



Darbari Seth Block, India Habitat Centre  
Lodhi Road New Delhi 110 003

**MINUTES OF THE NINETEENTH MEETING OF THE ACADEMIC COUNCIL  
HELD ON 21 JULY 2008 AT 10:30 A.M**

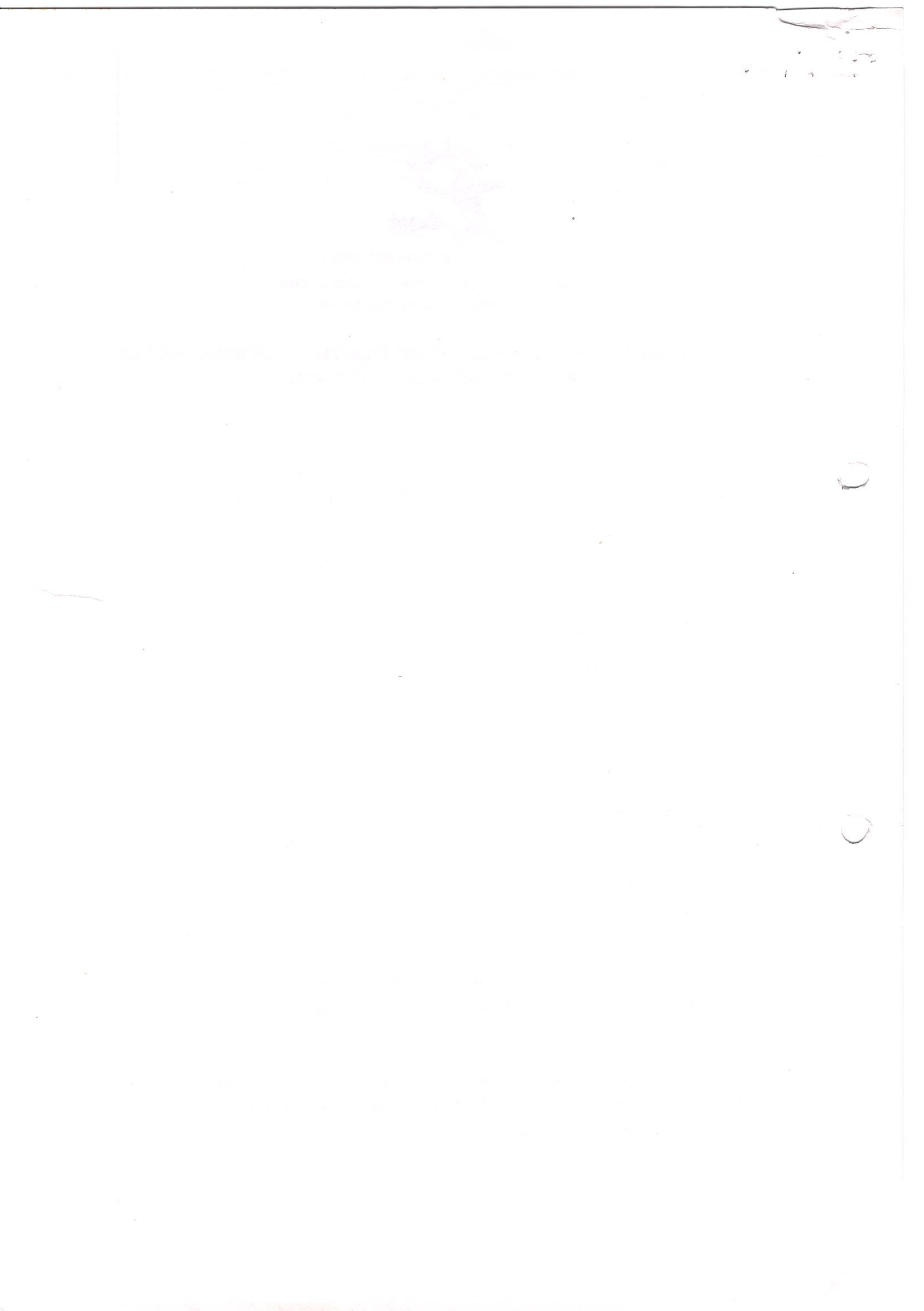
**PRESENT**

The following members of the Academic Council attended the meeting:

Dr P P Bhojvaid  
Dr Indira Rajaraman  
Dr Subodh K Sharma  
Dr Pradeep K Dadhich  
Dr E Sridharan  
Prof Rajat S Bakshi  
Dr Sanjay Saxena  
Dr Prateek Sharma  
Dr Arabinda Mishra  
Dr Saon Ray  
Dr P K Joshi  
Dr Deepti Gupta  
Dr Mala N Reddy  
Dr Neeraj Khara  
Dr T S Panwar  
Dr Sangeet Srivastava  
Mr Rajiv Seth

Prof P K Kalra, Dr S R Rao, Dr S K Sarkar, Dr Renu Swarup, , Dr O P Agarwal, Prof S Sundar, Dr VVN Kishore, Dr Y P Abbi, Dr Banwari Lal and Dr Sanjay P Mande did not attend the meeting.

The Chairman welcomed new members of the Academic Council. The meeting commenced with a vote of thanks to Dr Vibha Dhawan who was the Chairperson of the Academic Council until 30 June 2008.



**Item No. 1 To confirm the minutes of the eighteenth meeting of the Academic Council held on 05 February 2008**

The minutes of the eighteenth meeting of the Academic Council held on 5<sup>th</sup> February 2008 were confirmed, as circulated.

**Item No. 2 Matters for information**

The Council was informed that the new academic semester starts on 28 July 2008 in which two new programmes – M.Sc (Geoinformatics) and M.Sc (Plant Biotechnology) will be introduced.

The Council was informed that 31 students of the MSc 2006 batch have successfully completed the M.Sc (Environmental Studies) and (Natural Resources Management) programmes and 11 students of the MA (Public Policy & Sustainable Development) programme have successfully completed the first semester of their studies.

The work on the new campus has been completed and the shift is likely to take place in the semester starting July 2008.

**Item No. 3 Extension of maximum period of submission of thesis**

The Academic Council approved an extension of six months i.e. upto January 2009, to the maximum period allowable to submit the thesis in respect of two doctoral candidates, Ms Srivalli Ramakrishnan and Ms Shilpanjali Sarma.

**Item No. 4 Setting up of the Department of Biotechnology.**

The Academic Council recommended the setting up of the Department of Biotechnology in the Faculty of Applied Sciences. It also recommended the creation of 6 faculty posts in this Department.

**Item No. 5 To consider and approve courses of the M.Sc (Environmental Studies) (Natural Resources Management) and (Water Resources Management) programmes.**

The Academic Council was presented with a proposed restructuring of the M.Sc (Environmental Studies), (Natural Resources Management) and

(Water Resources Management) programmes. The Council approved the restructured programmes as appended in Annexure 5.1

The Academic Council discussed and approved the course outlines in respect of the following courses:

Outlines circulated in the agenda notes

NRN 183	Energy and the environment
NRS 132	Air quality management
NRS 137	Environmental monitoring laboratory
NRS 139	Environmental geosciences
NRS 142	Water quality management
NRS 173	Research Methodology
NRW 131	Glacier hydrology
NRW 161	Integrated watershed management
NRW 171	Water resources optimization and water quality modeling
NRW 173	Water and wastewater treatment process and design
NRW 163	Ground water hydrology and management

**Item No. 6 To consider and approve courses of the M.Sc (Geoinformatics) programme.**

The Academic Council discussed and approved the course outlines (outlines circulated in the agenda notes) in respect of the following M.Sc (Geoinformatics) courses:

NRG 101	Fundamentals of computers and programming
NRG 103	Project management
NRG 171	Principles of cartography
NRG 173	Principles of remote sensing
NRG 175	Principles of GIS and GPS

**Item No. 7 To consider and approve courses of the M.Sc (Plant Biotechnology) programme.**

The course outlines for courses to be offered in the first semester of the M.Sc (Plant Biotechnology) programme were discussed and approved by the Academic Council.

Outlines circulated in the agenda notes

BBP 101	Plant biotechnology laboratory – Part 1
BBP 151	Molecular and cell biology – Part I
BBP 153	Molecular plant physiology and biochemistry
BBP 155	Principles of genetic engineering and recombinant DNA technology

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

The following course outlines, for the MA (Public Policy and Sustainable Development) programme, were tabled at the meeting. (Annexures 8.1 and 8.2). They were discussed and approved by the Council.

PPM 165	Transportation Economics : Theory and Practice
PPS 102	Introduction to Science and Policy of Biodiversity Conservation

In addition, outlines of the following courses were tabled at the meeting (Annexure 8.3, 8.4 and 8.5). They were discussed and approved by the Council.

NRS 165	Introduction to sustainable development
PPM 111	Basic statistics and econometrics
NRW 175	Geoinformatics for water resource management

There being no other item, the meeting ended with a vote of thanks to the Chair.



## Master of Science in Environmental Studies

Semester I<sup>1</sup>

Existing		Proposed	
S.No.	Course	S.No.	Course
Credits		Credits	
<b>Theory</b>		<b>Theory</b>	
1.	NRS 121 - Ecology	1.	NRS 121 - Ecology
2.	NRS 131 - Environmental chemistry	2.	NRS 131 - Environmental chemistry
3.	NRS 155 - Environmental law and policy	3.	NRS 155 - Environmental law and policy
4.	NRS 101 - Communication skills	4.	NRS 101 - Communication skills
5.	NRS 111 - Quantitative techniques – 1	5.	<i>NRS 111 - Applied mathematics</i>
6.	NRS 162 - Hydrology and watershed science	6.	<i>NRS 139 - Environmental geosciences</i>
7.	NRS 127 - Cultural ecology and development	7.	<i>NRS 165 - Introduction to sustainable development</i>
		8.	<i>NRS 137 - Environmental monitoring laboratory</i>
Total credits earned		24	
		24	

<sup>1</sup> First semester is proposed to be common to all the three M.Sc. programmes viz. ES, NRM and WRM. Courses modified/relocated to other semester/deleted are underlined. New courses introduced are in bold and italics.

## Semester II

### Existing

S.No.	Course	Credits
<b>Theory</b>		
1.	NRS 112 - Quantitative techniques – II	3 (2.5-0.5-0)
2.	NRS 175 - Geoinformatics for natural resource management	4 (2-0-2)
3.	NRS 141 - Basic course in environmental and resource economics	4 (3-1-0)
4.	NRS 132 - <u>Environmental pollution and control</u>	4 (3-0.5-0.5)
5.	NRS 123 - <u>Biodiversity assessment and conservation</u>	4 (2.5-1-0.5)
6.	NRS 162 - <u>Hydrology and watershed science</u>	4 (3-0.5-0.5)

### Proposed

S.No.	Course	Credits
<b>Theory</b>		
1.	NRS 112 - <i>Statistical techniques</i>	4 (3-1-0)
2.	NRS 172 - Principles of geoinformatics	4 (2-0-2)
3.	NRS 141 - Basic course in environmental and resource economics	4 (3-1-0)
4.	NRS 132 – <i>Air quality management</i>	3 (2-1-0)
5.	NRS 142 - <i>Water quality management</i>	4 (3-1-0)
6.	NRS 187 - <i>Solid and hazardous waste management</i>	4 (3-1-0)

### Elective

7.	NRS 123 - <i>Biodiversity assessment and conservation</i>	4 (2.5-1-0.5)
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Total credits earned

23

23/27

**Note:** Students opting for NRS 123 will earn 27 credits and will have to earn minimum 21 credits in the third semester to obtain M.Sc. degree.

Students not opting for NRS 123 will earn 23 credits and will have to earn minimum 25 credits in the third semester to obtain M.Sc. degree.

### Semester III

#### Existing

#### S.No. Course Theory

Minimum six courses from the following electives

1. NRS 145 - Integrated impact assessment
2. NRS 173 - Research methodology
3. NRS 187 - Solid and hazardous waste management
4. NRS 171 - Environmental modelling
5. NRS 135 - Science and policy of climate change
6. NRS 147 - Environmental economics
7. NRS 105 - Independent study
8. NRS 133 - Environmental management
9. NRS 175 - Geoinformatics for natural resource management

#### Credits

- 4 (3-1-0)
- 4 (4-0-0)
- 4 (2.5-1-0.5)
- 4 (3-1-0)
- 4 (3-1-0)
- 4 (3-1-0)
- 4
- 4 (3-1-0)

#### Proposed

#### S.No. Course Theory Credits

1. NRS 145 - Integrated impact assessment 4 (3-1-0)
2. NRS 173 - Research methodology 2 (2-0-0)

#### Electives

1. NRS 147 - Environmental economics 4 (3-1-0)
2. NRS 171 - Environmental modelling 4 (3-1-0)
3. *NRS 127 - Cultural ecology and development* 3 (2-1-0)

4. *BBT 151 - Environmental biotechnology* 3 (2.25-0-0.75)
5. NRS 149 - Governance of natural resources 4 (2.5-1.5-0)
6. NRS 133 - Environmental management system 4 (3-1-0)
7. NRS 105 - Independent study 4
8. *NRS 162 - Integrated watershed management* 4 (3-1-0)
9. NRS 175 - Geoinformatics for natural resource management 4 (2-1-2)
10. NRS 135 - Science and policy of climate change 4 (3-1-0)
11. *NRG 161 - Landscape ecology* 4 (3-1-0)
12. *NRN 183 - Energy and the environment* 3 (2-1-0)
13. *NRN 181 - Clean development mechanism and carbon trading\** 4 (3-1-0)
14. *NRE 137 - Environmental risk assessment\** 4 (3-1-0)
15. *NRE 187 - Climate modelling\** 4 (3-1-0)
16. *NRS 113 - Advanced statistical techniques\** 4 (2-0-2)

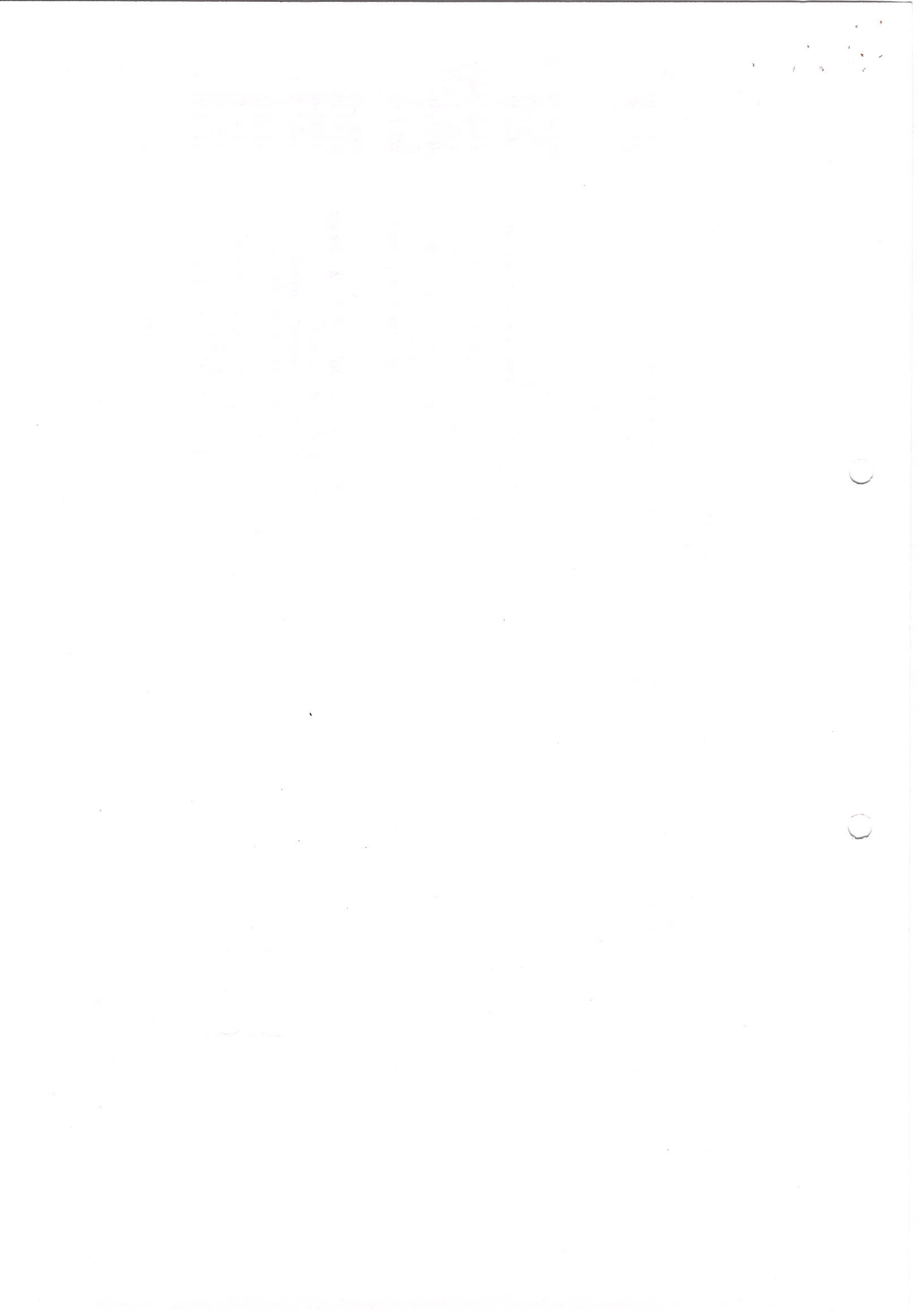
Total credits earned

24

Minimum total credits to be earned

21

\*To be offered from next session (2009)



Course No.:	PPM -165
Course title:	Transportation economics: Theory and practice
Number of credits:	3
No. of lectures-tutorial-practical:	42
Course coordinator:	Dr S Sriraman <i>Sarav Lak</i>

### Course outline

In this course, the tools of microeconomic analysis will be applied to the transport sector. We will build on theories and concepts developed in the microeconomics courses and we will show how extensions of the theory can deal with the idiosyncrasies of the transport sector. For example, the concept of "price" is generalized to include the value of time to the traveler. The demand for transporting freight is explained using the theory of the derived demand for an input. At the same time, the impact of modern approaches to management (logistics) would be considered. Just as the concept of "price" requires modification, we will see that "output" has many dimensions and explore the implications of this. In particular, we will examine the cost complexities exhibited in the transport sector and the need to modify pricing principles accordingly. The transport sector is very rich in terms of applications of concepts such as price discrimination and social cost benefit analysis. In addition, a study of transport economics would also involve application of microeconomics in analysis of policies, especially in relation to appropriate ways to regulate firms. The course, in general, covers the relationship between transport and the economy. Basically, the course has been designed to apply economic concepts in a practical setting and illustrate them using case studies especially chosen from the Indian context to provide important insights into the economics and management of different parts of the transport sector.

### Evaluation procedure

- Term Paper 40%
- Final examination 60%

The final exam will be a paper based written exam with objective and descriptive type questions and the term paper is to be submitted a fortnight after the course is completed.

The teaching methodology will include class lectures and case studies based analysis and discussions.

### Details of course contents and allotted time

S.No	Topic	Allotted time (hours)	
		Lectures	Tutorials/Seminars
	<b>Introduction</b>	6	
	a) Transport as a catalyst to economic development – measuring impacts and case studies of impacts including environmental ones		
	b) The basic framework: transportation and land-use		

S.No	Topic	Allotted time (hours)	
		Lectures	Tutorials/Seminars
	c) The transportation planning process		
	<b>Demand Analysis</b> a) Transport Demand – Basic theoretical framework b) Transport Demand – measuring demand in a spatial and temporal setting c) Traditional four-stage Demand models d) Modern approaches to modeling- theory and practice e) Practical issues in demand estimation	6	
	<b>Supply and Costs</b> a) Nature of output and Costs – definitions and measurement b) Economies of scale, density and scope in transport operations c) Empirical estimation of cost functions- approaches and illustrations	6	
	<b>Market Structure and Pricing</b> a) Market Structure profile b) Scope for pursuing different strategies c) Basic Pricing Principles- First best rules, Price discrimination, pricing with stochastic demand d) Road pricing and congestion pricing in practice e) Rail tariffs and public transport fares f) Pricing of ports and shipping services	10	
	<b>Investment Decisions in Transport</b> a) Nature of Investment Decisions b) Financial Evaluation of Transport Projects c) Social Cost benefit Analysis – Economic Evaluation d) Practical issues in evaluation and some case studies	6	
	<b>Regulation and Policy</b> a) Deregulation and Privatisation in transport– approaches b) Evolution of transport policy in India with a focus on case studies regarding different modes.	8	
		<b>42</b>	

### Suggested readings

1. McCarthy, P.S. (2001) *Transportation Economics*, Massachusetts: Blackwell Publishers.
2. Button, K.J. (1993) *Transport Economics*, 2<sup>nd</sup> edition, London: Heinemann.
3. Button, K.J. (1993) *Transport, the Environment and Economic Policy*, Aldershot: Edward Elgar
4. Boyer, K.D. (1998) *Principles of Transport Economics*, Massachusetts: Addison-Wesley.
5. Cole, S.: (1997) *Applied Transport Economics: Policy, Management and Decision Making*, London: Kogan Page. .
6. Winston, C.: (1985) Conceptual Developments in the Economics of Transportation: An Interpretive Survey, *Journal of Economic Literature*, Vol. XXIII (March 1985), pp.57-94.
7. Dalvi, M.Q. (1997) *Transport Planning and Policy*, Himalaya Publishing House, Mumbai, 1997.



Course No  
Course title

PPS 102  
**Introduction to science and policy of  
biodiversity conservation**

Number of Credits

3

Number of lectures-tutorials-practicals

37-5-0

Course Coordinator

Dr Neeraj Khera

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### Course outline

The purpose of this course is to equip the students with a clear understanding of the concept of biodiversity, its characteristics, value and threats, and conservation strategies, which will help them not only in defining the future conservation needs but also in analysing the policies and programmes of other sectors from a biodiversity perspective.

The course starts with the basic concepts of ecology and conservation to help students understand the basics. As the next step, application of ecological principles to various areas viz. ecological restoration, invasive species management, urban areas, climate change as well as biodiversity conservation, monitoring and impact assessment will be covered to give the students a more practical and analytical approach towards problem solving.

### Evaluation procedure

- 2 minor tests : 15+15
- Term paper : 30
- 1 major test (end semester) : 40

### Details of course contents and allotted time

S.No	Topic	Time allotted (hours)	
		L	T
1	<b>Ecological background:</b> Introduction to natural resources, concept of species, populations, communities and ecosystem; ecosystem components, ecological niche, ecological factors, concept of ecological succession, carrying capacity and ecological footprint, productivity and biomass, Carbon sequestration, Basic definitions and concepts of genetic, species and habitat diversity, ecosystem services	7	
2	<b>Distribution and assessment of ecosystems and species diversity</b> An overview of the global distribution of biodiversity, types of ecosystems, biomes, estimates of species in different ecosystems of the world; biodiversity Hot-spots; Biodiversity of India		2
3	<b>Value of Biodiversity, Causes and consequences of its loss</b> Direct and indirect values; total economic value; ethical values; an overview of different valuation techniques used to assess biodiversity; Rate of extinction of biodiversity, Causes and consequences of biodiversity loss; endemic, rare and threatened species  Economics of biodiversity loss (Guest lecture)	5	

S.No	Topic	Time allotted (hours)	
		L	T
4	An overview of Global biodiversity conventions (CBD, CMS, Ramsar, CITES, ITPGR, WHC); 2010 Biodiversity target, Biodiversity in Millennium Development Goals (MDGs), Indian policies and programmes relevant to biodiversity conservation, its sustainable use and equal benefit sharing	7	
5	An overview of the methods used for assessment and monitoring of biodiversity	2	
6	<b>Conservation strategies:</b> <i>In situ</i> conservation: Gap analysis; Establishment of protected areas; Design and management of protected areas; Connectivity and corridors An overview of the <i>Ex-situ</i> conservation methods, Captive breeding, new populations	6	
7	<b>Application of the principles of ecology and conservation biology:</b>  Ecological restoration- Philosophy and methods, community participation, examples; Urban ecosystem management- structural and functional components of urban ecosystems, management of urban ecosystems and biodiversity, success stories; landscape approach to biodiversity conservation; Invasive species, Genetically Modified Plants and Biofuels: their role and impact on ecosystem stability and biodiversity; Biodiversity Impact Assessment	7	
8	Integration of biodiversity in other sectors, Interrelationship of biodiversity and climate change; Business and local-community involvement in maintaining ecosystems and biodiversity	3	3
	<b>Total</b>	<b>37</b>	<b>5</b>

The course is reviewed and commented by the following experts.

1. Gary K. Meffe, Former Editor, Conservation Biology, Department of Wildlife Ecology and Conservation, University of Florida
2. Dr. William F. Fagan, Department of Biology, University of Maryland,
3. Prof. T. R. Rao, Ex-Director, Center for environmental management of degraded ecosystems (CEMDE), Delhi University

#### Suggested readings

1. Dodson, Stanley I., Timothy F. H. Allen, Stephen R. Carpenter, Anthony R. Ives, Robert L. Jeanne, James F. Kitchell, Nancy E. Langston, and Monica G. Turner. 1998. Ecology. Oxford University Press, New York
2. Richard B. Primack. 1998. *Essentials of conservation biology* Sinauer Associates Inc., USA

3. Barnes, Zak, Denton and Spurr. *Forest Ecology 1988, 4th edition*. John Wiley and Sons, New York (Chapter 5)
4. Meffe, G. K. and Carroll, R. L. 1997. *Principles of conservation biology*. Second edition. Sinauer Associates Inc., USA. (Chapters: 1,5, 10, 13, 15-19)

#### Other readings

1. Hunter, M. L. 2001. *Fundamentals of conservation biology*, second edition. Blackwell Science, Cambridge, UK
2. Hunter, M. L. 1999. *Maintaining biodiversity in forest ecosystems*. Cambridge University Press. ISBN 0-521-63104-1.
3. Sutherland, W. J. 2000. *The conservation handbook: Research, Management and Policy*. Blackwell Science, Oxford (Chapters: 3,10,14)
4. Miller, R. W. 1997. *Urban Forestry: Planning and Managing Urban Greenspaces*. Second Edition. Prentice Hall, Englewood Cliffs, New Jersey
5. Monica Turner, R H Gardner. *Landscape Ecology in Theory and Practice: Pattern and Process*. Springer Verlag
6. Guy R. McPherson, Stephen DeStefano. *Applied ecology and natural resource management*. Cambridge (Chapter 5)
7. Judith H. Myers. *Ecology and Control of Introduced Plants*. Cambridge University Press (Pages: 1-17, 224-247 )

1. The first part of the paper discusses the importance of the study and the objectives of the research.

2. The second part of the paper describes the methodology used in the study and the data collection process.

3. The third part of the paper presents the results of the study and discusses the findings.

4. The fourth part of the paper discusses the implications of the study and provides conclusions.

5. The fifth part of the paper discusses the limitations of the study and suggests areas for future research.

6. The sixth part of the paper discusses the contributions of the study to the field of research.

7. The seventh part of the paper discusses the practical applications of the study.

8. The eighth part of the paper discusses the ethical considerations of the study.

9. The ninth part of the paper discusses the funding of the study.

10. The tenth part of the paper discusses the acknowledgments of the study.

Course No:	NRS 165
Course title:	<b>Introduction to sustainable development</b>
Number of credits:	1
No of lectures-tutorial-practical:	14-0-0
Course coordinator(s)	Dr Mala N Reddy

*Mala Reddy*

### Course outline

The course seeks to build an inter-disciplinary perspective on understanding sustainable development concerns and challenges. This course familiarizes students with current debates and perspectives in analyzing constraints and opportunities for sustainable development. It also aims to provide students with a general introduction to the basic core competencies and practical skills required of a "generalist" development practitioner.

Course topics will be grounded in a practical, multi-disciplinary approach that will focus on the inter-relationship of each of the following core fields of study (Agriculture and Nutrition, Economics, Environment and Climate Science, Management, Policy, Anthropology and Social Studies, Public Health, and Technology and Engineering), thereby exposing students to the complex relationships between social, economic, and environmental processes.

### Evaluation procedure

Group review of a select book on sustainable development, followed by a presentation.

- |                  |      |
|------------------|------|
| ▪ Written Review | 60 % |
| ▪ Presentation   | 40%  |

### Details of course contents and allotted time

Module	Topic	Allotted Times (hours) Lecture & Class Discussion
1	Changing Perspectives <ul style="list-style-type: none"> <li>• Definitions &amp; Principles of Sustainable Development</li> <li>• Millennium Development Goals: Status (global and Indian), Inclusive Growth and Poverty Reduction, Impact on approach to development policy and practice in India, future directions</li> </ul>	3
2	Challenges to Sustainable Development <ul style="list-style-type: none"> <li>• Agriculture, Population &amp; Food Security</li> <li>• Public Health and Nutrition</li> <li>• Education</li> <li>• Natural Resources (Forests, Energy, Water)</li> <li>• Climate Change</li> </ul>	6

3	Responses to Sustainable Development Challenges <ul style="list-style-type: none"> <li>• Public Policy (Community Participation and Participatory Learning)</li> <li>• Gender and Human Rights</li> <li>• Technology and Engineering</li> <li>• Economics and Policy Coherence</li> </ul>	5
<b>Total</b>		<b>14</b>

### Suggested readings

1. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford: OUP
2. UN Millennium Project 2005. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals. Overview*.
3. Hazell, P. and X. Diao (2005). "The Role of Agriculture and Small Farms in Economic Development," Washington, D.C.: International Food Policy Research Institute
4. World Bank (2006) *Enhancing Agricultural Innovation: How to go beyond the strengthening of research systems*, World Bank: Agriculture and Rural Development
5. Sachs, D. Jeffrey and Wing Thye Woo. "Structural Factors in the Economic Reforms of China, Eastern Europe, and the Former Soviet Union" *Economic Policy*, Vol. 9, No. 18 (Apr., 1994), pp. 101-145.
6. Dahlsten, Sarah (2004) "Key Policy Coherence Issues in Agriculture and Migration" OECD.
7. Johnson, Jeff Dayton and Louka Katseli (2006) "Migration, Aid and Trade: Policy coherence for development" OECD Development Centre Policy Brief No 28.
8. UN Millennium Project 2005. *Innovation: Applying Knowledge in Development*. Science, Technology and Innovation Task Force Report.
9. Cornwall, A, & K. Brock. 2005. What do buzzwords do for development policy? a critical look at 'participation', 'empowerment' and 'poverty reduction' *Third World Quarterly* 26, 7 : 1043 – 1060.
10. Laurence, W.F. et al. "The Future of the Brazilian Amazon," *Science*, Vol. 291 (5503), 438-439. 19 January 2001.
11. IPCC, 2007: Summary for Policymakers of the Synthesis Report of the IPCC Fourth Assessment Report.
12. Luboobi, L. and J T Mugisha. HIV/AIDS Pandemic in Africa: Trends and Challenges. Fondazione Eni Enrico Mattei. 2005.
13. Sachs, J. and P. Malaney. 2002. The Economic and Social Burden of Malaria. *Nature*, 415 (7).
14. Sachs, J. *The End of Poverty*, 2005 (Chapters 1-4, 8, 14-18).
15. Human Development Reports

Course No.:	PPM 111
Course title:	Basic statistics and econometrics
Number of credits:	4 (3-1-0)
No. of lectures-tutorial-practical:	46-10-0
Course coordinator:	Dr Kaushik Deb

### Course outline

This course is an introduction to statistical methods and econometrics. The topics include probability distributions, confidence intervals, hypothesis testing, analysis of variance and regression analysis. After this course students should be able to use basic statistical and econometric methods in empirical studies. The students will be exposed to relevant examples in economics and business applications. The main objective of these examples is to motivate the use of statistical analysis and at the same time encourage students to go beyond the mechanical application of techniques and to develop critical judgment.

### Evaluation procedure

- Tutorial assignments: 20%
- Major test: 80%

### Details of course content and allotted time

Topic	Time allotted (hours)		
	Lectures	Tutorials	Practical
Introduction: Data and Statistics.	1		
Descriptive Statistics.	13	4	
Probability Distributions: Discrete and Continuous Distributions.	4		
Sampling and Sampling Distributions.	8		
Interval Estimation.	4		
Hypothesis Testing.	6	2	
Analysis of Variance.	2		
Simple Linear Regression.	4	4	
Multiple Regression.	4		
<b>Total</b>	<b>46</b>	<b>10</b>	

### Suggested readings

#### Books

1. Statistics for Business and Economics, 10th Edition
2. David R. Anderson | Dennis J. Sweeney | Thomas A. Williams



Course No: NRW 175  
 Course title: **Geoinformatics for water resource management**  
 Number of credits: 4 (2-0-2)  
 No. of lectures-tutorial-practical: 28-0-56  
 Course coordinator: Ashoke Basistha and Dr. P.K. Joshi

### Course outline

The course is conceptualized to provide competency in remote sensing (RS), geographic information systems (GIS) and related technologies. The course is designed as an elective to take up research work (at M.Sc./M.Phil/Ph.d. level) in the sub- fields of water resource management. The course is offered as an alternative to Geoinformatics for Natural Resources Management.

### Evaluation procedure

- 2 minor tests: 10% each
- Practical: 40%
- Major exam: 40%

### Details of course contents and allotted time

S.No.	Topic	Allotted time (hours)		
		L	T	P
1	<b>Geoinformatics for WRM</b> (Mapping Water bodies, land use land cover, soils, geomorphology)	4		6
2	<b>Digital Image Processing</b> (Rectification, enhancements, classification – unsupervised, supervised, hybrid, accuracy assessment)	8		14
3	<b>Geographical Information System</b> (Introduction, Data and Data Entry, Data Structure, Remote Sensing and GIS, Spatial Modelling, Terrain Modelling)	6		24
4	<b>Applications of Remote Sensing and GIS (Case Studies)</b> Water resource mapping, spatial interpolation of rainfall (using different techniques like IDW, Spline, kriging), rainfall - runoff modelling (SCS based), soil erosion modelling (RUSLE based), watershed characterization, reservoir sedimentation assessment, flood inundation and flood loss assessment (using RS data), flood flow modelling using digital elevation model and GIS techniques, irrigation water management	10		12
	<b>Total</b>	<b>28</b>		<b>56</b>

### Practical

P1-P6	–	Studying different features in satellite data
P7-P20	–	Digital Image Processing
P21-P44	–	GIS data analysis
P45-P56	–	Spatial modelling

The course is reviewed and commented by the following experts.

1. Dr. D.S. Arya, Assistant Professor, Department of Hydrology, IIT Roorkee
2. Dr. S.P. Aggarwal, Scientist E, Indian Institute of Remote Sensing, Kalidas Road, Dehradun

### Suggested readings

#### Text Books

1. Burrough, P.A. and McDonnell, R.A. (1998) *Principles of geographical information systems*. Oxford University Press, Oxford, 327 pp.
2. Campbell, J.B. (2002). *Introduction to remote sensing*, 3rd ed., The Guilford Press. ISBN 1-57230-640-8.
3. Heywood, I., Cornelius, S., and Carver, S. (2006) *An Introduction to Geographical Information Systems*. Prentice Hall. 3rd edition.
4. Jensen, J.R. (2000). *Remote sensing of the environment: an Earth resource perspective*. Prentice Hall. ISBN 0-13-489733-1.
5. Joseph, G (2003). *Fundamentals of Remote Sensing*. Universities Press, Hyderabad
6. Lillesand, T.M.; R.W. Kiefer, and J.W. Chipman (2003). *Remote sensing and image interpretation*, 5th ed., Wiley. ISBN 0-471-15227-7.
7. Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W. (2005) *Geographic Information Systems and Science*. Chichester: Wiley. 2nd edition.
8. Malczewski, J. (1999). *GIS and Multicriteria Decision Analysis*. New York: John Wiley and Sons
9. Singh V.P. and Fiorentino M. (1996). *Geographical information systems in hydrology*. Kluwer Academic Publishers.
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3. Asian Journal of Geoinformatics
4. Ecological Modelling
5. Geocarto International
6. International Journal of Climatology
7. International Journal of Geoinformatics
8. International Journal of Remote Sensing
9. ISPRS Journal of Photogrammetry and Remote Sensing
10. Journal of Indian Society of Remote Sensing
11. Remote Sensing of Environment
12. Water Resources Management

