



CENTRAL UNIVERSITY OF TAMIL NADU

DETAILED SYLLABI AND CURRICULUM
OF

the post graduate programmes in
General Economics / Financial Economics/ Actuarial
Economics/ Applied Quantitative Finance/ Environmental
Economics
offered
at
MADRAS SCHOOL OF ECONOMICS

April 2016

Environmental Economics - Core Courses

First Semester	Microeconomics I	
	Macroeconomics I	
	Statistical Methods	
	Mathematical methods	
Second Semester	Microeconomics II	
	Econometric Methods	
	Introduction to Environmental Systems	
	Resource and Environmental Economics	
Third Semester	Applied Econometrics	
	Environmental Valuation	
	Elective 1	
	Elective 2	
	Elective 3	
Fourth Semester	Sustainable Development	
	Environmental Policy	
	Elective 3	Dissertation instead of electives 3 & 4 worth 8 credits
	Elective 4	

Electives for Semester III

Agricultural Economics
Applied Macro and Financial Econometrics [C] {for GE, AE and EE}
Applied Econometrics [C] {for FE and AQF}
Economics of Insurance I [C]
Energy, Economics and Environment
Environmental Valuation [C]
Environment and Health
Financial Economics II (Pre-requisite Financial Economics I)
Financial Regulation and Banking Supervision
Fixed Income Securities
Games and Information
Health Economics
Industrial Development and Industrial Organization
Investment Banking
Programming and Computational Languages
Risk Analysis and Management [C]
International Trade & Finance
Stochastic Models

Note: 1. All Core and elective courses are worth 4 credits each.

2. Total credits = 68 for all programmes

3. 'C' Stands for core course for some streams which are allowed as electives for other streams

Electives for Semester IV

Advanced Technique in Finance
Economics of Global Climate Change
Economics of Insurance II (Pre-requisite Econ of Insurance I) [C]
Empirical Methods in Finance
Environmental Policy [C]
Finance and Financial Reporting [C]
Financial Instruments and Markets [C]
Financial Market Microstructure
Financial Regulation and Banking Supervision
Interest Rate Calculation and Option Pricing [C]
International Finance [C]
Macroeconomics II [for FE and AQF]
Microeconomics II [for AE]
Multinational Enterprises and Industrial Policy
Agricultural Development & Policy
Regional Economics
Risk Management - Theory and Practice [C]
Risk Model
Survival Model
Sustainable Development [C]

Note: 1. All Core and elective courses are worth 4 credits each.

2. Total credits = 68 for all programmes

3. 'C' Stands for core course for some streams which are allowed as electives for other streams

ENVIRONMENTAL ECONOMICS

EE:01 MICROECONOMICS

1. Consumer Behaviour and Demand Consumer preferences

opportunity sets, optimum choices, indirect utility demand functions, income and substitution effects, Slutsky equation, normal versus inferior goods, types of demand functions, elasticity, welfare evaluation, consumer surplus, equivalent variation and compensating variation, revealed preference (weak and strong axioms)

2. Utility Functions and Expected Utility Theorem

Expected utility function, measures of risk aversion, state-preference approach, portfolio theory and pricing of risk, present discounted value approach to investment decisions, adjustments for risk

3. Production and Cost

Production functions, types of production functions (Cobb-Douglas, CES, etc.), marginal products, rate of technical substitution, technical progress, cost functions, average and marginal costs, short run versus long run costs, economies of scale and scope, profit maximization, cost minimization, derivation of input demand

4. Competitive Markets

Assumptions of perfect market, competitive markets – demand and supply, demand and supply curves of individual firms, short-run versus long-run, competitive market equilibrium, tax incidence analysis, price-controls and shortages.

5. Imperfect Competition

Market failure, imperfect markets, sources of monopoly power, monopoly market equilibrium, price discrimination – first, second and third degree, tax incidence, oligopoly, Cournot Model, Stackelberg model, Bertrand Model, Monopolistic Competition.

Books

- Varian, H. R., Microeconomic Analysis, third edition, W.W. Norton and Co., 1992
- Mas-collel, Whinston and Green (1995): Micro-economic Theory, OUP
- Gravelle, H and R. Rees: Microeconomics, Pearson Education, 3rd Edition, 2004
- Henderson, M. and R.E. Quandt, Microeconomic Theory: Mathematical Approach, McGraw Hill, 3rd edition.
- Koutsoyiannes. A. “Modern Microeconomics” (Macmillan Press Limited, New York

Review Books

- Varian, H. R., Intermediate Microeconomics: A Modern Approach, third edition, 2010.
- Nicholson, W., Microeconomic Theory: Basic Principles and Extensions, eighth edition, South Western Thomson Learning, 2002

EE: 02 MACROECONOMICS

1. National Income Accounting

Accounting structure, key concepts in accounting for both closed and open economies – gross national product, gross domestic product, net national product, national income, savings and investment, balance of payments, circular flow of income, computational problems – expenditure approach, income approach and value added approach for measurement, input-output tables

2. Keynesian Models

Simple Keynesian Model, assumptions, concepts of involuntary unemployment, liquidity preference, paradox of thrift, investment function, IS-LM model – two sector model, goods and money market equilibrium, multiplier, liquidity trap, complete Keynesian model – three sector model, role of government in terms of monetary and fiscal policy

3. Keynesian Models versus Classical Models

Says Law, quantity theory of money, price flexibility and full employment, Clowers and Pattinking's money demand functions, equilibrium concept in classical model, synthesis between classical models and Keynesian models, interpretation and policy analysis

4. Expectation and Macroeconomic Adjustments

Expectations formations – Adaptive and rational expectations hypothesis, partial adjustment model, Lucas critique, Phillips curve, rules versus discretion, time consistency, inflation targeting, interest rate rules, effects of spending and taxes in models with flexible and sticky prices, perverse effects of fiscal expansion

5. Foreign Exchange

Market for foreign exchange, devaluation and depreciation, real and nominal exchange rate, factors affecting exchange rate, Mundell-Fleming model, fixed versus floating exchange rate, price adjustment, role of fiscal and monetary policies under alternative exchange rate regimes, purchasing power parity concept

Books

- Scarth, W., *Macroeconomics: An Introduction to Advanced Methods*, third edition, Thomson, 2007
- Mankiw, N. G., *Macroeconomics*, fifth edition, Worth Publishers, 2002
- Hall, E. and Taylor, J. B. *Macroeconomics*. W. W. Norton and Company, 1986
- Barro, R.J. *Macroeconomics*, Fifth edition, MIT Press 1997

EE: 03 MATHEMATICAL STATISTICS

1. Probability Theory

Concept of probability, conditional probability and Bayes' theorem; Random variables –discrete and continuous, Density and distribution functions, joint, marginal and conditional distribution, moment generating function, law of large numbers and Central Limit theorem

2. Probability Distributions

Discrete versus continuous distribution, uniform, binomial, negative binomial, Poisson, geometric and hyper-geometric, exponential, normal, log-normal and gamma; joint, marginal and conditional distribution, characteristic function and moment generating function, functions of random variables.

3. Sampling Methods and Sampling distributions

Simple random sampling: with and without replacement, stratified random sampling, probability and non-probability sampling, statistic and sample moments, sampling distributions: Student's-t, Chi-square and F-distribution, determinants of sample size, law of large numbers and Central Limit theorem

4. Estimation

Point estimation of population mean for large sample and small sample, estimation of population proportion and population variance, Maximum likelihood and method of moment estimation, properties of good estimators: unbiasedness, consistency, efficiency, sufficiency, Interval estimation.

5. Hypothesis Testing

Statistical hypothesis, simple versus composite hypothesis, critical region, types and size of error – type-I and type-II error, power of a test, p-value, Hypothesis test about: a population mean, population proportions, difference between two population means, difference between two proportions, a population variance, the ratio of two population variances, Tests of goodness of fit, the analysis of contingency tables (Chi-square test for testing independence of two-classification criteria), test for correlation, Rao-Blackwell Theorem, Cramer-Rao Identity

Books

- DeGroot, M.H. and M.J. Schervish, *Probability and Statistics*,
- Hogg, R. and A. Craig, J., *Introduction to Mathematical Statistics*, McGraw-Hill, 1965.
- Miller, I. and M. Miller, *Mathematical Statistics*, sixth edition, Prentice Hall International, 1999.
- Mood, A. M., R. A. Graybill and R.C. Boes, *Introduction to the Theory of Statistics*, McGraw-Hill, 1974.
- Ramachandran, K. M and C. P. Tsokos, *Mathematical Statistics with Applications*, 2009.

EE: 04 MATHEMATICAL METHODS

1. Differential Calculus

Introduction to Functions and Real Analysis; Derivatives – partial and total, economic applications, marginal and elasticity concepts, functions of several variables, implicit function theorem, higher order derivatives and Young's theorem, Taylor's approximation, convex sets, convex and concave functions, properties of linear homogenous functions, Euler's theorem

2. Linear Algebra

Vectors, matrices, inverse, simultaneous linear equations, Cramer's rule for solving system of linear equations, input-output model, Hawkin - Simon condition, open and closed models quadratic equation, characteristic (eigen) roots and vectors

3. Classical Optimization and Applications

Introduction to quadratic forms, unconstrained optimization, constrained optimization with equality constraints, Lagrangian method, Hessian and Jacobian matrices, applications – utility maximization, cost minimization, profit – output maximization

4. Linear and Non-linear Optimization

Duality theory, constrained optimization with inequality and non-negativity constraints, Kuhn-Tucker formulation, linear programming – formulation, primal and dual, solutions using graphical and Simplex methods, applications from economics and finance

5. Dynamics

Definite and indefinite integrals, applications – measuring consumer and producer surplus, continuous interest – discount calculations, difference and differential equations, phase diagrams, Cobweb model, multiplier accelerator, Harrod-Domar and Solow model

Books:

- Simon, C. and L. Blume, *Mathematics for Economists*, Norton, London, 1994
- Chiang, A. C., *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984
- Ok, E.A., *Real Analysis with Economic Applications*, Princeton University Press, 2007
- Knut Sydsaeter and Peter J. Hammond, *Mathematics for Economic Analysis*, Pearson Education Asia, 1995
- M.D. Intriligator, *Mathematical Optimization and Economic Theory*, Prentice-Hall, 1971

- Roberts B. and D.L. Schultze, *Modern Mathematics and Economic Analysis*, W.W. Norton and Company, 1973

EE: 05 MICROECONOMICS II

1. General Equilibrium and Welfare Economics

Absolute versus relative prices, perfectly competitive price and general equilibrium models – with and without production, uniqueness and determinacy, Edgeworth box, Pareto improvement and efficiency, Walrasian equilibrium, money in general equilibrium

2. Welfare Economics

Arrow-Debreu economy, welfare theorems, existence of Walrasian equilibrium, fixed-point theorem, core and core convergence, general equilibrium with time and uncertainty, Jensen's Inequality, social welfare function, transfer efficiency; Kaldor-Hicks-Samuelson criterion, Rawl's theory of social justice

3. Market Failure and Public Goods

Reasons for market failure – market imperfections, public goods, externality, macro-economic factors; types of public goods, theory of public goods – provision and pricing, government intervention, second-best solution, free riding, types of externalities – production and consumption externalities, Pigovian and Coasian solutions

4. Asymmetric Information

Moral hazard problem, adverse selection, principal agent problem, theory of lemon, credit market, implications of asymmetric information, market signaling, hidden information modeling, efficiency wage model, information and insurance

5. Game Theory

Sequential and simultaneous games, extensive forms and normal forms, dominant strategies and elimination of dominated strategies, Nash equilibrium, Dynamic games, backward induction, sub-game perfect equilibrium, applications with oligopoly markets: Cournot, Bertrand, Stackleberg and cartel

Books

- Varian, H.: *Microeconomic Analysis*, W.W. Norton, 3rd Edition, 1992
- Henderson, M. and R.E. Quandt, *Microeconomic Theory: Mathematical Approach*, McGraw Hill, 3rd edition.
- Gravelle, H and R. Rees: *Microeconomics*, Pearson Education, 3rd Edition, 2004.
- Mas-Colell, A. , M. Whinston and J Green: *Microeconomic Theory*, Oxford University Press, 1995
- Gibbons(1992): *Game Theory for Applied Economists*, Princeton University Press
- Mukherji, A.: *Walrasian and Non-Walrasian Equilibria: An Introduction to General Equilibrium Analysis*, Claredon Press, Oxford, 1990.
- Recent research papers in Microeconomics will be discussed

EE: 06 ECONOMETRIC METHODS

1. Simple Regression Analysis

Specification of the two variable regression model, Ordinary Least Squares estimation, Assumptions, BLUE property, General and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, ANOVA

2. Multiple Regression Analysis

Motivation, Assumptions and OLS estimation, Interpretation of OLS estimation, Goodness of fit, matrix approach to linear regression models, testing of hypothesis for a single parameter, for linear combination of parameters, for multiple linear restrictions.

3. Transformation of Variables and Dummy Variables

Choice of function forms: linear, log-linear, log-log, quadratic functional forms, Box-Cox test, models with quadratics and interaction terms.

Regression on dummy (qualitative) variables with two categories, with more than two categories- intercept shifters, dummy variable trap, interaction of two categorical variables, interaction of categorical and continuous (quantitative) variables- slope shifters, piecewise linear regression model, Chow test for cross-section data and for time-series data (test structural stability of regression models)

4. Extensions of Linear Models and Non-Linear Estimation

Method of maximum likelihood and its properties (including consistency), trinity of classical tests (Wald test, Lagrange multiplier, likelihood ratio),

Consequences, detection and remedial measures of multicollinearity, heteroskedasticity (WLS, MLE), and autocorrelation (GLS), Specification error (omitted variable, inclusion of irrelevant variables, measurement error in dependent and independent variables), method of moments (IV method)

5. Multi-Equation Models

Seemingly unrelated regression and its application.

Structural equation models-specification, endogenous, exogenous and predetermined variables, structural versus reduced form, simultaneity bias, identification: rank versus order condition, exact and over identifications, methods of estimation: indirect least squares, instrumental variable estimation, two-stage least squares and three-stage least squares.

Books

- Gujarati and Porter, *Basic Econometrics*, Fifth Edition, McGraw Hill/Irwin, 2009.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997. Greene
- Ramanathan, Ramu, *Introductory Econometrics with Applications*, 5th edition, 2002, Thomson Asia Pte Ltd., Singapore.
- Stock, James H., and Mark W. Watson (2006): *Introduction to Econometrics*, Second Edition, (Addison-Wesley Series in Economics).
- Wooldridge, J., *Introductory Econometrics: A Modern Approach*, 2015, Nelson Education.

EE: 07 ENVIRONMENT-ECONOMY INTERLINKAGES

1. Introduction

Environmental dilemmas; human values and environmental problems; environmental justice; Earth's major biomes – functions, changes, and measuring changes in the system; measuring biotic and abiotic components of the system

2. Human Population Change; Environmental Hazards

Population dynamics; population ecology; population and urbanization; resources – natural capital, energy resources, food resources, water resources, soil resources; limits to growth and environmental hazards; environmental demands of human population, precautionary principle

3. Air Pollution and Global Atmospheric Change

Types and sources of air pollution; indoor air pollution and health effects; trans-boundary pollution – ozone depletion, acid deposition, global warming; urban air pollution – policy responses

4. Water Pollution and Solid Waste

Water pollution and health impacts; water as a resource – water footprint; urbanization and solid waste; management of municipal solid waste; industrialization and hazardous waste; managing hazardous waste – national and international policies

5. Energy Sources

Energy consumption patterns; non-renewable energy resources – coal, oil, natural gas; limits to growth; nuclear energy and citing dilemmas; decommissioning nuclear power plants; renewable energy sources – solar and other renewable sources; conservation and efficiency

Books

- Wright, R.T., *Environmental Science: Towards Sustainable Future*, Pearson, Eleventh Edition, 2011
- Kump, L.R., J.F. Kasting, and R.G. Crane, *Earth Systems*, third edition, Prentice Hall, 2009
- Ristinen, R. and J. Kraushaar, *Energy and the Environment*, John Wiley and Sons, 1998

EE: 08 RESOURCE AND ENVIRONMENTAL ECONOMICS

1. Introduction

Economy-environment interaction; Material Balance Principle; entropy law; market failure; property rights; open, closed and common access resources; resource economics – environmental economics – ecological economics: characteristics and synergy

2. Environment vs Development

Relation between development and environmental stress; Environmental Kuznet's curve hypothesis – theory and empirical evidence; concept of sustainable development; indicators of sustainability; various approaches to environmental accounting

3. The Theory of Externality and Public Goods

Market failure; Pigouvian solution; Buchanan's theory; Coase's theorem and its critique; Pigouvian vs Coasian solution; detrimental externality and non-convexities in the production set; Property rights; collective action.

4. Economics of Exhaustible Resources

Hotelling's rule; Solow-Hartwick's Rule; competitive market structures and optimal extraction policy; monopoly, oligopoly, cartel and other market structures – optimal extraction policy; uncertainty and the rate of resource extraction; exploration and extraction; resource scarcity – indicators, evidence and critique.

5. Economics of Renewable Resources

Characteristics of renewable resources – growth functions and growth rate; economic models of fisheries, economics of optimal harvest cycles of forests; extinction of species, economics of Biodiversity.

Books:

- Kolstad, C., *Intermediate Environmental Economics*, Oxford University Press, 2012 (2nd Edition)
- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000.
- Hanley, N., J.F. Shogren, and B. White, *Environmental Economics: In Theory and Practice*, Oxford University Press, 2006.
- Prato, T., *Natural Resource and Environmental Economics*, Wiley-Blackwell, 1999.
- Grafton, Q., Adamowicz, W., Dupont, D., Nelson, H., Hill, R.J., Renzetti, S., *The Economics of Environment and Natural Resources*, Wiley-Blackwell, 2004.
- Perman, R., Ma, Y., Common, M., Maddison, D., Mcgilvray, J., *Natural Resource and Environmental Economics*, Pearson Education Limited, 2011 (4th Edition).
- Gopalakrishnan, C., *Classic Papers in Natural Resource Economics*, Palgrave Macmillan, 2000.
- Conrad, J.M. and C. Clark, *Natural Resource Economics – Notes and Problems*, Cambridge University Press, 1987.
- Dasgupta, P.S. and G.M. Heal, *Economic Theory and Exhaustible Resources*, University Press (Selected chapters), 1979.

EE: 09 ENVIRONMENTAL VALUATION

1. Introduction

Environmental evaluation and public policy; measuring demand for environmental goods – consumer surplus, compensating and equivalent surplus, weak substitutability

2. Concept of Value

Measuring values, benefits and costs – overview; total value – use and non-use values of goods; Willingness-to-Pay versus Willingness-to-Accept; economic valuation of changes in human health – mortality and morbidity concepts; statistical value of life; economic valuation of biodiversity – existential value concept

3. Production Function Approaches to Economic Valuation

Environmental valuation from market information including prices – dose response function, productivity change method, substitution cost method, illness costs, human capital; defensive cost method – defensive costs of decreased drinking water quality; applications

4. Revealed Preference Approaches

Revealed preference models of valuation – basic theory; Hedonic pricing method – property market and labor market; travel cost method – zonal model, individual model, random utility model

5. Stated Preference Approaches and Benefit Transfer

Contingent valuation method – bias, experimental markets; choice modeling – choice experiment, contingent comparison, contingent scoring, pair comparison; applications; benefit transfer approaches – value transfer in theory and practice

Books

- Bateman, Ian J. et al.: *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar, 2002.
- Freeman, A. M.: *The Measurement of Environmental and Resource Values*, 2nd Edition, Resources for the Future, 2003.
- Johansson, P.-O.: *Cost-benefit analysis of environmental change*, Cambridge University Press, 1993.
- Kadekodi, G.K. (ed) (2004), *Environmental Economics in Practice – Case Studies from India*, Oxford University Press, Delhi.
- Chopra, K. and V. Dayal (ed.) (2009), *Handbook of Environmental Economics in India*, Oxford University Press, Delhi.
- Haque, A.K.E., M.N. Murty, and P. Shyamsundar (ed.) (2011), *Environmental Valuation in South Asia*, Cambridge University Press, Delhi.

EE: 10 ENVIRONMENTAL POLICY

1. Design of Environmental Policy Instruments - 1

Uncertainty and choice of policy instrument – price or quantity controls; efficiency without optimality – charges and standards approach; marketable emission permits for environmental protection; taxes *versus* subsidies; regulatory compliance and enforcement

2. Design of Environmental Policy Instruments – 2

Third-wave of environmental policy; information disclosures and environmental management – theory and empirical evidence; small scale sector – collective pollution abatement; comparative analysis of different instruments

3. Geography, Trade and Environment

Geography and Institutions – Environmental Linkages; Impact of trade on environment and environment on trade; Porter's hypothesis; differential environmental standards – race to bottom and pollution havens hypothesis; case studies.

4. International Environmental Issues

Transboundary pollution; economics of global warming; different international Protocols; Causes and consequences of ozone depletion and climate change; Rio conference (Agenda 21); Protocols relating to climate change, Ozone depletion and biodiversity

5. Environmental Regulation in India

Evolution of environmental policy in India; Air and water Acts; fiscal incentives; enforcement and implementation issues; emerging options – eco-taxes and eco-subsidies; case studies on pollution control in India

Books:

- Baumol, W.J. and W.E. Oates, *The theory of Environmental Policy*, Cambridge University Press, 1988.
- Kolstad, C., *Intermediate Environmental Economics*, Oxford University Press, 2012 (2nd Edition)
- Kolstad, C., *Environmental Economics*, Oxford University Press, 2000
- Sandmo, A., *The Public Economics of the Environment*, Oxford University Press, 2000.
- Freemand III, A.M. *The Economic Approach to Environmental Policy*, Edward Elgar, 1998.
- Kraft, M. E. *Environmental Policy and Politics*. 4th ed. Pearson/Longman, 2007
- Sankar, U. (2001), *Environmental Economics*, Oxford University Press, Delhi
- Chopra, K. and V. Dayal (ed.) (2009), *Handbook of Environmental Economics in India*, Oxford University Press, Delhi

EE: 11 APPLIED ECONOMETRICS

1. Discrete Response Models

Introduction to binary variables, limitation of LPM, logistic curve, Probit and Logit models, Multinomial models, Ordinal models, Count data models

2. Limited Dependent Variables, Sample Selection and Duration Models

Censored versus truncation, TOBIT model, Truncated regression, Heckman selection model, Duration (hazard) models

3. Panel Data Models

Introduction to panel data, pooled repeated cross-section model, within and between estimators, fixed effects, random effects, Hausman test, one way and two way models, random coefficient model (Hierarchical /multi-level models)

4. Average Treatment Effects

Counterfactuals and self-selection, Methods to control selection: Regression versus Matching and Propensity Score, Difference in Difference Methodology, Regression Discontinuity Research Design, Quantile regression, Randomised Experiments-Use and Abuse

5. Spectral Analysis

(components to be included)

Books

- Angrist, J. D., & Pischke, J. S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.
- Baltagi, Badi. *Econometric analysis of panel data*. John Wiley & Sons, 2008
- Cameron, C.A. and Trivedi, P.K. *Microeconometrics: Methods and Applications*. Cambridge U.P., 2005.
- Greene, William H. *Econometric Analysis*. 6th Edition, Prentice Hall. 2008.
- Johnson, R.A. and D.W. Wichern, *Applied Multivariate Statistical Analysis*, 6th Edition
- Wooldridge, J. M. *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, 2nd edition, 2010.
- Tacq- (1997) *MVT in social science research* Sage International

EE:12 SOCIAL COST BENEFIT ANALYSIS

1. Foundations of Cost Benefit Analysis and Investment Criteria

Pareto optimality; market failures due to externalities, public goods, economies of scale, uncertainty and market imperfections; efficiency vs equity; aggregation in cost benefit analysis – across time, across goods, across agents, and across different states of the world; time preference - private and social; net present value; internal rate of return on investment; payback period; choice of discount rate; social discount rate.

2. Shadow Prices:

Shadow prices for goods and factors when (a) goods are traded and non-traded and (b) markets are perfect, imperfect or non-existent; derivation of shadow prices.

3. Weights:

Aggregation across agents; distributional weights – basis and practical issues.

4. Project Valuation and Uncertainty

Identification of relevant costs and benefits; UNIDO guidelines and procedures for project valuation; uncertainty and risk, risk aversion, risk premium.

5. Cost Benefit Analysis and Environment

Ecosystem complexity; uncertainty and irreversibility; discounting and the environment; environmental limits to cost-benefit analysis; applications

Books

- Boardman, A.E., Greenberg, D.H., Vining, A.R. and D.L. Weimer, *Cost-Benefit Analysis: Concepts and Practice, 3rd Edition*, Pearson Education, 2006
- Lyn Squire and van der Tak, *Economic Analysis of Projects*, John Hopkins University Press, 1992.
- Pearce, D.W. and A. Das Gupta, *Cost Benefit Analysis*, Cambridge University Press, 1983.
- Hanley, N. and C.L Spash, *Cost Benefit Analysis and the Environment*, Edward Elgar, 1993

EE: 13 Applied Financial Econometrics

1. Univariate Stationary Time-series Models

Introduction to stochastic process, stationary processes, Wold representation theorem, autocovariance functions, autocorrelation and partial autocorrelation, autoregressive and moving average models, conditions for stationary and invertible process, Box-Jenkins approach, forecasting. Seasonal models, de-seasonalization of time series (classical decompositions).

2. Univariate Nonstationary processes

Nonstationary process, deterministic and stochastic trends, Integrated process and random walk, random walk with drift, Unit root process- Martingale process, test for unit root- Dicky Fuller tests, other unit roots tests –PP, KPSS, ARIMA process. Fractional integrated process

3. Modeling volatility clustering

Volatility-Meaning and measurement, Volatility clustering, Econometric models of volatility, ARCH model, GARCH model and its various extensions, testing for ARCH/GARCH effects, Stochastic volatility models, multivariate GARCH modeling

4. Multivariate Stationary and Non-stationary processes

ARDL Models and its applications, vector autoregressive model, Granger causality, impulse response function, variance decomposition, introduction to cointegration, testing for cointegration: Single-equation approaches: ARDL and Engle Granger method, Johansen test for cointegration, Vector error correction model

5. Dynamic (Stationary and Non-Stationary) Panel Data Models

Arellano and Bond Estimator, Arellano and Bover Estimator and Blundell and Bond System GMM Estimator, Nonstationarity and Panel data, Panel unit root and cointegration tests, Panel VAR models

Books

- Baltagi, Badi. *Econometric Analysis of Panel Data*, 5th Edition, Wiley, 2013.
- Brooks, C., *Introductory Econometrics for Finance*, 3rd Edition, Cambridge University Press, 2014.
- Enders, W., *Applied Econometric Time Series*, second edition, John Wiley and Sons, 2006.
- Hamilton, J. D., *Time Series Analysis*, Princeton University Press, 1994.
- Johnston J. and DiNardo, J. *Econometric Methods*. 4th Ed. McGraw-Hill 1997.
- Maddala G.S. and In-Moo Kim, *Unit Roots, Cointegration, and Structural Change*, 1998.
- Pesaran, H.M. *Time Series and Panel Data Econometrics*, Oxford University Press, 2015.

EE:14 GAMES AND INFORMATION

1. Games of Complete Information

Static games; solution concept: Nash equilibrium, mixed and pure strategies, maximin principle; extensive forms, backward induction, subgame perfection, repeated games; applications

2. Games of Incomplete Information

Incomplete and imperfect information; static games of incomplete information, solution concepts, Bayes-Nash equilibrium; dynamic games of incomplete information, equilibrium refinements: weak perfect Bayesian equilibrium, sequential equilibrium and trembling hand perfect equilibrium, forward induction; applications

3. Cooperative Games

Elements of cooperative games, transferable utility games, core, Shapley-Value, coalition structure, credibility and core, matching games, examples

4. Bargaining

Bargaining with complete information, bargaining as an extensive game: Rubinstein model, axiomatic bargaining: Nash bargaining solution, relation between strategic and axiomatic models, outside options, inside options, bargaining with incomplete information, one-sided and two-sided uncertainty, private and correlated values, applications

5. Differential Game

Repeated and differential game, commitment and sub-game perfection, solution concept: open and closed loop solutions, Markov-Perfect equilibrium, hierarchical game and Stackleberg solution, applications

Books

- Osborne, M. J., *An Introduction to Game Theory*, Oxford University Press, 2003
- Gibbons, R., *A Primer in Game Theory*, Harvester-Wheatsheaf, 1992
- Fudenberg, D and J. Tirole, *Game Theory*, MIT Press, 1991
- Osborne, M. J. and A. Rubinstein, *A Course in Game Theory*, MIT Press, 1994
- Muthoo, A., *Bargaining Theory with Applications*, Cambridge University Press, 1999

EE:15 ENERGY ECONOMICS AND ENVIRONMENT

1. Energy and Economy

First and second laws of thermodynamics; forms of energy; understanding energy-economy linkages; Energy Data, Energy Balance and Energy Flows; Understanding and Analyzing Energy Demand; Geo-political issues concerning energy supply

2. Economics of Non-renewable Energy Sources

Economics of coal, petroleum and natural gas; pricing of exhaustible resources; energy prices – theory and empirics; economic regulation of energy markets; electricity regulation and restructuring

3. The Economics of Renewable Energy Supply

Renewable Resources for Electricity Generation; Drivers of Renewable Energy; The Economics of Renewable Energy Supply; Economics of Bio-fuels

1. Energy Demand Analysis Using the Econometric Approach

Energy Demand Analysis at a Disaggregated Level; Sectoral Energy Accounting; Energy Demand Analysis – Industries, Transport, Residential and Commercial Sectors

2. Environmental Implications of Energy

Energy–Environment Interactions; Climate Change and Environmental Kuznets Curve; The Clean Development Mechanism

Books

- Tietenberg, T. *Environmental and Natural Resource Economics*, seventh edition, Addison Wesley, 2006
- Munasinghe, M. and P. Meier, *Energy Policy Analysis and Modelling*. U.K.: Cambridge University Press, 1993.
- Ristinen, R. and J. Kraushaar, *Energy and the Environment*, John Wiley and Sons, 1998.

EE: 16 SUSTAINABLE DEVELOPMENT

1. Introduction

Need for studying the economics of sustainable development; meaning of sustainable development – Comparison with static and dynamic economic efficiency; Weak *versus* strong sustainability

2. Valuing Market and Non-market Ecosystem and Social Services

Uses of monetary valuation; Cost-benefit analysis; Techniques of monetary valuation – recap; Applications

3. Measuring Sustainable Development

Defining conventional gross net product (GNP); modifying GNP for missing (non-market) values – Green GNP; genuine savings; critical capital concerns and strong sustainability

4. Sustainable Development – Ecological Economics

Precautionary Principle; biodiversity and precautionary principle; economic growth and natural carrying capacity

5. Sustainable Development – Visions, Principles, and Operational Rules

Sustainable Development Indicators; Neoclassical economic growth and sustainability; social capital, community sustainability and environmental justice; trans-boundary environmental degradation; global economic integration and environment

Books

- Pearce, D. and E. Barbier, *Blueprint for a Sustainable Economy*, Earthscan, 2000.
- Daly, H.E., *Beyond Growth: The Economics of Sustainable Development*, Beacon Press, 1996.
- Rogers, P. K.F. Jalal and J.A. Boyd, *An Introduction to Sustainable Development*, Earthscan, 2008
- Deb, D. *Beyond Developmentality: Constructing Inclusive Freedom and Sustainability*, Daanish Books, 2009
- Sengupta, R. (2012), *Ecological Limits and Economic Development*, Oxford University Press, Delhi
- Murty, M.N. (2009), *Environment, Sustainable Development, and Well-being: Valuation, Taxes and Incentives*, Oxford University Press, Delhi
- UNU-HIS, UNEP, *Inclusive Wealth Report 2012: Measuring Progress Towards Sustainability*, Cambridge University Press, 2012

EE:17 ECOLOGICAL ECONOMICS

1. Principles of Ecological Economics

Economy *versus* ecology – an inevitable conflict?; green critique of economic orthodoxy; reconstructing economics – the role of ecology and thermodynamics; entropy – a unifying concept for ecological economics; use of entropy in ecological economics

2. Conceptual Foundations of Ecological Economics

Evolution in biology, physics and economics – a conceptual analysis; interdisciplinary research between economists and physical scientists – retrospect and prospect;

3. Integrating Ecology and Economics

Economic agent as a biological species; human economy as a subset of global ecosystem; natural capital as a factor of production; human economy, non-human economy, competitive exclusion; the limits to growth debate – technological progress, economic carrying capacity, biodiversity conservation; ecological integrity and ecosystem health

4. Alternatives to Conventional Economic Growth

Principles of industrial ecology and biomimicry; towards economics of zero and negative growth; Hermand Daly and the steady state economy; Maslow's hierarchy of needs and the steady state revolution

5. Policy Issues

Ecological footprint – global and regional trends; ethics and ecology – intergenerational issues; green economic policy; international case studies – the US, European Union countries, China and India

Books

- Daly, H.E., *Beyond Growth: The Economics of Sustainable Development*, Beacon Press, 1996.
- Daly, H. E., and J. Farley, *Ecological economics: principles and applications*. Island Press, 2003.
- Faber, M., R. Manstetten and J. Proops, *Ecological Economics: Concepts and Methods*, Edward Elgar, 1996.
- Deb, D. *Beyond Developmentality: Constructing Inclusive Freedom and Sustainability*, Daanish Books, 2009
- Sengupta, R. (2012), *Ecological Limits and Economic Development*, Oxford University Press, Delhi

EE:18 TRADE AND ENVIRONMENT

1. Introduction

Impact of trade on environment and environment on trade; globalization and trade-and-environment debate; pollution in a small open economy; scale, composition, and technology effects; endogenous pollution policy

2. Trade and Effects on South

Equilibrium pollution and Environmental Kuznet's curve – income and threshold effects; increasing returns to abatement; pollution havens models of international trade; free trade *versus* environment – empirical assessment; case studies: effects of environmental regulations on oil exporting countries

3. Trade in Endangered Species and Hazardous Waste

Bio-prospecting; CITES – non-compliance; trade in genetic resources; recycling and trade of hazardous material; international treaties governing hazardous waste trade; case studies

4. Trade in Emissions

Tradable permits for emission reduction – theory; sulphur trading and the US experience; carbon markets – the European and the US experience; European ETS – general framework, allocation rules and emission reduction; carbon price signals from the European ETS; clean development mechanism and emerging trading units

5. Trade Laws

Regional agreements; international trade regimes – WTO; leading issues in the WTO negotiations; dispute settlement mechanisms; trade and foreign direct investment

Books

- Copeland, B.R. and M.S. Taylor, *Trade and the Environment: Theory and Evidence*, Princeton University Press, 2005.
- Hunter, D., J. Salzman, and D. Zaelke, *International Environmental Law and Policy*, Foundation Press, 2006
- *Environment and Trade: A Handbook*, Second Edition. International Institute for Sustainable Development, 2005.
- Reeve, R., *Policing International Trade in Endangered Species: The CITES Treaty and Compliance*, Royal Institute of International Affairs, 2004

EE:19 ENVIRONMENT AND HEALTH

1. Introduction

Review of market failures; statistical value of life and health – empirical estimates of statistical value of life; disability adjusted life years

2. Environmental Effects on Health

Health production function; exposure, dose and response; indoor and outdoor air pollution; effects of air pollution on children, adults; effects of climate variability and climate change on mortality and morbidity; environmental toxicology; environmental carcinogenesis; water-borne diseases; municipal, industrial and hazardous waste – health implications

3. Medical Production of Health

Individual as producer of health; characteristics of health services and production; design of health-related insurances; role of the physician as a producer of health; healthcare organisation and funding; effects of health care expenditure on health; market for pharmaceuticals

4. Market Failure in the Provision of Health Care

Adverse selection in insurance markets; moral hazards, externalities, and other market failures in health care; problems of risk and uncertainty; unequal information; imperfect competition; equality in health care

5. Health and Environmental Policy – Inter-linkages

Global policy initiatives: Earth Summit – social, economic and environmental pillars for sustainable development; UN Millennium Development goals – environment and health linkages; national environmental and health action plans – case studies from developing countries in Africa and Asia

Books

- Yassi, A., T. Kiellstrom, T. de Kok, and T.L. Guidotti, *Basic Environmental Health*, Oxford University Press, 2001
- Phelps, C. *Health Economics*, 4th edition, Pearson Education, 2009
- Nadakavukaren, A. *Our Global Environment: A Health Perspective*, Waveland Press, 2005.
- Holgate, S.T., Maynard, R.L. and Koren, H.S., *Air Pollution and Health*, Academic Press, 1999.
- Ramani, K.V., D. Mavalankar, and D. Govil (2008), *Strategic Issues and Challenges in Health Management*, Sage Publications, New Delhi

EE:20 ECONOMICS OF GLOBAL CLIMATE CHANGE

1. Introduction

Science of climate change; global and regional climate predictions; uncertainty in science; physical impacts of climate change – agriculture, sea level rise, health, extreme events; policy debate

2. Climate Change Policy - Mitigation

Efficiency, public goods, externalities; environmental policy instruments – emissions trading, carbon tax, emission trading *versus* tax; stock pollutants and discounting; decisions under risk and uncertainty;

3. Integrated Assessment

Costs and benefits of greenhouse gas mitigation; integrated assessment models; simulation exercises based on DICE model and its variants; sensitivity and uncertainty analysis; Stern review

4. Climate Change Policy - Adaptation

Climate change impact assessment – applications for agriculture, sea level rise and health; vulnerability assessment; economics of adaptation; measurement of adaptation cost; issues in financing adaptation; case studies

5. Climate Change Negotiations and Equity

Criteria for distribution of emission reduction burden; distribution criteria for adaptation fund; inter and intra-generational equity issues; discounting in climate change context

Books

- Perman, R., Ma. Y., Common, M., Maddison, D., Mcgilvray, J., Natural Resource and Environmental Economics, Pearson Education Limited, 2011 (4th Edition).
- Intergovernmental Panel on Climate Change – Fifth Assessment Report, 2011
- Stern, N., *The economics of climate change – The Stern Review*, Cambridge University Press, 2006.
- Nordhaus, W.D., *Managing the Global Commons: The Economics of Climate Change*, MIT Press, 1994.
- Nordhaus, W. and J. Boyer, *Warming the World: Economic Models of Global Warming*, MIT Press, 2003.
- Toman, M.A., U. Chakravorty, and S. Gupta, *India and Global Climate Change: Perspectives on Economics and Policy from a Developing Country*, RFF Press, 2003.
- Nordhaus, W. (2008), *A Question of Balance: Weighing the Options on Global Warming Policies*, Yale University Press, New Haven

