry, and J.A. Groundwater. Prentice Hall, 1979.
7. Zheng, C and Bennett, G.D. Applied Contaminant Transport Modeling: Theory and Practice. Van Nostrand Reinhold. 1995

Note: \*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practicals per Semester



**Course Title: Soil and Land Management**

**Course code: NRS 183, Credit: 4 (L: T: P- 42: 11: 5)**

**Faculty: Dr.Ram Karan Singh**

**Course objective:**

The main objective of this course is to provide students the fundamental knowledge of Soil Science.

It also covers the sustainable use and management of land resources with practical approaches for managing soils for their productive use and conservation.

**Brief course outline:**

Fundamental aspects of soil resources, inventory and characterization for practical purposes.

Approaches and procedures for the interpretation of soil information for the purpose of appropriate soil management strategies.

The procedures and techniques for soil/land degradation assessment, and the technical aspects related to land capability classification and soil conservation measures.

Contemporary fields of inquiry related to soil processes, e.g. soil and land degradation at multiple scales, issues related to soil contamination etc.

The course has formal lectures, tutorials, practical/demonstration sessions and discussions. Lectures form the core of the course and will place an emphasis on the concepts. Discussions are centered around the student's seminar on selected topics.

**Details of course content and lecture plan:**

TOPIC	TIME (HOURS)		
	Lectures	Tutorials	Practical
Introduction, soil formation, soil properties	2	0	0
Soil survey and profile; soil taxonomy	2	0	0

Soil moisture, its measurement and management; soil drainage and drainage system design, soil moisture management issues and solutions	6	2	2
Soil organic matter and carbon sequestration	3	0	0
Soil fertility: soil nutrients and plant needs, nutrient uptake from soil, role of fertilizers, soil health issues; soil quality index	3	2	1
Soil erosion and land degradation – agents, types, causes and factors affecting erosion, methods of soil erosion estimation, erosion control techniques, role of erosion in productivity	5	2	2
Land degradation – types (chemical, physical and biological), assessment techniques and distribution in India;	5	1	0
Different types of wastelands and there distribution in India	2	1	0
Soil and land conservation- Agronomic and other measures with special reference to India,	4	1	0
Land-use planning and land use classification in India	4	0	0
Land evaluation, land quality indicators and land capability and suitability classification with special reference to India	3	2	0
Land management: drivers of change and practices	2	0	0
Role of information system in soil-land conservation	1	0	0
Total	42	11	5

**Evaluation Procedure:**

S.NO.	COMPONENT	MARKS (%)	REMARKS
1.	Minor Test-1	15	
2.	Minor Test-2	15	
3.	Assignments/Tutorials/Seminars	15	
4.	Practical	10	
5.	Major Test	45	

### Reference Books:

1. Indian Society of Soil Science, fundamentals of soil science
2. Brady, N. C. and R. R. Weil, (2002), The nature and properties of soil, 13th edition. Pearson Education Inc.
3. Narayana, Dhruva V, V, (1993), Soil and water conservation in India, ICAR, and New Delhi.
4. Miller Raymond W and Roy L Donahue, (1990), Soils: An introduction to soils and plant growth Prentice-Hall of India, Private Limited.
5. Barrow C J, (2001), Land degradation: Development and breakdown of terrestrial environments, Cambridge University Press.
6. Young, A. (1998). Land Resources: Now and for the future, Cambridge University Press.
7. Seghal J, (1994) soil degradation in India: Status and Impact, Oxford & IBH publishing, New Delhi
8. Baver, L D and Gardner W H, (1972), Soil Physics, 4t editions, John Wiley & sons New York.
9. Morgan, R P C, ed., (1981), and Soil conservation: problems and prospects. John Wiley, UK
10. FAO 1993 Guidelines for land-use planning, FAO Development series N 1, Rome
11. FAO 1984 Guidelines for land evaluation for Rainfed Agriculture FAO Soil Bulletin No 52
12. USDA 1993 Soil survey manual (Indian edition) Scientific publishers
13. USDA 1964 A manual on conservation of soil and water (Indian edition) Oxford & IBH publishing co., New Delhi
14. Davidson, D.A. 1992. The Evaluation of Land Resources. Longman, London.
15. Roberts, J. C. 1979. Principles of land use planning in Beatty, M. T., G. W. Peterson and L. W. 16. 16.
16. Swindale. 1979. Planning the uses and management of land. Monograph 21, American Society of Agronomy, Madison, WI.
17. Cook, R. L. and B. G. Ellis.1987. Soil management. John Wiley and Sons, Inc., New York, NY.



## Environmental Economics

NRS 147: Four Credits (42\*-14\*\*-0\*\*\*)

### Faculty

Dr Surender Kumar

### Course outline

This course will familiarize students with the theory and application of economics to environmental problems and prepare them for analysing issues in environmental economics and policy. It will focus on the design of cost-effective environmental policies and on methods for determining the value of environmental amenities. The course consists of lectures, student led discussions, student presentations, and other assignments. To achieve the course objectives, active participation in class and timely completion of assignments are important. Students are also expected to search for currently debated environmental problems and policies in India and other countries that would trigger discussions in the class, especially during tutorials. The course relies on select mathematical methods and techniques such as differentiation, select methods in econometrics.

### Evaluation Procedure

- 1 Term paper: 25%
- 2 minor tests: 30% (15% each)
- 1 major test (end semester): 45%

### Details of course content and allotted time

Topic	Allotted Time (Hours)		
	Lectures	Tutorials	Practical
A refresher in basic mathematical analysis/econometrics ■ Differential and integral calculus- Select concepts in econometrics (handy for valuation methods)	4	2	0
Markets and efficiency ■ Market failure- Incomplete markets- Externalities- Non-exclusion and the commons- Non-rivalry & public goods (including newly emerging concept of global public goods)- Non-convexities- Asymmetric information	2	1	0
Theory of non-market valuation and methods of valuing environmental costs and benefits (including case studies) ■ Revisiting measures of economic value ■ Use values and non-use values ■ Household production models ■ Hedonic valuation models ■ Travel cost models ■ Constructed market models of valuation (CVM) ■ Abatement cost estimation approaches	14	5	0
Environmental policy instruments ■ Regulating pollution through standards - Pigouvian fees ■ Emissions fees and marketable permits ■ Regulation with unknown control costs	14	4	0

<ul style="list-style-type: none"> <li>■ Audits, enforcement and moral hazard</li> <li>■ Environmental policy and technological changes</li> <li>■ Porter's hypothesis</li> </ul>			
Environmental and economic accounting	4	1	0
International trade and environment	4	1	0
<ul style="list-style-type: none"> <li>■ International trade and environment linkages</li> <li>■ Global environmental issues</li> </ul>			
Total	42	14	0

**Books:**

- Jha, Veena, A. Markandya, and R. Vossenaar. 1999. *Reconciling Trade and the Environment: Lessons from case studies in developing countries*, Cheltenham, Edward Elgar Publications.
- M. N. Murty and Surender Kumar. *Environmental and Economic Accounting for Industry*, Oxford University Press 2004.
- Nick Hanley, Jason F Shogren and Ben White. *Environmental Economics in Theory and Practice*. MacMillan 1997.
  - Tietenberg, T. *Environmental and Natural Resource Economics*, Harper Collins, 1994.
  - Kolstad Charles D. *Environmental Economics*. Oxford University Press. 2003.
  - Freeman Myrick A. *The Measurement of Environmental and Resource Values: Theory and Methods*. Second Edition. Resources for the Future, 2003.
  - Baumol William J. and Oats Wallace E. *The Theory of Environmental Policy*. Second Edition. Cambridge University Press, 1994.
  - Stavins Robert N. *Economics of the Environment: Selected Readings*. Fourth Edition. W.W. Norton and Company. 2000.
- Xepapadeas, A. *Advanced Principles in Environmental Policy*, Edward Elgar, Cheltenham, U.K. 1997.

**Selected Papers:**

- Alberini, A. and M. Cropper. 1998. Contingent Valuation, in *The New Palgrave Dictionary of Economics and the Law*, P. Newman (ed.).
- Arrow, K.J., P. Dasgupta, L. Goulder, G. Daily, P. Ehrlich, G. Heal, S. Levin, K;-G. Mäler, S. Schneider, D. Starrett, and B. Walker. Are We Consuming Too Much? *Journal of Economic Perspectives* 18(3, 2004): 147-172.
- Bohm, P. and C.S. Russell. 1985. Comparative Analysis of Alternative Policy Instruments. In A.V. Kneese and J.L. Sweeney (eds), *Handbook of Natural Resource and Energy Economics*, Vol. I, North Holland, Amsterdam, 395-460.
- Burrows, P. 1995. Nonconvexities and the Theory of External Costs. In D. Bromley (ed.) *Handbook of Environmental Economics*. Blackwell, Oxford, U.K. 243-250.
- Burtraw, D. 1996. The SO2 Emissions Trading Program: Cost Savings without Allowance Trades. *Contemporary Economic Policy*. April. 79-94.
- Chichilinsky, G and G. Heal. 1994. "Who Should Abate Carbon Emissions: An International Viewpoint," *Economics Letters*, 443-449.
- Coase, R.H. 1960. The Problem of Social Costs. *Journal of Law and Economics* 3:1-44.
- Cropper, M. and W.E. Oates. 1992. Environmental Economics: A Survey. *Journal of Economic Literature* 30: 675-740.
- Hanemann, W.M. 1991. Willingness to Pay and Willingness to Accept: How Much Can They Differ? *American Economic Review* 81:635-647.
- Harrison, D., Jr. and D.L. Rubinfeld. 1978. Hedonic Housing Prices and the Demand for Clean Air. *Journal of Environmental Economics and Management* 5:81-102.
- Helfand, G.E. 1991. Standards versus Standards: The Effect of Different Pollution Restrictions. *American Economic Review* 81:622-634.



- Holterman, S., 1976, Alternative Tax Systems to Correct for Externalities and the Efficiency of Paying Compensation, *Economica*, 1-16.
- Jaffe, A. B., R. G. Newell and R. N. Stavins. 2002. Environmental Policy and Technological Change, *Environmental and Resource Economics* 22, 41-69.
- Khanna, M. 2001. Non-mandatory Approaches to Environmental Protection. *Journal of Economic Surveys*, 15(3), 291-324.
- Kumar, S. 2005. Environmentally Sensitive Productivity Growth: A Global Analysis Using Malmquist-Luenberger Index', *Ecological Economics*.
- Kumar, S. and D. N. Rao. 2001. Valuing the Benefits of Air Pollution Abatement: Using a Health Production Function. *Environmental Resource Economics* 21, 91-102.
- Kumar, S. and M. Khanna. 2005. Measurement of Environmental Efficiency and Productivity: A Cross Country Analysis', Working Paper No. 29, National Institute of Public Finance and Policy, New Delhi.
- Murty, M. N. and S. Kumar. 2002. Measuring Cost of Sustainable Industrial Development in India: A Distance Function Approach. *Environment and Development Economics*, vol. 7, pp. 467-486.
- Murty, M. N. and S. Kumar. 2003. Win-Win Opportunities and Environmental Regulation: Testing the Porter Hypothesis for Indian Manufacturing Industries', *Journal of Environmental Management*, vol. 67(2), pp. 139-144.
- Pendleton, L. and R. Mendelsohn. 2000. Estimating Recreation Preferences Using Hedonic Travel Cost and Random Utility Models. *Environmental Resource Economics*, 17, 89-108.
- Schmalensee, R. et al. 1998. An Interim Evaluation of the Sulfur Dioxide Emissions Trading, *Journal of Economic Perspectives* P 3: 53-68.
- Seskin, E.P., R.J. Anderson, Jr., and R.O. Reid. 1983. An Empirical Analysis of Economic Strategies for Controlling Air Pollution. *Journal of Environmental Economics and Management* 10:112-24.
- Shortle, J.S. and R.D. Horan. 2001. The Economics of Nonpoint Pollution Control. *Journal of Economic Surveys*, 15(3), 255-290.
- Stavins, R., 1998. What Can We Learn From the Grand Policy Experiment? Lessons from SO<sub>2</sub> Allowance Trading. *Journal of Economic Perspectives* 3: 69-88.
- Weitzman, M. 1974. Prices Vs. Quantities. *Review of Economic Studies* 41: 477-491.
- Barrett, Scott. 2000. Introduction to the special issues on trade and environment: local versus multilateral reforms' *Environment and Development Economics*, Vol. 5, Part 4, pp. 349-359.

Note: \*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practical per Semester

**The term paper involves the following tasks:**

**Stage 1:** A one page essay describing an environmental problem, the context in which it occurs, and some ways of resolving the problem. Identify behavioral solutions to the problem that you would like to investigate in your term paper.

**Stage 2:** A two page outline of the type of economic analysis you will undertake for the environmental problem you have identified. In the case of environmental policy problems, this involves identifying who is causing the problem, what is motivating them to cause it, what are the barriers to their adopting one of the technological or behavioral solutions you have identified above, and the kinds of policies that would be needed to control the environmental problem. In the case of an environmental valuation problem, this involves specifying the environmental good to be valued, the method that you plan to follow to value it, the population that you will focus on, and advantages/limitations of your approach. For either type of problem, it is important to consult journal articles in environmental economics to learn about what others have done. Five articles from economic journals that are relevant to your topic should be read for and referred to in this assignment.



**Stage 3:** Turn in a paper consisting of 15-20 double spaced typed pages. Not more than 5 pages may be used to review related literature. The rest of the term paper should be devoted to developing an economic model to analyse the environmental problem selected in Stage I. The assumptions, objectives and policy implications that can be derived from the model should be clearly stated.

All term papers are to be presented in class. Presentations should be of about 15 to 20 minutes per student.

## Climate Change, Ecosystems and Society (NRS 135)

4 Credits (42\* - 14\*\* - 0\*\*\*)

**Pre-requisite:** Consent of Teacher

**Faculty:** Dr. Vivek Kumar (VK), Dr. Philippe Tulkens (PT)

### Aim of the course

The aim of this course is to develop an understanding of scientific and policy aspects of a global concern of mankind i.e. climate change.

The students can opt a career in climate change research / policies. They can also play a role in addressing climate change by adopting and advocating climate friendly life styles.

### Course outline

This course will provide an introduction to climate system and its inter-relationship with different ecosystems, human systems, and socio-economic systems. The course will discuss causes of climate changes, natural as well as anthropogenic and its impacts on different systems. The course will also cover the response measures to combat climate change both at policy as well as at implementation level. The inter-linkages of the UNFCCC with other international conventions will also be introduced through this course.

### Course content

No	Topic	Allotted time (Hrs)
<b>1</b>	<b>The climate system</b>	<b>4</b>
i	Structure and composition of earth's atmosphere, Energy budget of earth's atmosphere, general circulation and horizontal and vertical energy transfers	2
ii	Other components of climate system viz oceans, cryosphere, biosphere and geosphere and their inter-relationship. Introduction to climate relevant cycles (i.e. hydrological, carbon and nitrate cycles)	2
<b>2</b>	<b>Science of climate change</b>	<b>4</b>
i	Greenhouse effect, greenhouse gases, their sources and sinks, clouds, aerosols and ozone layer and greenhouse effect, radiative forcings	2
ii	Natural causes of climate change, past climatic changes	1
iii	Anthropogenic activities and rising concentration of GHGs in the atmosphere, greenhouse warming potential	1
<b>3</b>	<b>Tools to study climate change</b>	<b>8</b>
i	Climate construction using instrumental records	1
ii	Paleo-climate analysis using proxy data	1
iii	Climate simulation through modeling, climate change projections from different models	1
iv	Uncertainties in climate change projections	1

	v GHG instrumentation, measurement of different GHG gases (CO <sub>2</sub> , N <sub>2</sub> O, CH <sub>4</sub> etc), Detail function of Gas Chromatograph (GC), various detectors and functionalities	2
	vi Tutorials – simple climate models simulation	2
<b>No</b>	<b>Topic</b>	<b>Allotted time (Hrs)</b>
<b>4</b>	<b>Impacts of climate change, case studies from India &amp; S. Asia</b>	<b>14</b>
	i Sea level rise, vulnerability of coastal areas and island states	3
	ii Water resources and glacier retreat	2
	iii Agriculture	2
	iv Forests and biodiversity	2
	iv Extreme events	1
	v Human health	1
	vi Infrastructure, industry	1
	vii Tutorials – Review of select studies on climate change impacts and discussion	2
<b>5</b>	<b>Policy responses to climate change: mitigation and adaptation</b>	<b>8</b>
	i Scientific assessment: IPCC, its establishment, purpose, organization and climate change projections	1
	ii Policy international framework: UNFCCC, its evolution, objective, highlights of various articles, Indian negotiating stance	1
	iii Developed and developing country commitments under the UNFCCC	1
	iv Climate change mitigation programs, an overview	2
	v Existing policies and legal framework in India, enabling activities such as ALGAS and reporting requirements e.g. NATCOM	1
	vi Tutorials – Review of select policies, mechanism, institution etc. and discussion	2
<b>6</b>	<b>Technologies for climate change mitigation</b>	<b>4</b>
	i Clean and energy efficient technologies for climate change mitigation	2
	ii Forests and CO <sub>2</sub> sequestration, LULUCF	1
	iii CO <sub>2</sub> sequestration opportunities for India	1
<b>7</b>	<b>Adapting to climate change</b>	<b>4</b>
	v Adapting to climate change, integration of traditional wisdom with climate change adaptation, case studies	2
	vi Adaptation and sustainable development linkages	1
	vii Linking climate change mitigation and adaptation	1
<b>8</b>	<b>Linkages of UNFCCC with other international conventions such as CBD, CCD, Ramsar Convention, MDG</b>	<b>2</b>
<b>9</b>	<b>Term-paper discussion and presentation by students<sup>+</sup></b>	<b>6</b>



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\*Lectures per Semester / \*\*Tutorials per Semester / \*\*\*Practical per Semester

+ Students will be asked to select a topic of their interest and prepare a short term-paper on that. This may be presented during one of the lectures. In addition, there will be two tutorials which may involve an analysis of an article/news item or presentation of a case study.

Course title: **Integrated Impact Assessment:** (Environment, Health and Social Impact Assessment)

Number of credits: 4 (3-1-0)

Number of lectures-tutorial-practical: 42-14-0

Course coordinator: Dr. Arabinda Mishra

### **Faculty**

Dr. Neeraj Khera

Dr. Avanish Kumar

Dr. Ram Karan Singh

Dr. Arabinda Mishra

### **Course outline:**

There is growing realization that the multi-dimensional nature of sustainable development targets requires the use of different disciplinary approaches, in an integrated framework, to the impact assessment of development projects/programmes. Integrated Impact Assessment (IIA) provides such a framework for a balanced consideration of the economic, environmental, social and health impacts of development interventions at the project, sector and economy levels. The course in Integrated Impact Assessment (IIA) is designed to build detailed knowledge, understanding and skills among students for conducting IIA, so that they are able to identify sustainable modes of environmental operation. The course starts with an overview of IIA – the different methodologies on which it draws, the state of the art, current practices, constraints and future directions. This is followed by in-depth exposure to the key approaches to IIA - environmental, social and health – with a focus on methodology and tools in the key discipline areas. Technology assessment, risk assessment, etc are discussed at the conceptual level to provide students with a flavour of the emerging dimensions of IIA. The final module of the course is intended to strengthen students' analytical capacity and assessment skills by making them work through actual/simulated scenarios.

### **Evaluation procedure:**

- Minor tests : 30%
- Assignments : 15%
- Class discussion : 5%
- Final examination : 50%

**Details of course content & allotted time**

Topic	Allotted time (hours)			
	Lecture	Tutorial	Practical	Subtotal/Total
<b>Introduction &amp; an Overview of IIA</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
Defining IIA; Sustainable Development challenges and need for IIA	1			
Key Approaches of IIA: Environment, Social Health and Economic	1			
Current Practices, Changing Perspectives & Debate in IIA	1			
<b>Assessing Environmental Impacts: the EIA Approach</b>	<b>6</b>	<b>2</b>	<b>0</b>	<b>8</b>
Environmental Impacts – examples, need for assessment, difficulties; The EIA Approach – Background, Objectives, Components & Techniques, Impact prediction & analysis, Treatment of Risk and Uncertainty, EIA inputs to the project cycle and development planning	4	1		
EIA in India – Legislative aspects, Current practices & Constraints	1			
EIA case study	1	1		
<b>Assessing Environmental Impacts (2): the Ecosystem Approach</b>				<b>8</b>
Ecosystem Approach – Fundamentals and applications, Framework for ecosystem approach				
Case study				
<b>Incorporating Health Concerns: the HIA Approach</b>				<b>8</b>
Impact of environment on health, Morbidity Pattern in India				
Developing framework for HIA Analysis, Changing concept and approach in Health Impact Assessment				
Health Need Assessment, tools and techniques in HIA				
HIA Case Study				
<b>Handling Social Issues: the SIA Approach</b>				<b>8</b>
Overview and scope of Social Impact Assessment (SIA)	1			
SIA and Community: marginalized/vulnerable groups, indigenous people, resettlement & rehabilitation and development	2			
SIA and Gender Impact Assessment	2			
SIA and NRM	2			
SIA Case Studies		1		
<b>Integrated Analysis of Environmental, Social &amp; Health Impacts</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>9</b>
Challenges for IIA: Removing inconsistencies and differences between different approaches; other methodological and practical issues	1			



Topic	Allotted time (hours)			
	Lecture	Tutorial	Practical	Subtotal/Total
Scope for integrated approach in economic analysis: concept of economic analysis, Cost-Benefit Analysis (CBA), Social CBA, Cost Effectiveness Analysis (CEA)	3	1		
The Analytic Hierarchy Process (AHP) based approach to project appraisal	3	1		
<b>Mapping Tools and Techniques in IIA</b>				<b>4</b>
Role and relevance of GIS Techniques in IIA				
<b>Public Participation in IIA and its relevance to decision-making</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
Contribution of IIA to decision-making – prospects & constraints; Stakeholder participation in IIA – importance, methodological and practical issues	1			
<b>Emerging Dimensions &amp; Future Directions</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
Strategic Environmental Assessment (SEA), Technology Assessment, Risk Assessment	2			
<b>IIA Case Studies</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>6</b>
Case Study 1	1	1		
Case Study 2	1	1		
Case Study 3	1	1		
<b>Total</b>				<b>56</b>

#### Suggested readings:

1. Canter 1998. Environmental impact assessment.
2. Asian Development Bank 1997. Environmental impact assessment for developing countries in Asia, Vol I & II. ADB Publication
3. British Medical Association 1998. Health and Environmental Impact Assessment- an integrated approach. Earthscan
4. Vanclay F and Bronstein D A 1995. Environmental and Social Impact assessment, Wiley publishers.
5. Linkage methods for environment and health analysis – General guidelines. Edited by D Briggs, C. Corvalan, M. Nurminen, World Health Organization, Geneva , 1996. 136 p
6. Handbook of Environmental Impact Assessment. R.R. Bathwal. New Age International Publishers.

## Resource Economics

NRS 143: Four Credits (42\*-14\*\*-0\*\*\*)

### Faculty

Dr Arabinda Mishra

### Course outline

The course constitutes an elective to be offered to M.Sc. (Natural Resources). It begins by exposing students to basic concepts in optimization and relevant introductory topics in microeconomics. Different categories of natural resources are covered separately with focus on forestry, fishery and exhaustible energy resources. This is followed by discussions on stock pollutants, issues of risk and uncertainty, and biodiversity conservation and valuation. The course includes additional modules relating to: (a) the sustainable development concepts, relevant indicators (such as genuine savings) and natural resource accounting and (b) to the economics of property rights regimes (with focus on common property rights). It is expected that the course will help bridge the gap between theoretical models and empirical study of resource allocation and management issues in a real-world context.

### Evaluation Procedure

- Tutorials/assignments: 10%
- Term paper: 25%
- 2 Minor Tests (10% each): 20%
- 1 Major test (end semester): 45%

### Details of course content and allotted time

Topic	Allotted Time (Hours)		
	Lectures	Tutorials	Practicals
▪ Basics concepts in static & dynamic optimisation	6	3	-
▪ Introduction: Asset markets, issues of discounting, the resource allocation problem, Renewable and non-renewable resources.	2	1	-
▪ Renewable resources: basic optimal harvest problem; economics of fishery; economics of forestry.	9	3	-
▪ Non-renewable resources: basic optimal depletion problem; Hotelling's rule; exhaustible energy resources.	9	3	-
▪ Stock pollutants, risk and uncertainty	4	1	
▪ Biodiversity conservation and valuation	4	1	
▪ Issues of sustainability: intergenerational well-being, SD indicators, natural resource accounting	4	1	-
▪ Economics of property rights regimes	4	1	-
Total	42	14	0

### **Text Books**

1. Conrad J M. 1999. Resource Economics. Cambridge University Press.
2. Hanley, N., J.F. Shogren and B. White. 1997. Environmental Economics in Theory and Practice. Oxford and London. Oxford University Press and Macmillan.
3. Sydsaeter and Hammond. Mathematics for Economics. LPE.

### **Reference Books**

1. Ostrom, E. chap in Sankar U (ed). 2001. Environmental Economics.
2. D.W. Bromley (ed). 1995. The Handbook of Environmental Economics. Blackwell, Cambridge, Massachusetts.
3. Dasgupta P. 2001. Human well-being and the environment. New York: Oxford University Press.
4. Dasgupta, P.S. and G.M. Heal. Economic Theory and Exhaustible Resources. Cambridge, Cambridge University Press. 1979.
5. Fisher, A.C. Resource and Environmental Economics. Cambridge, Cambridge University Press. 1981.
6. Kadekodi chap and Singh & Hegde chap in Kadekodi G K (Ed). 2004. Environmental Economics in Practice. Oxford University Press.
7. Kerr J M, Marothia D K, Singh Katar, Ramasamy C., Bentley W M. Natural Resource Economics: Theory and Applications in India. 1997. Oxford and IBH Company Private Limited.
8. Kneese, A.V. and J.L. Sweeney (Eds.). Handbook of Natural Resource and Energy Economics. Amsterdam, Elsevier.
9. Varian H L. 2003. Intermediate Microeconomics: A Modern Approach. East West Press. Sixth Edition.



## **Governance and management of natural resources**

**Lecture Tutorial:** 36-20

### **Evaluation:**

Term paper: 30%

Minor tests: 20%

Tutorials: 20%

Final Exam: 30%

### **Course objectives:**

This course seeks to familiarise students with the concepts and practice of the governance of natural resources. Students are exposed to theoretical and conceptual issues in analyses of governance and management of natural resources, as well as to changing paradigms in NRM and governance. Through case study-based learning and interactions, they are exposed to practical issues and problems in natural resource management.

### **Unifying framework for the course**

Starting with a review of conceptual and theoretical issues in the governance of natural resources, the course proceeds by tracing a trajectory of changing paradigms in governance. This entails the shifting emphasis from the state to the market, to local institutions and the current emphasis on partnerships: the drivers of these shifts, and the empirical evidence with their functioning.

Thus, the course is split into six blocks/modules

- 1) Overview of theoretical concepts and approaches
- 2) The bureaucracy (State) in Natural Resource Management
- 3) Decentralisation and changing role of the state
- 4) Collective Action and Management of Common Property resources
- 5) Markets as a form of natural resource allocation
- 6) Role of NGOs and civil society groups: emphasis on partnerships

### **Fit with core courses**

Students have been exposed to basic environmental laws and policies in a core course as well as to conceptual treatments of property rights and institutions in the courses on Environmental and Natural Resource Economics. In this course, they learn more about the social and organisational context in which these laws and policies are implemented. Law, property rights and institutional frameworks are approached from a perspective of legal pluralism, which examines the interface of statutory law and property right regimes with other sets of laws and institutional frameworks.

### **Approach and pedagogy**

The approach is inter-disciplinary, encouraging students to think beyond the confines of a single discipline. The pedagogy relies on a mix of lecture, case studies and exercises.

Topic	Lecture	Tutorials
<p><b>Block 1: Overview of conceptual issues and approaches</b> Establishing the rationale for NRM regimes: Introducing concepts of carrying capacity, ecological foot-print, resilience, tragedy of the commons.</p> <p>Conceptual distinctions and nuances</p> <ol style="list-style-type: none"> <li>1) Institutions and organisations</li> <li>2) Governance and Government</li> <li>3) Management and Governance</li> </ol> <p>Theoretical approaches to governance and contribution of different disciplines:</p> <ol style="list-style-type: none"> <li>1) Rational Choice and New Institutional Economics</li> <li>2) Public Administration and Management</li> <li>3) Socio-technical Perspectives</li> <li>4) Legal Anthropological Approaches, legal pluralism in governance</li> <li>5) Influence of neo-liberal ideologies on governance</li> </ol>	8	3
<p><b>Block 2: The Bureaucracy and Natural Resource Management</b> The relevance and appropriateness of the bureaucratic set-up for NRM (Weberian conceptions). Understanding accountability and transparency; rent-seeking perspectives. Reform of public institutions. Role of the bureaucracy in reform processes. Lessons from water, forestry and pollution control.</p>	6	3
<p><b>Block 3: Decentralisation and changing role of the state</b> Distinction between decentralisation and devolution. The participation paradigm. Understanding resource user organisations. Lessons from JFM and Irrigation Management Transfer in India. The 73<sup>rd</sup> and 74<sup>th</sup> Amendments to the Constitution of India.</p>	9	4
<p><b>Block 4: Collective Action and Management of common property resources</b> The emergence and survival of common property institutions Understanding conditions for collective action. Collective action as a socially embedded process; understanding social, power and gender relationships in Natural Resource Management. Mainstreaming gender and equity considerations in Natural Resource Management. Case studies/lessons from water-surface and groundwater, land and forestry.</p>	9	6
<p><b>Block 5: Markets as a form of natural resource allocation</b> Equity, efficiency and sustainability implications. Market creation as a reform strategy. Issues and perspectives.</p>	2	2
<p><b>Block 6: Role of NGOs and civil society in Natural Resource Management</b> The emphasis on partnerships for sustainable development Issues and lessons for replication.</p>	2	2

## **Readings:**

### **Module 1**

North, D.C. 1990. Institutions, institutional change and economic performance. Cambridge University Press

Ostrom, E. (1990). Governing the commons. The evolution of institutions for collective Action. Cambridge University Press. Cambridge.

Folke, C and Berkes, F. 1995. Mechanisms that link property rights to Ecological Systems. In Susan Hanna and Mohan Munasinghe eds. *Property Rights and the Environment. Social and Ecological Issues*. The Beijer Institute of Ecological Economics and the World Bank. 1995

Bac, M. Property Rights Regimes and the Management of resources. *Natural Resources Forum*. 22(4): 263-269

Merry S.E. 1998. Legal Pluralism. *Law and Society Review* 22(5): 869-896

### **Module 2:**

Wade, R. 1988. The management of irrigation systems: how to evoke trust and avoid prisoners' dilemma. *World Development* 16(4): 489-500

Paul, S. 1992. Accountability in public services: exit, voice and control. *World Development*. 20 (7): 1047-1060

World Bank, 2003. Reforming Public Institutions and strengthening governance. A World Bank Strategy Implementation Update.

Korten, David C. 1989. From bureaucratic to strategic organisation. In: Frances C Korten and Robert Y Siy, Jr. edited *Transforming a bureaucracy*.

### **Module 3:**

Esman, M.J., and Uphoff, N.T. 1984. Local Organisations as intermediaries. Chapter 1 in *Local Organisations. Intermediaries in Rural Development*. Cornell University Press. Ithaca, pp. 15-41

Mollinga, P.P. 2001. Power in Motion: A critical assessment of canal irrigation reform, with a focus on India. *IndianPIM working paper No. 1*

Guha, Sumit, 1999. Communities, Kings and Woodlands: Historical reflections on Joint Forest Management, pp. 55-70, in Jeffrey, R and Nandini Sunder, (eds.) *A new moral economy for India's forests ? Discourses of Community and Participation*. Sage Publications. New Delhi.

Vira, B. 1999. Implementing Joint Forest Management in the Field: Towards an understanding of the community-bureaucracy interface, pp. 254-275, in Jeffrey, R and Nandini Sunder, (eds.) *A new moral economy for India's forests ? Discourses of Community and Participation*. Sage Publications. New Delhi.



Poffenberger, M and C. Singh, 1996. Communities and the state: re-establishing the balance in Indian Forest Policy, in M.Poffenberger and B McGean, eds. Village Voices, Forest Choices: Joint Forest Management in India. Delhi: Oxford University Press.

Poffenberger, M. 1990. Facilitating change in forest bureaucracies in M. Poffenberger, ed. Keepers of the Forest. West Hartford, C.T: Kumarian Press.

#### **Module 4:**

Wade, R. 1988. Village Republics. Cambridge: Cambridge University Press

Agrawal, A.2001. Common Property Institutions and Sustainable Governance of Resources. *World Development* 29(10): 1649-1672

Meinzen-Dick, R. 1996. Policy trends in farmer participation. Paper presented at Workshop on Institutional Reform in Indian Irrigation. National Council of Applied Economic Research. New Delhi. November 6, 1996.

Agrawal, A & Gibson, C. C. 1999. Enchantment and disenchantment: the role of community in natural resource conservation. *World Development* 27(4): 629-649

Shah, A. 2002. Women, water, irrigation. Respecting Women's Priorities. *Economic and Political Weekly*. October 26, 2003. 4413-4420.

Van Koppen, B. 2001. Gender in integrated water management: an analysis of variation. *Natural Resources Forum* 25: 299-312

Locke, C 1999. Women's representation and roles in 'Gender' Policy in Joint Forest Management, pp. 235-253, in Jeffrey, R and Nandini Sunder, (eds.) A new moral economy for India's forests ? Discourses of Community and Participation. Sage Publications. New Delhi.

Kumar, S. 2002. Does "participation" in common pool resource management help the poor ? A social cost-benefit analysis of Joint Forest Management in Jharkhand, India. *World Development* 30(5): 763-782

#### **Module 5:**

Moore, M. 1989. The fruits and fallacies of neo-liberalism: the case of irrigation policy. *World Development* 17(11): 1733-1750

Bauer, C.J. 1997. Bringing water markets down to earth: the political economy of water rights in Chile, 1976-95. *World Development* 25(5): 639-656

#### **Module 6:**

Shashidharan, E.M. 2000. Civil society organizations and irrigation management in Gujarat, India. In *Water for food and rural development. Approaches and initiatives in South Asia*, ed. P.P. Mollinga, pp. 247-265. New Delhi: Sage Publications

Blair, H. 2000. Participation and accountability at the periphery: democracy and local governance in six countries. *World Development* 28(1): 21-39

**Students are actively encouraged to regularly browse through a number of policy and governance oriented journals such as *World Development, Public Administration Review, The Economic and Political Weekly, and Natural Resources Forum.***

**Policy Analysis for Sustainable Resource Management**  
**4 credit course**

**Course objectives.** This course seeks to familiarize students with different approaches to policy analysis for natural resource management. Students are introduced to different connotations of the term policy, the objectives of a policy analysis, different conceptual approaches to policy analysis as well as methodological and ethical issues in doing policy analyses. Students are familiarized with different analytical frameworks that can be employed to examine natural resources policy and are exposed to the case study method as employed in policy research.

The underlying premise of the course is that there is a discrepancy between the prescriptive and process dimensions of policy, and that this discrepancy needs to be appreciated in a context of complex social and environmental interactions. Policy formulation and implementation for natural resource management is shaped by several actors and processes, and the relative strength that they bring to reform processes. The course proceeds through a mix of lectures, cases and assignments, encouraging students to apply the concepts and theories learnt and developed in the course.

Evaluation:

Minor Tests: 15% x 2 = 30%

Case study: Presentation of a policy study : 20%

Final Exam: 30%

Assignments and class presentations: 20%

**Policy Analysis for sustainable resource management**

	Lectures	Tutorials
<b>Introduction.</b> Meaning and connotations of the term policy. Objectives of a policy analysis and approaches to policy analysis: analysis <i>of</i> policy and analysis <i>for</i> policy; linear and interactive models of policy analysis; <i>policy as prescription vs policy as process.</i>	6	3
<b>Why policy for sustainable resource management ?</b> The meaning of sustainable development. The Brundtland Commission: The concept of sustainability; social, environmental and economic dimensions. Indicators of sustainability. The concepts of carrying capacity and ecological footprint. Tragedy of the commons. Property right regimes. Open access, state, private and common property.	4	2
<b>Frameworks for analyzing policies for sustainable resource management</b> Definition of a "policy response". The PSIR framework. The Sustainable Livelihoods framework & The Capital	6	6



Assets Framework. The Vulnerability Assessment Framework. Actor-Oriented Approaches. The coalition advocacy framework. Perspectives in legal pluralism.		
<b>The policy context for natural resource management</b> Changing paradigms in governance. Decentralization and changing role of state. Role of multilateral and bilateral organizations; neo-liberal ideologies and market creation, NGOs and civil society. Resulting situations of legal pluralism.	<b>6</b>	<b>4</b>
<b>Research for policy transformation and implementation: methodological and ethical issues.</b> Participatory Methodologies for natural resource management, PRA tools, ethnographic approaches, communicating research to policy-makers; ethical issues in research	<b>6</b>	<b>4</b>
<b>Public Policy for sustainable development: learning from case studies.</b> The case study method of research. Analytic vs statistical generalization. Processes of policy implementation. The politics of policy. (Policies for natural resources management, population, poverty alleviation, and food security). Indian and international context. This module is based on assignment and presentations in the class, each of which examines a case of a "policy study".	<b>1</b>	<b>8</b>

### Readings list

1. Hogwood, B and Gunn, Lewis A. 1984. Policy Analysis for the real world, ELBS and Oxford University Press. Chapter 2 "Analysing public policy".
2. Thomas, John W and Grindle, M.S. 1990. After the decision: implementing policy reforms in developing countries. World Development. 18(8): 1163-1181
3. Hempel, Lamont C. 1996. Environmental Governance: the global challenge. Island Press.
4. 291 pp. Chapter 5. The Environmental Policy-Making Process.
5. Sutton, Rebecca. 1999. The Policy Process: an overview. Overseas Development Institute. Working Paper 118.
6. Sabatier, P. ed. Theories of the Policy Process. Boulder, CO, West View Press.
7. Howlett, M and M. Ramesh (1995). Studying Public Policy: policy cycles and policy sub-systems. Toronto, Oxford University Press.
8. David L Weimner and Aidan R. Vining. Policy Analysis: concepts and practice. 2d edition, Englewood Cliffs, NJ: Prentice Hall, 1999.

9. Our common future. 1987. The Brundtland Commission on Environment and Development.
10. Hardin, G. 1968. The tragedy of the commons. *Science*. 162: 1243-48.
11. Bac, M. 1998. Property Rights Regimes and the management of resources. *Natural Resources Forum*. Vol. 22(4): 263-269
12. Folke, C and Berkes, F. 1995. Mechanisms that link property rights to Ecological Systems. In Susan Hanna and Mohan Munasinghe eds. *Property Rights and the Environment. Social and Ecological Issues*. The Beijer Institute of Ecological Economics and the World Bank. Environmentally Sustainable Development Series.
13. Carney, D. Ed. 1998. *Sustainable Rural Livelihoods. What contribution can we make ?*
14. Chambers, R and Conway, G. 1992. Sustainable rural livelihoods: practical concepts for the 21<sup>st</sup> Century. IDS Discussion paper No. 296
15. Scoones, I. 1998. Sustainable Rural Livelihoods. A framework for analysis. IDS Working Paper No. 72.
16. Meinzen-Dick, R. and Adato, M. 2001 Applying the sustainable livelihoods framework to impact assessment in natural resource management. Paper presented at the workshop on Integrated Management for Sustainable Agriculture, Forestry and Fisheries. 28-31 August, 2001. Cali, Colombia.
17. Merry S.E. 1998. Legal Pluralism. *Law and Society Review* 22(5): 869-896
18. Korten, David C. 1989. From bureaucratic to strategic organisation. In: Frances C Korten and Robert Y Siy, Jr. edited *Transforming a bureaucracy*.
19. Mollinga, P.P. 2001. Power in Motion: A critical assessment of canal irrigation reform, with a focus on India. IndianPIM working paper No. 1
20. Vira, B. 1999. Implementing Joint Forest Management in the Field: Towards an understanding of the community-bureaucracy interface, pp. 254-275, in Jeffrey, R and Nandini Sunder, (eds.) *A new moral economy for India's forests ? Discourses of Community and Participation*. Sage Publications. New Delhi.
21. Poffenberger, M and C. Singh, 1996. Communities and the state: re-establishing the balance in Indian Forest Policy, in M.Poffenberger and B McGean, eds. *Village Voices, Forest Choices: Joint Forest Management in India*. Delhi: Oxford University Press.
22. Poffenberger, M. 1990. Facilitating change in forest bureaucracies in M. Poffenberger, ed. *Keepers of the Forest*. West Hartford, C.T: Kumarian Press.
23. Moore, M. 1989. The fruits and fallacies of neo-liberalism: the case of irrigation policy. *World Development* 17(11): 1733-1750
24. Bauer, C.J. 1997. Bringing water markets down to earth: the political economy of water rights in Chile, 1976-95. *World Development* 25(5): 639-656
25. World Bank, 2003. *Reforming Public Institutions and strengthening governance. A World Bank Strategy Implementation Update*.

26. Shashidharan, E.M. 2000. Civil society organizations and irrigation management in Gujarat, India. In *Water for food and rural development. Approaches and initiatives in South Asia*, ed. P.P. Mollinga, pp. 247-265. New Delhi: Sage Publications
27. Chambers, Robert. 1994. Participatory Rural Appraisal: challenges, potentials and paradigm. *World Development* 22(10): 1437-1454
28. Vaughan, Roger J and Buss, Terry F. 1998. Communicating Social Science research to policy-makers. *Applied Social Research Methods Series*. Vol. 48. Sage Publications. Thousand Oaks. California. Chapter 1 "Offering advice".
29. Neuman, Lawrence W. 1997. *Social Research Methods. Qualitative and Quantitative Approaches*. Chapter 13 and 14. "Qualitative research design" and 'Field research'.
30. Dreze, J and Sen A. 1992. *India: Economic Development and Social Opportunity*.



**Course title: TREES OUTSIDE FORESTS****Number of credits: 4****Number of lectures-tutorial-Practicals: 42-14-14**

**Course outline:** The course covers basic concepts, aim and management of trees outside forests including trees in agroforestry system, social forestry plantations and Urban-peri urban forests. The course will help students to identify the type of agroforestry, social and urban forestry practices applicable to different climates and landscapes, knowledge of design and management of these systems, . The course also includes student visits to agroforestry systems, social and Urban plantations and interaction with the people involved in raising and maintaining these TOFs.

**Evaluation procedure** (Percentage of marks to be allotted to each type of test):

2 minor tests	: 10 + 10
Practicals	: 15
Assignments, Presentations, field report	: 15
1 major test (end semester)	: 50

**Details of course content & allotted time**

<i>Topic</i>	<i>Allotted time (hours)</i>		
	<i>L</i>	<i>T</i>	<i>P</i>
• Introduction and historical background	1		
<b><i>Classification of Trees Outside Forests</i></b>			
<b><i>Agroforestry Plantations</i></b>			
• <b><i>Basic definitions and concepts:</i></b> Advantages and constraints; Status of agroforestry research and area in India; Classification of Agroforestry systems	1		
• <b><i>Design of agroforestry plantations:</i></b> Pattern and spacing; Diagnosis and Design methodology ; Prospects of GPS/GIS in preparing agroforestry design	3		
• <b><i>Principles of species selection for Agroforestry:</i></b> Evaluation of species for the site and agroforestry design; Germplasm sources and provenance variation; Concept of multipurpose trees	1		
• <b><i>Management of agroforestry plantations:</i></b> Genetic improvement of agroforestry trees; role of biotechnology and other new technologies in agroforestry; green manuring, fodder banks; protection from pests and diseases	3		
• Extension of agroforestry technology to farmers; strategies for enhancing adoption of agroforestry technology	1	2	
<b><i>Community forest</i></b>	4		
Definitions and concepts; Components and implementation at local and national levels; Social attitudes and community participation; Participation, extension and conflict resolution; Energy plantations Choice of species , types of community forests			

<b>Urban and peri urban tree Plantations</b>			
• Definitions and historical background; Art and science of cultivating urban trees; Distribution and ownership; Administration; <i>Urban climate</i> and wildlife; tree architecture; value of urban and peri urban forests	1		
• <b>Landscaping:</b> Design of urban forests; Principles of design; Methods of establishing and maintaining landscapes	4	4	
• <b>Silvicultural techniques for raising urban trees, species selection</b>	3	2	
• <b>Urban forest management:</b> Special objectives and methods of urban forest planning and management; Problems and strategies of urban forest management	3		
• <b>Protection of urban trees:</b> Disease, insects and stress problems of urban trees; Difficulties in protection measures; Specialized protection techniques for urban trees	2		
<b>Commercial Plantations</b>	2		
Introduction; Species, monocultures Vs mixed cultures Sustainability; Productivity and diversity; Management Economics; Advantages and Threats			
<b>Forestry in degraded forest areas, fringe areas of Protected areas</b>	2		
<b>Assessment and measurement of trees outside forests</b>	3	6	14
Challenges and objectives; Methods and tools for inventorying TOFs; Using GIS and remote sensing for spatial and temporal trend analysis; Field inventory			
Direct and indirect benefits of TOFs, economic valuation methods for TOFs, TOFs for rural livelihoods	4		
Policy interventions for TOFs in India, International initiatives on the sustainable management of trees outside forests; Case studies from different countries	4		
<b>Total</b>	<b>42</b>	<b>14</b>	<b>14</b>

#### Readings:

1. *Trees outside forests: Towards a better awareness*. FAO Conservation Guide. 35. ISBN-92-5-104656-5
2. Miller, R. W. 1997. *Urban Forestry: Planning and Managing Urban Greenspaces*. Second Edition. Prentice Hall, Englewood Cliffs, New Jersey
3. Mellink et al. 1991. *Agroforestry in Asia and the Pacific*. FAO-RAPA PUBLICATION 1991/5
4. D. N. Tewari: 1995. *Agroforestry for increased productivity, sustainability and poverty alleviation*. Dehra Dun: International Bok Distributors.
5. Gilbert, O. L. 1989. *The Ecology of Urban Habitats*. Chapman and Hall, London and New York.
6. Grey, G. W. and F. J. Deneke. 1986. *Urban Forestry*. Second edition. Wiley, New York.
7. Harris, R. W., J. R. Clark and N. P. Matheny. 2004. *Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines*. Third edition. Prentice-Hall, Upper Saddle River, New Jersey.



TERI school of  
advanced studies  
Darbari Seth Block, India Habitat Centre,  
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Statistics and Mathematics-I	Ram Karan Singh
Statistics and Mathematics-II	Ram Karan Singh
Communication skills	Nandini Kumar
Cultural Ecology and Development	Avanish Kumar

*Courses in Semester –II*

Research Methodology	Avanish Kumar
Biodiversity assessment and conservation	Neeraj Khera

*Courses in Semester – III (Concentration areas)*

<i>Solid and hazardous waste management*</i>	<i>Suneel Pandey</i>
<i>Env. Pollution monitoring and auditing*</i>	<i>Nandini Kumar</i>
<i>Env. Modelling</i>	<i>Ram Karan Singh</i>
<i>Soil conservation and Land management</i>	<i>Ram Karan Singh</i>
<i>Environmental economics</i>	<i>Surender Kumar</i>
<i>Climate Change, Ecosystems and society</i>	<i>Vivek Kumar</i>
<i>Integrated Impact assessment</i>	<i>Arbinda Mishra</i>
<i>Resource economics</i>	<i>Arbinda Mishra</i>
<i>Governance and Management of Natural Resources</i>	<i>Vishal Narain</i>
<i>Policy analysis for sustainable Resource Management</i>	<i>Vishal Narain</i>
<i>Trees Outside Forests</i>	<i>Neeraj Khera</i>
<i>Water conservation</i>	<i>Kapil Narula</i>



**Course Title: Environmental Modeling**  
**Course code: NRS 171: Course Credit: 4 (42:14:0)**  
**Faculty: Dr. Ram Karan Singh**

**Objective:** The basic objective of the course is to introduce the students about the basic knowledge of water, air and noise pollution. It also introduces about basic modeling techniques and their applications in water, air, noise and ecological management. Course also takes in account of various national and International standards related to water, air and noise pollution and trans boundary features of the same.

**Part-I Water pollution:**

**Brief course outline:** Sources and effects of water pollutants, introduction to principles of water quality modeling, distribution of water quality in rivers, estuaries and lakes, contaminant transport in groundwater, water quality modeling applications and discussion of case studies.

**Details of course content and lecture plan:**

TOPIC	TIME (HOURS)		
	Lectures	Tutorials	Practical
Introduction: Sources and effects of water pollutants in Indian context	2	-	-
Principles of water quality modeling: River hydrology and derivation of basic stream equations, surface water pollutants, physical laws and their use in modeling	4	1	-
Surface Water Quality Modeling: Distribution of water quality in rivers, estuaries and lakes, measurements and evaluation of DO and BOD in rivers, Eutrophication process and basic mechanisms and its significance in surface water.	5	3	-
Ground Water Quality Modeling: Contaminant transport in groundwater; basics and fate of pollutants in ground water, hydrodynamic dispersion, decay, reactive processes; site specific groundwater quality problems in India.	4	2	-
Water quality model applications: Model set-up, calibration, and validation procedures, selection; case studies and applications of water quality model.	4	2	-
Ecological modeling	2	-	-
<b>Total</b>	<b>21</b>	<b>8</b>	<b>0</b>

## **Reference Books:**

### **Water pollution**

1. Chapra, S: Surface Water-quality modeling, Tata McGraw-Hill, 1997.
2. Thomann, Robert V., John A. Mueller. Principles of Surface Water Quality Modeling and Control.
3. HarperCollins Publisher Inc., New York, 1987
4. Bouwer, H. Groundwater hydrology. Mc-Graw Hill International Editions (Civil Engineering series), 1978
5. Todd, D.K. Groundwater hydrology. John Wiley and Sons, 1980
6. Freeze, A., Cherry, and J.A. Groundwater. Prentice Hall, 1979.
7. Zheng, C and Bennett, G.D. Applied Contaminant Transport Modeling: Theory and Practice. Van Nostrand Reinhold. 1995

### **Air and Noise pollution**

1. Boubel, R W, Fox, D L, Turner, D B (Ed.) and Stern, A C (Ed.) (1994) Fundamentals of Air Pollution, 3rd edition, Academic Press Inc.
2. Turner, D B (1994) Workbook of Atmospheric Dispersion Estimates: An introduction to dispersion modeling, 2nd edition, and Lewis publishers.
3. Wark, K, Warner, C F, and Davis, W T (1997) Air Pollution- Its origin and control, Addison Wesley Longman, Inc.
4. Rao C S (1991), Environmental pollution controls engineering, New Age International (P) Ltd., Publishers, New Delhi.
5. Pasquill, F and Smith, F B (1983) Atmospheric Diffusion, Ellis Horwood Ltd., Chichester.
6. Heinsohn R J and Kabel R L (1999) Sources and control of air pollution, Prentice hall, NJ
7. Rau, J.G. (1980) Environmental Impact analysis handbook. McGraw Hill, New York

## Governance and management of natural resources

Credits: 4

Lecture Tutorial: 36-20

### Evaluation:

Minor Tests: 15% X 2= 30%

Final Exam: 40%

Assignments and presentations: 30%

### Course objectives:

This course seeks to familiarise students with the concepts and practice of the governance of natural resources. Students are exposed to theoretical and conceptual issues in analyses of governance and management of natural resources, as well as to changing paradigms in NRM and governance. Through case study-based learning and interactions, they are exposed to practical issues and problems in natural resource management.

Starting with a review of conceptual and theoretical issues in the governance of natural resources, the course proceeds by tracing a trajectory of changing paradigms in governance. This entails the shifting emphasis from the state to the market, to local institutions and the current emphasis on partnerships: the drivers of these shifts, and the empirical evidence with their functioning.

Thus, the course is split into six blocks/modules

- 1) Overview of theoretical concepts and approaches
- 2) The bureaucracy (State) in Natural Resource Management
- 3) Decentralisation and changing role of the state
- 4) Collective Action and Management of Common Property resources
- 5) Markets as a form of natural resource allocation
- 6) Role of NGOs and civil society groups: emphasis on partnerships

Topic	Lecture	Tutorials
Block 1: Overview of conceptual issues and approaches		
Establishing the rationale for NRM regimes: property rights (state, common, private property, open access). Legal pluralism. Conceptual distinctions and nuances 1) Institutions and organisations 2) Governance and Government 3) Management and Governance Theoretical approaches to governance and contribution of different disciplines: 1) Rational Choice and New Institutional Economics 2) Public Administration and Management 3) Socio-technical Perspectives 4) Legal Anthropological Approaches, legal pluralism in governance 5) Influence of neo-liberal ideologies on governance	8	3



on Folk Law and Legal Pluralism, Fredericton, University of New Brunswick, Canada, August 26-30, 2005.

5. Wade, R. 1985. The market for public office: why the Indian state is not better at development. *World Development*, 13(4): 467-497.

### Block 3:

1. Esman, M.J., and Uphoff, N.T. 1984. Local Organisations as intermediaries. *Chapter 1* in Local Organisations. Intermediaries in Rural Development. Cornell University Press. Ithaca, pp. 15-41
2. Korten, David C. 1984. People-centred development: toward a framework in David
3. C Korten and Rudi Klaus eds. *People-Centred Development. Contributions toward theory and planning frameworks*. Kumarian Press.
4. Korten, David C. 1989. From bureaucratic to strategic organisation. In: Frances C Korten and Robert Y Siy, Jr. edited *Transforming a bureaucracy*.
5. Kolavalli, Shashi and John Kerr, 2002. Scaling up participatory watershed development in India. *Development and change* 33(2): 213-235.
6. Poffenberger, M. 1990. Facilitating change in forest bureaucracies in M. Poffenberger, ed. *Keepers of the Forest*. West Hartford, C.T: Kumarian Press.
7. Mollinga, P.P. 2001. *Power in Motion: A critical assessment of canal irrigation reform*, with a focus on India. IndianPIM working paper No. 1
8. Vasavada Shilpa, Abha Mishra and Crispin Bates. 1999. How many committees do I belong to ? In Jeffrey, R and Nandini Sunder, (eds.) *A new moral economy for India's forests ? Discourses of Community and Participation*. Sage Publications. New Delhi.

### Block 4

1. Ostrom, E. (1990). *Governing the commons. The evolution of institutions for collective Action*. Cambridge University Press. Cambridge.
2. Tang, S.Y. 1991. Institutional Arrangements and the management of common pool resources. *Public Administration Review*. 51(1): 42-51
3. Narain, V. 2004. Brackets and Black Boxes: Research on water users associations. *Water Policy*. 6(3): 185-196
4. Wade, R. 1988. *Village Republics*. Cambridge: Cambridge University Press
5. Agrawal, A. 2001. Common Property Institutions and Sustainable Governance of Resources. *World Development* 29(10): 1649-1672
6. Agrawal, A & Gibson, C. C. 1999. Enchantment and disenchantment: the role of community in natural resource conservation. *World Development* 27(4): 629-649
7. Van Koppen, B. 2001. Gender in integrated water management: an analysis of variation. *Natural Resources Forum* 25: 299-312
8. Locke, C 1999. Women's representation and roles in 'Gender' Policy in Joint Forest Management, pp. 235-253, in Jeffrey, R and Nandini Sunder, (eds.) *A new moral economy for India's forests ? Discourses of Community and Participation*. Sage Publications. New Delhi.
9. Narain, V. 2003 *Institutions, Technology and water control: water users associations and irrigation management reform in two large -scale systems in India*. Orient Longman:Hyderabad. 244 pp. *Chapter 5, Beyond Community: demythologising participation in irrigation management*.
10. Rajan, J.B. 2003. Declining indigenous regulations on fishery: a case of Kadakkodi (sea court) in Kerala, South India. Paper presented at the XIII International Congress of the Commission on Folk Law and Legal Pluralism, Chiang Mai, Thailand, 7-10 April, 2002.

**Course title: Trees Outside Forests**

**Number of credits: 4**

**Number of lectures-tutorial-Practicals: 42-7-14**

**Course outline:** The course covers basic concepts, aim and management of trees outside forests including trees in agroforestry system, social forestry plantations and Urban-peri urban forests. The course will help students to identify the type of agroforestry, social and urban forestry practices applicable to different climates and landscapes, knowledge of design and management of these systems. The course also includes student visits to agroforestry systems, social and Urban plantations and interaction with the people involved in raising and maintaining these TOFs.

**Evaluation procedure** (Percentage of marks to be allotted to each type of test):

2 minor tests: 10 + 10

Practicals: 15

Assignments, Presentations, field report: 15

1 major test (end semester): 50

**Details of course content & allotted time**

No	Topic	Allotted time (hours)		
		L	T	P
	Introduction and historical background	1		
	<b>Classification of Trees Outside Forests</b>			
	<b>Agroforestry Plantations</b>			
	<b>Basic definitions and concepts:</b> Advantages and constraints; Status of agroforestry research and area in India; Classification of Agroforestry systems	1		
	<b>Design of agroforestry plantations:</b> Pattern and spacing; Diagnosis and Design methodology ; Potential of GPS/GIS in preparing agroforestry design	3		
	<b>Principles of species selection for Agroforestry:</b> Evaluation of species for the site and agroforestry design; Germplasm sources and provenance variation; Concept of multipurpose trees	1		
	<b>Management of agroforestry plantations:</b> Genetic improvement of agroforestry trees; role of biotechnology and other new technologies in agroforestry; green manuring, fodder banks; protection from pests and diseases	3		
	Extension of agroforestry technology to farmers; strategies for enhancing adoption of agroforestry technology	1	1	

4. D. N. Tewari: 1995. *Agroforestry for increased productivity, sustainability and poverty alleviation*. Dehra Dun: International Bok Distributors.
5. Gilbert, O. L. 1989. *The Ecology of Urban Habitats*. Chapman and Hall, London and New York.
6. Grey, G. W. and F. J. Deneke. 1986. *Urban Forestry*. Second edition. Wiley, New York.
7. Harris, R. W., J. R. Clark and N. P. Matheny. 2004. *Arboriculture: Integrated Management of Landscape Trees, Shrubs and Vines*. Third edition. Prentice-Hall, Upper Saddle River, New Jersey.



Course No.: NRS 145

Course title: **Integrated Impact Assessment**

Number of credits: 4 (3-1-0)

Number of lectures-tutorial-practical:42-14-0

Course coordinator: Dr. Arabinda Mishra

### **Faculty**

Dr. Arabinda Mishra

Dr. Avanish Kumar

Dr. Ram Karan Singh

Dr. Neeraj Khera

### **Course outline:**

There is growing realization that the multi-dimensional nature of sustainable development targets requires the use of different disciplinary approaches, in an integrated framework, to the impact assessment of development projects/programmes. Integrated Impact Assessment (IIA) provides such a framework for a balanced consideration of the economic, environmental, social and health impacts of development interventions at the project, sector and economy levels. The course in Integrated Impact Assessment (IIA) is designed to build detailed knowledge, understanding and skills among students for conducting IIA, so that they are able to identify sustainable modes of environmental operation. The course starts with an overview of IIA – the different methodologies on which it draws, the state of the art, current practices, constraints and future directions. This is followed by in-depth exposure to the key approaches to IIA - environmental, social and health – with a focus on methodology and tools in the key discipline areas. Social CBA is introduced as a possible tool for the integrated analysis of the environmental, social and health impacts of development projects or programmes. AHP is introduced as an easily understood multiple-criteria decision-making technique. Technology assessment, risk assessment, etc are discussed at the conceptual level to provide students with a flavour of the emerging dimensions of IIA. The final module of the course is intended to strengthen students' analytical capacity and assessment skills by making them work through actual/simulated scenarios.

### **Evaluation procedure:**

- Minor tests : 30%
- Assignments : 20%
- Final examination : 50%

Topic	Allotted time (hours)			
	Lecture	Tutorial	Practical	Subtotal/Total
SIA and NRM	2			
SIA Case Studies		1		
<b>Integrated Analysis of Environmental, Social &amp; Health Impacts</b>	<b>7</b>	<b>2</b>	<b>0</b>	<b>9</b>
Challenges for IIA: Removing inconsistencies and differences between different approaches; other methodological and practical issues	1			
Scope for integrated approach in economic analysis: concept of economic analysis, Cost-Benefit Analysis (CBA), Social CBA, Cost Effectiveness Analysis (CEA)	3	1		
The Analytic Hierarchy Process (AHP) based approach to project appraisal	3	1		
<b>Mapping Tools and Techniques in IIA</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
Role and relevance of GIS Techniques in IIA	4			
<b>Public Participation in IIA and its relevance to decision-making</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
Contribution of IIA to decision-making – prospects & constraints; Stakeholder participation in IIA – importance, methodological and practical issues	1			
<b>Emerging Dimensions &amp; Future Directions</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
Strategic Environmental Assessment (SEA), Technology Assessment, Risk Assessment	2			
<b>IIA Case Studies</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>6</b>
Case Study 1	1	1		
Case Study 2	1	1		
Case Study 3	1	1		
<b>Total</b>				<b>56</b>

#### Text Books:

1. Canter, L.W. 1996. Environmental Impact Assessment. 2<sup>nd</sup> Edn. New York, McGrawHill.
2. Asian Development Bank 1997. Environmental impact assessment for developing countries in Asia, Vol I & II. ADB Publication
3. Lee, N. and C. Kirkpatrick (Eds). 2000. Integrated Appraisal and Sustainable Development in a Developing World. Cheltenham, Edward Elgar.
4. British Medical Association 1998. Health and Environmental Impact Assessment- an integrated approach. Earthscan
5. Vanclay F and Bronstein D A 1995. Environmental and Social Impact assessment, Wiley publishers.
6. Linkage methods for environment and health analysis – General guidelines. Edited by D Briggs, C. Corvalan, M. Nurminen, World Health Organization, Geneva , 1996. 136 p

## **Policy Analysis for Sustainable Resource Management**

**4 credit course: 30-26**

**Course coordinator: Dr. Vishal Narain**

**Course objectives.** This course seeks to familiarize students with different approaches to policy analysis for sustainable resource management. Students are introduced to different connotations of the term policy, the objectives of a policy analysis, different conceptual approaches to policy analysis as well as methodological issues in doing policy analyses. Students are familiarized with different analytical frameworks that can be employed to examine natural resources policy and are exposed to the case study method as used in policy analysis.

The underlying premise of the course is that there is a discrepancy between the prescriptive and process dimensions of policy, and that this discrepancy needs to be appreciated in a context of complex social and environmental interactions. Policy formulation and implementation for natural resource management is shaped by several actors and processes, and the relative strength that they bring to reform processes. The course proceeds through a mix of lectures, cases and assignments, encouraging students to apply the concepts and theories learnt and developed in the course.

### **Evaluation:**

Final Exam: 40%

Minor Tests: 15% x 2= 30%

Presentation of a policy study: 10%

Tutorials and case presentations in class: 20%



## Readings list

- Hogwood, B and Lewis A Gunn. 1984. Policy Analysis for the real world, ELBS and Oxford University Press. *Chapter 2 "Analyzing public policy"*.
- Thomas, John W & M.S Grindle. 1990. After the decision: implementing policy reforms in developing countries. *World Development*. 18(8): 1163-1181
- Hempel, Lamont C. 1996. Environmental Governance: the global challenge. Island Press. 291 pp. *Chapter 5. The Environmental Policy-Making Process*.
- Sutton, Rebecca. 1999. *The Policy Process: an overview*. Overseas Development Institute. Working Paper 118.
- Keeley, J and Scoones, I. 1999. *Understanding environmental policy processes: a review*, IDS Working Paper, No 89, Brighton: IDS
- The Brundtland Commission on Environment and Development. 1987. *Our common Future*: Oxford University Press.
- Hardin, G. 1968. The tragedy of the commons. *Science*. 162: 1243-48.
- Bac, M. 1998. Property Right Regimes and the management of resources. *Natural Resources Forum*. Vol. 22(4): 263-269
- Chambers, R and Conway, G. 1992. *Sustainable rural livelihoods: practical concepts for the 21<sup>st</sup> Century*. IDS Discussion paper No. 296. Institute for Development Studies
- Scoones, I. 1998. *Sustainable Rural Livelihoods. A framework for analysis*. IDS Working Paper No. 72. Institute for Development Studies.
- Meinzen-Dick, R. and Adato, M. 2001. *Applying the sustainable livelihoods framework to impact assessment in natural resource management*. Paper presented at the workshop on Integrated Management for Sustainable Agriculture, Forestry and Fisheries. 28-31 August, 2001. Cali, Colombia.
- Griffiths, J. 1986. What is legal pluralism? *Journal of legal pluralism and unofficial law*. 24: 1-56
- Benda Beckmann, F von. 1989. Scape-goat and magic charm: law in development theory and practice. *Journal of legal pluralism and unofficial law* 28:129-149.
- Long, N and van der Ploeg, J. 1989. Demythologizing planned development; an actor perspective, *Sociologia Ruralis*, vo. XXIX (3/4): 227-249

Poffenberger, M and C. Singh, 1996. Communities and the state: re-establishing the balance in Indian Forest Policy, in M.Poffenberger and B McGean, eds. *Village Voices, Forest Choices: Joint Forest Management in India*. Delhi: Oxford University Press.

Keeley, J and I Scoones. 2003. Understanding Environmental Policy Processes. Cases from Africa. Earthscan: London. *Chapter 3. Knowledge, power and politics: the environmental policy-making process in Ethiopia* and *Chapter 5: Environmental Policy-Making in Mali: Science, Bureaucracy and Soil Fertility Narratives*.

Worku, Tessema.2000. Stakeholder participation in policy processes in Ethiopia: Managing Africa's soils, No. 17, London, IIED.

### **Additional readings**

Sabatier, P. ed. *Theories of the Policy Process*. Boulder, CO, West View Press.

Howlett, M and M. Ramesh (1995). *Studying Public Policy: policy cycles and policy sub-systems*. Toronto, Oxford University Press.

David L Weimner and Aidan R. Vining. *Policy Analysis: concepts and practice*. 2d edition, Englewood Cliffs, NJ: Prentice Hall, 1999.

**FOUNDATIONS OF FINANCE  
Course Outline**

	<b>Topic</b>	<b>Lectures</b>	<b>Tutorials</b>
<b>I.</b>	<b>FINANCIAL ANALYSIS</b>		
1.	Financial Statements <ul style="list-style-type: none"> <li>▪ Basic Concepts underlying Financial Accounting and Management Accounting</li> <li>▪ Generally accepted accounting principles and the accounting environment</li> <li>▪ The accounting equation</li> <li>▪ Balance Sheet – concepts of share capital, reserves &amp; surplus, secured/unsecured loans, current liabilities, fixed assets, depreciation accounting, investments, miscellaneous expenditure and losses, amortization, current assets, working capital, net worth .....</li> <li>▪ Profit &amp; Loss Account – concepts of gross profit, operating profit, PBIDT, PBIT, PBT, PAT, Retained Earnings .....</li> <li>▪ Sources &amp; Uses of Funds Statements – cash basis, working capital basis .....</li> </ul>	<b>5</b>	
2.	Financial Statement Analysis <ul style="list-style-type: none"> <li>▪ Objectives and uses of Financial Statement Analysis</li> <li>▪ Classification of Ratios –liquidity ratios, debt ratios, coverage ratios, Solvency Ratios, profitability ratios, market-value ratios .....</li> <li>▪ Interpretation of Ratios</li> <li>▪ Common Size &amp; Index Analysis .....</li> <li>▪ Dupont Analysis .....</li> </ul>	<b>3</b>	<b>2</b>
3.	Break-even Analysis & Leverages <ul style="list-style-type: none"> <li>▪ Concept and Nature of Leverage</li> <li>▪ Various Risks</li> <li>▪ Operating Leverage .....</li> <li>▪ Cost-Volume-Profit Analysis .....</li> <li>▪ Financial Leverage .....</li> <li>▪ EBIT-EPS Analysis</li> <li>▪ Total Leverage .....</li> </ul>	<b>2</b>	<b>2</b>
<b>II</b>	<b>FINANCING INSTRUMENTS</b>		
4.	Short-term Financing <ul style="list-style-type: none"> <li>▪ Types of Financing – permanent and temporary financing .....</li> <li>▪ Trade Credit Financing .....</li> <li>▪ Working Capital Advance by Commercial Banks – concept of cash credit/ overdrafts, loans, letter of credit.....</li> <li>▪ Other sources of short-term financing – concepts of bills discounting, commercial paper, factoring .....</li> </ul>	<b>2</b>	



	<ul style="list-style-type: none"> <li>▪ Conflicting Rankings</li> <li>▪ Multiple IRR</li> </ul>		
		<b>4</b>	<b>3</b>

	<b>Topic</b>	<b>Lectures</b>	<b>Tutorials</b>
IV.	<b>PRINCIPLES OF CAPITAL INVESTMENT (Contd.)</b>		
10.	Cost of Capital <ul style="list-style-type: none"> <li>▪ Basic Concepts .....</li> <li>▪ Cost of Debt .....</li> <li>▪ Cost of Preference Capital.....</li> <li>▪ Cost of Equity .....</li> <li>▪ Weighted Average Cost of Capital .....</li> </ul>		
		<b>4</b>	<b>3</b>
		<b>38</b>	<b>18</b>

## ADVANCED CONCEPTS IN FINANCE FOR REGULATORS

### Course Outline

	Topic	Lectures	Tutorials
I.	<b>SECURITIES MARKETS</b>		
1.	Equity Market <ul style="list-style-type: none"> <li>▪ Primary &amp; Secondary Markets .....</li> <li>▪ Organized Exchanges .....</li> <li>▪ Buying &amp; Selling Equities – concepts of types of orders and margin accounts .....</li> <li>▪ Regulation of Securities Market .....</li> </ul>	4	1
2.	Fixed-Income Securities <ul style="list-style-type: none"> <li>▪ Classes of Fixed-Income Securities .....</li> <li>▪ Debt Markets .....</li> </ul>	1	
3.	Derivatives <ul style="list-style-type: none"> <li>▪ Options – types of contracts .....</li> <li>▪ Valuation of Options .....</li> <li>▪ Financial Futures – foreign currency, interest-rate, market index .....</li> <li>▪ Forward Contracts .....</li> </ul>	6	2
4.	Mutual Funds <ul style="list-style-type: none"> <li>▪ Mutual Fund Organization .....</li> <li>▪ Advantages of Mutual Funds .....</li> <li>▪ Types of Mutual Funds.....</li> <li>▪ Calculating Fund Returns .....</li> <li>▪ Risk-adjusted Performance .....</li> </ul>	4	1
II.	<b>VENTURE &amp; PRIVATE EQUITY FUNDING</b>		
5.	Venture Capital <ul style="list-style-type: none"> <li>▪ Concept of Venture Funding.....</li> <li>▪ Concept of Private Equity Funding .....</li> <li>▪ Venture Capital in India .....</li> <li>▪ Regulation of VCF Industry .....</li> </ul>	2	
III.	<b>BANKING</b>		
5.	Banking System in India <ul style="list-style-type: none"> <li>▪ Structure of the Indian Banking Industry.....</li> <li>▪ Functions of Commercial Banks .....</li> <li>▪ Regulation and Role of RBI .....</li> </ul>	2	
6.	Assets & Liabilities of Scheduled Commercial Banks <ul style="list-style-type: none"> <li>▪ Capital Adequacy .....</li> <li>▪ Risk Adjusted Capital Requirements .....</li> <li>▪ Concept of CRR and SLR .....</li> </ul>	2	

**Masters Programme on Regulation**

**Course title: Principles of economics**

**Number of credits: 4 (3-1-0)**

**Number of lectures-tutorials-practicals: 45-11-0**

**Course outline:**

This course would cover the basic concepts of economics. This would include familiarity with different markets structures and their characteristics, principles of costs and revenue, concepts related to demand and supply, etc. in microeconomics. The basics in macroeconomics would discuss the interaction of the goods, assets and the international markets and the policy instruments in the hands of the government.

**Evaluation procedure:**

- Class discussions/ presentation: 5%
- Tutorials/assignments: 5%
- 2 Minor tests: 60% (30% each)
- 1 Major test (30%)

**Details of course content & allotted time**

No	Topics	Allotted time (hrs.)		
		Lectures	Tutorials	Practicals
1.	<b>Introduction to economics</b>	1		
A.	<b>Microeconomics</b>			
2.	<b>Consumer Behaviour</b>	5	1	
	- Demand analysis Income and substitution effects			
	<i>Learning objective</i> Upon successful completion of this topic, the student will be able to Understand the concept of demand Define, calculate, and interpret the price elasticity of demand			
3.	<b>Theory of the firm</b>	6	1	
	Laws of production (laws of returns to scale and laws of diminishing returns) Theory of costs			
	<i>Learning objective</i> Understand issues related to returns to scale			
4.	<b>Theory of pricing</b>	7	1	
	- Perfect competition - Monopoly - Price discrimination - Monopolistic competition - Oligopoly (classical and collusive oligopoly) - Average cost pricing - Limit pricing			
	<i>Learning objective</i> Upon successful completion of this topic, the student will be able to Use demand/supply analysis to determine equilibrium market price and Discuss the characteristics of the following business structures: Pure Competition,			



	the balance of payments and exchange rates trade in goods, market equilibrium and the balance of trade capital mobility and the Mundell Fleming Model			
	<i>Learning objective</i> Upon successful completion of this topic students would be able to understand the international linkages of macroeconomics.			
<b>11.</b>	<b>Aggregate demand and supply</b>	3	1	
	aggregate demand curve and aggregate demand policies - the aggregate supply curve - wage unemployment relationship			
	<i>Learning objectives</i> Upon successful completion of this topic the students would be able to understand the basics of macroeconomic equilibrium.			
<b>12.</b>	<b>Inflation and unemployment</b>	3	1	
		45	11	0

**Basic textbooks**

1. Hal R. Varian, Intermediate Microeconomics: A Modern Approach, 6<sup>th</sup> Edition, 2003, Affiliated East-West Press
2. Mankiw, Macroeconomics 5<sup>th</sup> edition, 2003
3. Pindyck and Rubinfeld, Microeconomics, 5th Edition, 2001
4. Dornbusch, Fischer, Startz, Macroeconomics, Mc Graw Hill, 8<sup>th</sup> Edition, 2001

**Readings on public goods and externalities**

1. Kolstad, Charles (2000) Environmental Economics, New York: Oxford University Press
2. Theodore Bergstrom, Regulation of Externalities, Journal of Public Economics, 5:131-138, 1976
3. Theodore Bergstrom, Laurence Blume, and Hal Varian, Private Provision of Public Goods, Journal of Public Economics, 29:25-49 1986
4. Urs Schweitzer, Externalities and the Coase Theorem: Hypothesis or Result? Journal of Institutional and Theoretical Economics, 144:245-266, 1988

Readings on game theory

1. Rasmusen, E., Games and Information, Blackwell, 1989.

Additional reference material such as copies of journal articles, reports, and lecture notes would be given/made known during the course of study.

Comments of Prof. A. Mitra – Institute of Economic Growth

Dear Saon,

The course outline seems perfect. Just a few suggestions:  
In section 4 while discussing about the externalities it may be useful to introduce the concept of agglomeration economies, which are of two types the urbanisation economies and the

**Course no.: BBT-151**

**Course title:** Environmental Biotechnology

**Number of credits:** 2-0-1

**Number of lectures-tutorial-practicals:** 28-0-28

**Faculty:**

Dr Banwari Lal

Dr Abha Agnihotri

Guest Faculty

**Course outline:**

The course will cover important topics in environmental biotechnology- microbiology, agriculture and environment; the prokaryotic and eukaryotic cells and organisms, basics of microbiology and biotechnology. The course will cover in details the biotransformation and biodegradation of specific pollutants, removal of pollutants from the environments, bioremediation of polluted lands or water bodies and microbe based nanotechnology. Emphasis is also given to the environment-friendly biotechnological approaches for sustainable agriculture, the socio-economic, ethical and environmental aspects of genetically modified organisms, bioinformatics, bio safety and IPR issues. The aim of the course will be both to understand the basic concepts in environmental biotechnology as well as application of biotechnology for addressing environmental problems.

**Evaluation procedure:**

- Class discussion and Practicals: 15 %
- Tutorials/assignment: 15 %
- 2 minor tests: 30% (15% each)
- 1 major test (end semester): 40%

**Details of course content & allotted time**

**Module 1**

Faculty: Dr Banwari Lal

Topic	Hrs/ lecture	Lectures	Practical
<b>Microbiology, Biotransformation and Biodegradation</b>		<b>14</b>	<b>21</b>
Prokaryotic cell structure and function. Overview of microbial genetics: Genes and their organization, Genetic code and Gene expression, Gene transfer and exchange mechanisms.	3		
Techniques of isolation, enrichment, purification and characterisation of microbes.	1		
Methods for identification of microbes; biochemical test, FAME analysis, 16D rDNA sequence, techniques of preservation of microbes.	3		
Current issues in environmental pollution and environmental protection: Methods in determining biodegradability; Use of microbes in biodegradation; Bioremediation of industrial solid and liquid wastes.	4		

4. Agricultural Microbiology. Authores G. Rangaswami and DJ Bagyaraj published from Prentice-Hall India New Delhi.
5. Principles of Biochemistry (3rd edition). Authors: Nelson and Cox (2003) Lehninger, Macmillan press.
6. Applied plant biotechnology. Authors: Chopra VL, Malik VS and Bhat SR (1999), Oxford University Press
7. Environmental pollution and control (4th edition). Peirce, Weiner and Vesilind (1998), Butterworth-Heinemann.
8. Biotechnology and safety Assessment (2nd edition). Thomas (1999), Replika Press Pvt. Ltd.
9. Environmental microbiology. Authors: Varnam and Evans (2000), ASM press.

#### **Other suggested readings**

1. Soil Microbiology, DJ Bhagyaraj
2. Microbiology by L M Prescott, J H Harley and D A Klein
3. An Introduction to Microbiology by Barry
4. Biochemistry and molecular biology of plants. Authors: Buchanan BB, Gruissem W and Jones RL (2000), American Society of Plant Physiologists
5. Introductory plant biology. Stern KR (1997) Wm Brown publishers.
6. Web sites/ notes provided



Course No.:	NRS 185
Course title:	<b>Water conservation</b>
Number of credits:	4 (3-1-0)
Number of lectures-tutorials-practicals:	42-14-0
Course coordinator(s):	Mr Kapil Narula, Dr. sarangi

**Course outline:**

The reasons for increased interest in protecting water concern over increased vulnerability to water-related stress are not difficult to discern. The users of water fall into three sectoral categories namely, agriculture, domestic and industrial sector. While agriculture sector demands a huge share of water for irrigation, the industrial and domestic sectors are mainly responsible for contaminating fresh water sources. Long term sustainability of fresh water resources cannot be guaranteed measured in terms of both availability and quality. Efficient water resources management and water conservation practices are a need of the time. This course will expose the students to the following aspects:

- a) Introduction to water resources evaluation and assessment - SPAC, WUE, methods of assessment, sectoral water use and demand, assessment of water stress and need for water conservation
- b) Water resources conservation and management including institutional and policy aspects such as rainwater harvesting, conjunctive water use, catchment planning, watershed management, irrigation use and efficiency, advanced treatment systems and zero discharge, participatory irrigation management including WUAs, methods of minimizing evaporation losses, water pricing, river basin organizations, collective action and decentralization etc.

**Evaluation procedure:**

- Minor (2 Minors) : 40 percent (20 percent each)
- Tutorial and term papers : 10 percent
- Quiz : 10 percent
- Major : 40 percent

**Details of course content & allotted time**

Content	Allotted time (hours)	
	Lectures	Tutorials
<i>Introduction to water conservation and assessment</i> Severity of water crisis, importance of conservation Soil, Plant, Atmosphere Continuum (SPAC); Water use efficiency (WUE) Methods of water resources assessment (hydrology cycle, surface flow assessment, groundwater recharge assessment) Water stress: principles and indicators for assessing water stress Water quality assessment: indicators for assessing water quality	12	6
<i>Water resources conservation and management</i> - Water conservation measures <ul style="list-style-type: none"> <li>• Soil moisture retention and conservation (cover crop, mulching, etc)</li> <li>• Traditional systems and man made structures (ponds, tanks, reservoirs)</li> <li>• Rainwater harvesting</li> <li>• Groundwater recharging</li> <li>• Minimizing evaporation losses</li> </ul> - Irrigation: types, scheduling, efficiency Case studies in various ecosystems: Arid, semi arid and humid ecosystems	16	5