SYLLABI OF Ph.D. PROGRAMME

Ph.D. in Agricultural Economics

Major Courses: 12 credits

Course Code	Course Title	Credit Hours
AEC- 601	Advanced Micro Economic Analysis	2 (1+1)
AEC- 602	Advanced Macro Economic Analysis	2 (2+0)
AEC- 603	Advanced Econometrics	3 (2+1)
AEC- 604	Advanced Production Economics	3 (2+1)

Minor Courses: 06 credits

a. It is suggested the student may choose at least one out of three courses listed below as part of minor courses as these are related to policy advocacy and bring in global perspectives with an aim to build a larger understanding of the subject to the student.

b. Further, it is suggested that the student may choose the remaining Courses from any other discipline including the disciplines of Agricultural Economics/ABM and are related to the research problem selected by the student.

c. The final choice of the minor courses should be mandatorily approved by the Student Advisory committee/HoD.

Course Code	Course Title	Credit Hours
AEC- 606	Advanced Agricultural Marketing and Price Analysis	3 (2+1)
AEC- 607	Quantitative Development Policy Analysis	2 (1+1)
AEC- 608	Natural Resource Management	3 (2+1)
AEC- 609	Environmental Economics	3 (2+1)

Minor courses may be taken from above list or subjects closely related to a student's major subject

Supporting Courses: 05 credits

Course Code	Course Title	Credit Hours
AEC- 605	Operations Research	3 (2+1)

One course of 600 series of 2 credits from Statistics or computer discipline may be taken depending upon availability.

- Some of these courses are available in the form of e-courses/MOOCs. The students may be allowed to register these courses/similar courses on these aspects, if available online on SWAYAM or any other platform.
- If a student has already completed any of these courses during UG, he/she may be permitted to register for other related courses with the prior approval of the HoD/BoS.
- It is also suggested that the student may choose the Supporting Courses other than the listed courses, provided the opted courses are related to the research problem selected by the student and be mandatorily approved by the Student Advisory committee/HoD".

Course Code	Course Title	Credit Hours
AEC- 660	Doctoral Seminar -I	1 (1+0)
AEC- 661	Doctoral Seminar -II	1 (1+0)
RESEARCH		75
Total		100

There will be two Doctoral Seminar and a research scholar has to published one review paper as output of these seminar. At Ph.D. level, Research Plan Proposal (RPP) be delivered by the end of SEM II.

A. Semester-wise Distribution of Major including Core and Optional, Minor and Supporting Courses

Course No.	**Course Title**	**Credit hours**
Semester-I		
AEC- 601	Advanced Micro Economic Analysis	2 (1+1)
AEC- 603	Advanced Econometrics	3 (2+1)
Minor		
AEC- 606	Advanced Agricultural Marketing and Price Analysis	3 (2+1)
AEC- 608	Natural Resource Management	3 (2+1)
Supporting		
AEC- 605	Operations Research	3 (2+1)
Semester-II		
AEC- 602	Advanced Macro Economic Analysis	2 (2+0)
AEC- 604	Advanced Production Economics	3 (2+1)
Minor		
AEC- 607	Quantitative Development Policy Analysis	2 (1+1)
AEC- 609	Environmental Economics	3 (2+1)
Supporting		
Semester-III		
AEC- 660	Doctoral Seminar -I	1 (1+0)
Semester-IV		
AEC- 661	Doctoral Seminar -II	1 (1+0)
Research		75
TOTAL CREDIT IN Ph.D. PROGRAMME		**Min.100**

Note:

1. The courses to be offered by the department as Major, Minor and Supporting in a particular semester are under the discretion of the BOS of the department.
2. Distribution of Minor and Supporting courses depends upon the availability of courses offered in other departments of the Bhavana and University.

Course Contents

I. Course Title: Advanced Micro Economic Analysis
II. Course Code: AEC 601
III. Credit Hours: 1+1
IV. Why this course?
This course is required to upscale the knowledge of students about micro economics. So that they can get a deeper and better understanding of the subject.
V. Aim of the course
To gain fundamental understanding of consumer behaviour, producer's strategy, market structure through which transactions take place and human and firms interact. Develop foundation of scarce resource allocation for optimum results.
VI. Organization of the course
The course is organised as follows–

No.	Block	Unit
1.	Consumer Theory	1. Consumer Theory
2.	Market and General Equilibrium	1. Market 2. General Equilibrium
3.	Market failure and welfare	1. Market Failure 2. Welfare Economics

VII. Theory
Block 1- Consumer Theory
Unit 1: Consumer Theory
Theory of consumer behaviour – Duality in consumer theory - expenditure function and indirect utility function - Measurement of Income Effect and Substitution Effect. Measurement of Changes in Consumers' Welfare – Consumer's Surplus, Compensating Variation and Equivalent Variation - Dynamic versions of demand functions – Integrability of demand functions. Demand Models – Linear Expenditure System, Almost Ideal Demand System. Applications of consumer theory – Household model and time allocation – Labour supply decisions by households.
Block 2- Market and General Equilibrium
Unit 1: Market
Perfect competition – Monopoly, monopolistic competition and oligopoly. Oligopoly models – collusive and non-collusive models of oligopoly - Cournot model, Chamberlin model, Stackleberg solution.
Unit 2: General Equilibrium
General equilibrium theory – Conceptual overview - General equilibrium conditions with Production and Consumption. Existence, Uniqueness and Stability of general competitive equilibrium. Walrasian general equilibrium – Mathematical derivation of conditions for general equilibrium.
Block 3- Market Failure and Welfare
Unit 1: Market failure
Market failure - Incomplete markets - Asymmetric information – Principal-Agent problem, adverse selection and moral hazard. Externalities – Network externalities, Public goods – Optimal provision of public goods.
Unit 2: Welfare Economics
Welfare Economics - Concepts, problems, approaches and limitations of Welfare Economics, Pareto conditions of maximum welfare – Criteria for social welfare - Social Welfare functions, Social versus Private costs and benefits.
VIII. Practical

• Problems in consumer utility maximization
• Estimation of income and substitution effects;
• Estimation and comparison of Consumer's surplus, equivalent variation and compensating variation.
• Estimation of demand models – Derivation and estimation of labour supply equations from household models comparative static analysis in consumption.
• Advanced problem solving in price determination under perfect competition, monopoly, oligopoly and monopolistic competition.
• Game theory models.
• Problems solving in General Equilibrium Theory and Welfare Economics.
• Problems in public goods provision.

IX. Teaching Methods/ Activities

• Lectures
• Case studies
• Assignments (Group/individual)
• Group Discussions

X. Learning outcome

After successful completion of the course, the student will be able to-Understand the different market competition. Work out strategies for attaining equilibrium in the market.

XI. Suggested Reading

• Henderson JM and Quandt RE. *Microeconomic Theory: A Mathematical Approach* Tata McGraw Hill Publishing Co Ltd
• Koutsoyiannis A. *Modern Micro Economics.* Macmillan Press Ltd
• Ferguson and Gould. *Micro Economic Theory.* Richard D Erwin Inc USA

I. Course Title: Advanced Macro Economics

II. Course Code: AEC-602

III. Credit Hours: 2+0

IV. Why this course?

A deeper understanding of the conceptual and structural framework is imperative to develop vision of a student about how the knowledge of various macroeconomic models is applied in real economy.

V. Aim of the course

To understand the functioning of national economy, its history and models. The policies governing the modern economic system and concerned institutions.

VI. Organization of the course

The course is organised as follows–

No.	Block	Unit
1.	Introduction	1. Overview
2.	Economic Models	1. Open Economy Models 2. Dynamic Macroeconomic Models
3.	Business cycle and policies	1. Business Cycles 2. Macroeconomic Polices

VII. Theory

Block 1- Introduction

Unit 1: Overview

Conceptual framework - Classical, Keynesian, Neo-Classical, and Neo-Keynesian macroeconomics; Review of Keynes-Classical Synthesis; Aggregate Demand and Supply in the closed economy with fixed and variable price level- determination of wage, prices, output and employment

Block 2- Economic Models

Unit 1: Open Economy Models

Exchange rate determination; purchasing power parity; asset market approach; Short-run open economy models; Mundell-Fleming model- exchange rate regime: perfect capital mobility under fixed and flexible exchange rate; effectiveness of fiscal policy and monetary policy; Dornbusch's overshooting model; monetary approach to balance of payments; international financial markets

Unit 2: Dynamic Macroeconomic Models

Introduction to dynamic macroeconomic Models; Dynamic aggregate demand and supply – short and long term equilibrium- rational expectations approach

Block 3: Business Cycle and Policies

Unit 1: Business Cycles

Business cycle and its alternative equilibrium model, Stability analysis Economics of Great Events-Depression, Hyperinflation and Deficits; Advances in Business Cycle Theory; Real Business Cycles & Neo-Keynesian Economics

Unit 2: Macroeconomic Polices

Monetary policy - Design of Monetary Policy; Inflation Targeting, Fiscal Policy - Government Budget Constraint: The Arithmetic of Deficits and Debt, Current versus Future Taxes, the Evolution of Debt-to-GDP Ratio; Public Borrowing-Internal and external aid, Deficit financing, Development Financing; BOP & Adjustment Policies - Foreign Exchange Policy -International macro-economic policies, IMF, IBRD, UNCTAD.

VIII. Teaching Methods/ Activities

• Lectures.
• Case studies.
• Assignments (Group/individual).
• Group Discussions

IX. Learning outcome

After successful completion of this course the student will be able to-Figure out how policies are framed to safe guard the national economy. Understand the rationale behind the working of different economy.

X. Suggested Reading

• Heibroker RL. *Understanding Macro Economics.*
• Mehta JK. *Macro Economics.*
• Edgemand MR. *Macro-Economics: Theory & Policy.*
• David' W Pearce. *The dictionary of modern Economics.*
• Allen RGD. 1968. *Macro–Economic Theory: A Mathematical Treatment.* London: Macmillan.
• Stanlake GF. *Macro–Economics: An Introduction*. Longman, London.
• Mithai DM. 1981. *Macro–Economics: Analysis and Policy*. Oxford and IBH, New Delhi.
• Hicks JR *Critical Essays in Monetary Theory.*
• Nawiyn WT. *Theory of Money*.

I. Course Title: Advanced Econometrics

II. Course Code: AEC 603

III. Credit Hours: 2+1

IV. Why this course?

The heart of any research is carrying out the analysis with the most appropriate model. The results obtained are crucial for the researchers. Thus, this course acts as the centre point of building up analytical framework of research. The students need to learn building up of

models that will be used to test the hypothesis framed. Use different analysis depending upon the requirement and type of data.

V. Aim of the course

The course aims at providing the knowledge and command over analysis of data collected to get the desired result. Train the student in use of econometric models.

VI. Organization of the course

The course is organised as follows:

No.	Block	Unit
1.	Concepts	1. Review
2.	Least squares and dummy variables	1. Concept of Least Squares 2. Dummy Variable
3.	Econometric models	1. Models and their extensions 2. Simultaneous equation models

VII. Theory

Block 1: Concepts

Unit 1: Review

Review of classical regression model – review of hypothesis testing – restrictions on parameters – single equation techniques.

Block 2: Least Squares and Dummy Variables

Unit 1: Concept of least squares

Ordinary least squares – weighted least squares - generalized least squares – method of principal components – instrumental variables method – maximum likelihood method - errors in variables, non-linearity and specification tests – non spherical error terms.

Unit 2: Dummy Variable

Dummy variables - Qualitative and truncated dependent variables – limited dependent variables –LPM, probit and logit models, their multinomial extensions.

Block 3: Econometric Models

Unit 1: Models and their extensions

Autoregressive distributed lag models – panel data fixed and random effects models and their extensions.

Unit 2: Simultaneous equation models

Simultaneous equation methods –identification – estimation by indirect least squares 2SLS, PIML, SURE, 3SLS

VIII. Practical

Estimation of multiple regression model - GLS estimation methods – testing misspecification errors – Testing and Managing multicollinearity, heteroscedasticity and autocorrelation - estimation of LPM, Logit and Probit models - comparing two regressions - Chow test - estimation of distributed lag models – panel data random and fixed effects models - Indirect least squares 2SLS, SURE, 3SLS, estimation of simultaneous equation models.

IX. Teaching Methods/Activities

• Lectures.
• Case studies.
• Assignments (Group/individual).
• Group Discussions

X. Learning outcome

After successful completion of the course, the student will be able to–

• Analyse the data collected for testing the framed hypothesis.
• Get expertise in analytical framework.

XI. Suggested Reading

• Greene WH. 2002. *Econometric Analysis*. Pearson Education.

• Johnston J and Dinardo J. 2000. *Econometric Methods*. Mc Graw-Hill.
• Koutseyianis A. 1997. *Theory of Econometrics*. Barner & Noble.

I. Course Title: Advanced Production Economics
II. Course Code: AEC 604
III. Credit Hours: 2+1
IV. Why this course?
There is requirement of getting acquainted with decision making process in case of factors and products. The researcher needs to understand about working on production process and work out suitable suggestions to improve it.
V. Aim of the course
The course deals with the concept of advanced production economics. The exposition would be mathematically oriented. The course would also cover the analysis of production functions, its interpretation, decision making with multiple input use, factor sharing and decision making under risk and uncertainty.
VI. Organization of the course
The course is organised as follows:

No.	Block	Unit
1.	Consumer Theory	1. Production Process
2.	Market and General Equilibrium	1. Production Functions and characteristics
3.	Market failure and welfare	1. Decision Making in Production 2. Technology, Efficiency and Risk Management 3. Programming

VII. Theory
Block 1: Production process
Unit 1: Production Process
Agricultural Production process – Relationship between farm planning and production economics-scope of agricultural production and planning-methods/procedures in agro-economic research and planning.
Block 2: Production Function
Unit 1: Production Functions and characteristics
Production functions, components, assumptions, properties and their economic interpretation - Concepts of homogeneity, homotheticity,, APP, MPP, elasticities of substitution and their economic relevance – Production relations – optimality-Commonly used functional forms, nature, properties, limitations, estimation and interpretation - linear, Spillman - Cobb Douglas, quadratic, multiplicative (power) functional forms - Translog, and transcendental functional forms - CES, production functional forms-Conceptual and empirical issues in specification, estimation and application of production functions- Analytical approaches to economic optimum - Economic optimum – determination of economic optimum with constant and varying input and output prices - Economic optimum with production function analysis - input use behaviour.
Block 3: Dynamics of production process
Unit 1: Decision Making in Production
Decision making with multiple inputs and outputs – MRT and product relationship cost of production and adjustment in output prices-single input and multiple product decisions- Multi input, and multi product production decisions - Decision making with no risk -Cost of wrong decisions - Cost curves – Principles and importance of duality theory - Correspondence of production, cost, and profit functions – Principles and derivation of demand and supply functions.

Unit 2: Technology, Efficiency and Risk Management

Technology, input use and factor shares -effect of technology on input use decomposition analysis-factor shares-estimation methods- Economic efficiency in agricultural production – technical, allocative and economic efficiency – measurement -Yield gaps analysis – concepts and measurement - Risk and uncertainty in agriculture – incorporation of risk and uncertainty in decision making – risk and uncertainty and input use level-risk programming.

Unit 3: Programming

Simulation and programming techniques in agricultural production-Multiple Objective Programming (MOP) – Goal programming, Weighted sum and Compromise programming – applications.

VIII. Practical

Estimation of different forms of production functions- Optimal input and product choice from estimated functions-Derivation of demand and supply functions and estimation-Estimation of cost function and interpretations-Optimal product and input choice under multi input and output system-Estimation of factor shares from empirical functions estimated-Estimating production functions incorporating technology changes: Decomposition analysis and incorporation of technology-Estimation of efficiency measures – Stochastic, probabilistic and deterministic frontier production functions-Risk programming – MOTAD-Quadratic programming-Simulation models for agricultural production decisions-Goal programming – Weighted, lexicographic and fuzzy goal programming-Compromise programming.

IX. Teaching Methods/Activities

- Lectures.
- Case studies.
- Assignments (Group/individual).
- Group Discussions

X. Learning outcome

After successful completion of the course, the student will be able to-Get familiar with different production function and use them in practise and come out with useful decision. Work out the efficiency of the production process and use models for finding the optimum solution.

XI. Suggested Reading

- Baumol WG. 1973. *Economic theory and operations analysis*. Practice Hall of India Private Limited, New Dehli. 626 p.
- Gardner BL and Rausser GC. 2001. *Handbook of Agricultural Economics* Vol. I Agricultural Production. Elsevier.
- Heady EO. 1952. *Economics of Agricultural Production and resources use*. Practice Hall of India.
- Heady EO and Dillon JL. 1961. *Agricultural Production functions*. Kalyani Publishers, Ludhiana, India. 667 p.

I. Course Title: Operations Research

II. Course Code: AEC-605

III. Credit Hours: 2+1

IV. Why this course?

In sphere of management, it is important, to take correct decision of assigning tasks and roles to individuals. The business is full of uncertainty and in this situation the manager has to take decision. It becomes imperative to gain knowledge of models used for finding this solution of performing well.

V. Aim of the course

To gain elementary knowledge of solving problems and decision making for managing farming and organisation in resource constraint in order to achieve the objective.

VI. Organization of the course

The course is organised as follows–

No.	Block	Unit
1.	Concepts	1. Concepts
2.	Inventory and models	1. Inventory- A Review 2. Models
3.	Decision making	1. Decision making 2. Game theory

VII. Theory

Block 1: Concepts

Unit 1: Concepts

Elementary concepts and objectives of Operations Research, Review of Linear programming - Assumptions & Methods, Non-linear programming problem - Quadratic programming, Multi Objective Programming (MOP)

Block 2: Inventory and Models

Unit 1: Inventory- A Review

Inventory control models, costs involved in Inventory management, types of inventory, Economic order quantity model, Waiting line models: Waiting line problem, Characteristics of a waiting line system, Single channel model,

Unit 2: Models

Markov Chains, Sequencing, Replacement models, Transportation and Assignment problems.

Block 3: Decision Making

Unit 1: Decision Making

Decision making under risk and uncertainties, decision problem, maximax criterion, maximin criterion, minimax regret criterion, Laplace criterion, Pay off tables, Decision trees, Expected value of perfect information.

Unit 2: Game Theory

Game Theory – Two-person Zero sum game, Simulation, Network Analysis- PERT & CPM.

VIII. Practical

- Linear and Non-linear programming problem,
- Quadratic programming, Multi-Objective Programming- Goal Programming,
- Lexicographic, Weighted Sum, Determining economic order quantity, reorder levels of EOQ model.
- Waiting line problem, Problems on Markov Chains, Sequencing and Replacement models.
- Formulating and solving transportation type problems, Assignment problems as a special type of transportation problem.
- Solving deterministic and probabilistic queuing models Structuring and solving decision trees for optimal decisions Game theory, Simulation, Developing network (PERT/CPM) diagrams and determining the critical path.

IX. Teaching Methods/ Activities

- Lectures.
- Case studies.
- Assignments (Group/individual).
- Group Discussions

X. Learning outcome

After successful completion of this course, the student will be able to-Gain expertise in formulating problems of management into mathematical form and work out the optimum

solutions. Apply the knowledge of different models in better decision making and controlling of the firm.

XI. Suggested Reading

• Taha HA. *Operations Research: An Introduction*.
• Veerabhadrappa H. *An Introduction to Operations Research.*
• Gupta PK and Hira DS. *Operations Research*.
• Sharma R. *Operations Research*.
• Sharma JK. *Operation Research.*
• Greene WH. 2002. *Econometric Analysis*. Pearson Education.
• Johnston J and Dinardo J. 2000. *Econometric Methods*. Mc Graw-Hill.
• Koutseyianis A. 1997. *Theory of Econometrics*. Barner & Noble.

I. Course Title: Advanced Agricultural Marketing and Price Analysis

II. Course Code: AEC 606

III. Credit Hours: 2+1

IV. Why this course?

Efficient markets, connectivity in markets, facilities of transport and storage ensure that there is growth in marketing of the produce as well as the industries based on those produce. The decision of selling the produce at the right time, and at a higher price is crucial to ensure remunerative returns to the farmer. Thus, this course is required to enhance the knowledge to students in agricultural markets and price analysis.

V. Aim of the course

To impact adequate knowledge and analytical skills in the field of agricultural marketing and enhance expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities. Learning outcome: After successful completion of this course, the student will be able to-Gain the knowledge of marketing and agricultural prices. Work out the interaction between different markets and analyse their working. Gain expertise in forecasting of price and build up market intelligence.

VI. Organization of the course

The course is organised as follows:

No.	Block	Unit
1.	Concepts	1. Agricultural Marketing- Insights
2.	Marketing Institutions and Dynamics	1. Institutions and their functions 2. Market Dynamics
3.	Techniques	1. Commodity marketing 2. Models for Analysis

VII. Theory

Block 1: Concepts

Unit 1: Agricultural Marketing-

Insights Importance of market analysis in the agricultural system - types of marketing-advantages and disadvantages - quantitative estimation -the distinguishing characteristics and role of agricultural prices -data sources for agricultural products and prices - software used in market analysis.

Block 2: Marketing Institutions and Dynamics

Unit 1: Institutions and their functions

Role of various formal institutions in agricultural marketing - and functions - measuring their efficiency - public - private partnership - institutional arrangements. Successful case studies.

Unit 2: Market Dynamics

Multi market estimation, supply response models. Market integration and price transmission - supply/value chain management. GAP analysis. Current trends in information in the changing agri-food system.

Block 3: Techniques

Unit 1: Commodity Marketing

Agricultural commodity marketing -spot and futures- marketing of derivatives speculation, hedging, swap, arbitrage etc. commodity exchanges - price discovery and risk management in commodity markets-Regulatory mechanism of futures trading.

Unit 2: Models for Analysis

Lag operators and difference equations; stationary and stochastic processes; Unit roots and cointegration; conditional heteroscedasticity: ARCH and GARCH models -forecast evaluation; methods of forecasting. price indices and econometric estimation and simulation.

VIII. Practical

- Estimation of demand/supply forecasting,
- Supply chain/value chain analysis for different commodities
- Commodity models- multi market estimation- time series analysis
- Market integration studies- price discovery price volatility estimation
- Commodity price forecasting using econometric software

IX. Teaching Methods/ Activities

- Lectures.
- Case studies.
- Assignments (Group/individual).
- Group Discussions

X. Suggested Reading

- Acharya SS and Agarawal NL. 1994. *Agricultural Prices-Analysis and Policy*. Oxford and IBH Publishing company Pvt. Ltd, New Delhi.
- Acharya SS and Agarawal NL. 2004. *Agricultural Marketing in India.* Oxford and IBH Publishing company Pvt. Ltd, New Delhi.
- Kohls RH and Joseph N. Uhl: *Marketing of Agricultural products* by Collier MacMillan International.
- Rhodes VJ. 1978. *The Agricultural Marketing System*. Grid Pub. Ohio.

I. Course Title: Quantitative Development Policy Analysis

II. Course Code: AEC 607

III. Credit Hours: 1+1

IV. Why this course?

Policy reforms are inevitable. They are continuously required to deal with the loop holes of previous policy and control the present situation in a better manner. Reforms take place in both microeconomic and macroeconomic polies. The analysis of these policies helps us to develop a framework for designing and implementing the policies.

V. Aim of the course

To develop expertise in understanding the rationale behind development of policies. Conceptualization of equilibrium and working out the economic implications of development policy. Learning outcome: After the completion of the course, the student will be able to- Conceptualize policy framework. Get acquainted with analysing the policy and work out corrective solutions.

VI. Organization of the course

The course is organised as follows

No.	Block	Unit
1.	Concepts	1. Policy Framework

2.	Demand-supply and household behaviour	1. Demand- Supply Analysis 2. Household Behaviour and models
3.	Approaches to review policy and welfare	1. Multi-Pronged approach to policy review 2. General equilibrium and programming

Theory

Block 1: Concepts

Unit 1: Policy Framework

Policy framework – goals, value, beliefs and welfare maximization. Market – Policy and State – State vs. Market – Failure of Policy – Failure of Markets – Rationale for Government Intervention. Role of Quantitative Policy Analysis.

Block 2: Demand-supply and household behaviour

Unit 1: Demand- Supply Analysis

Demand analysis for policymaking – Alternative approaches to demand analysis – Policy implications. Supply response – Alternative approaches to measurement of supply response – Nerlovian models of supply response – Policy implications.

Unit 2: Household Behaviour and models

Household behaviour and policy analysis – Household models.

Block 3: Approaches to review policy and welfare

Unit 1: Multi-Pronged approach to policy review

Partial equilibrium analysis – Concept of reference prices – Price distortions – indicators and impact. Transaction costs – Implications for efficiency and productivity – Institutional solutions - Multi market approach to policy analysis.

Unit 2: General equilibrium and programming

Social Accounting Matrices and multipliers -– Computable General Equilibrium models to assess economy wide impact of policy changes. fuzzy goal programming- Compromise programming.

VII. Practical

• Review of criteria for policy evaluation
• Estimation of price elasticities
• Review of estimation of complete demand systems
• Estimation of Nerlovian supply Response model
• Review of Household models
• Specification and estimation of household models
• Partial equilibrium analysis
• Input–output table
• Social Accounting Matrix
• Construction of a SAM
• Computation of Multipliers
• Multi Market Analysis
• Review of Computable General Equilibrium Models.

VIII. Teaching Methods/Activities

• Lectures.
• Case studies.
• Assignments (Group/individual).
• Group Discussions

I. Course Title: Natural Resource Management

II. Course Code: AEC 608

III. Credit Hours: 1+1

IV. Why this course?

The environment envisages the whole living creatures within it. There are resources we obtain from the nature and at the same time spoil the environment by exploiting the resources. Thus, it is necessary for the student to develop environment friendly plans to utilize the scarce resources.

V. Aim of the course

Concept building on natural resources. Gaining expertise in economic aspect of natural resources and maintain a balance between economic gains and environment conservation. Learning outcome-After the completion of the course, the student will be able to-Understand the natural resources and methodologies to develop plans for their optimal use. Work out the economics of forest, fisheries and ground water. Be able to deal with the legal matters of the natural resources.

VI. Organization of the course

The course is organised as follows:

No.	Block	Unit
1.	Concepts	1. Concepts
2.	Models and Management	1. Models for economic view of natural resources 2. Management of water resources
3.	Regulations and planning	1. Property Rights 2. Dynamics of resource economics

VII. Theory

Block 1: Concepts

Unit 1: Concepts

Natural resources - definition - characteristics and classification. Stock dynamics of renewable and non-renewable resources. Equation of motion for renewable and non-renewable resources. Fundamental equation of renewable resources.

Block 2: Models and Management

Unit 1: Models for economic view of natural resources

Growth curves of fishery and forest resources. The role of time preference in natural resource use. Simple two-period model of optimal use of renewable and non-renewable resources. Advanced models of optimal resource use – Static Vs. dynamic efficiency in natural resource use Applications of dynamic programming and optimal control.

Unit 2: Management of water resources

Economics of groundwater use - optimal extraction of groundwater. Analytical and numerical solutions for optimal inter-temporal allocation of natural resources. Optimal harvesting of single rotation and multiple rotation forests. Optimal management of fishery.

Block 3: Regulations and planning

Unit 1: Property Rights

Property rights in natural resources and their implication for conservation and management of natural resources. Management of common property natural resources – Institutional arrangements for conservation and management of common pool fishery, groundwater and forestry resource.

Unit 2: Dynamics of resource economics

Resource scarcity – Natural resource degradation – Poverty and resource degradation – Natural resource accounting - Pricing and valuation of natural resources – Natural resources policy. Practical Derivation of the fundamental equation of renewable resources-Estimation of growth curves and stock dynamics for fishery and forestry resources. Simple two period problem of optimal resource use – Numerical solution for simple two-period model of dynamic efficiency in natural resource extraction. Multi-period dynamic efficiency – Using

Excel Solver in solving dynamic natural resource harvesting problems. Using analytical solution procedures for solving natural resource management problems – Optimal control.

VIII. Teaching Methods/Activities

- Lectures.
- Case studies.
- Assignments (Group/individual).
- Group Discussions

IX. Suggested Reading

- Hackett SC. 2001. *Environmental and Natural Resource Economics: Theory, Policy and the Sustainable Society*. M.E. Sharpe, Armonk, NY.
- Hartwick JM and Olewiler ND. 1998. *The Economics of Natural Resource Use*. 2nd Ed. Addison-Wesley Educational Publ.
- Kerr JM, Marothia DK, Katar Singh, Ramasamy C and Bentley WR. 1997. *Natural Resource Economics: Theory and Applications in India*. Oxford & IBH.
- Pearce DW and Turner K. 1990. *Economics of Natural Resources and the Environment*. John Hopkins Univ. Press.
- Prato T. 1998. *Natural Resource and Environmental Economics*. Iowa State Univ. Press.
- Sengupta R. 2000. *Ecology and Economy, an Indian Perspective*. Oxford Univ. Press.
- Tietenberg T. 2003. *Environment and Natural Resource Economics*. 6th Ed. Addison Wesley.

I. Course Title: Environmental Economics

II. Course Code: AEC 609

III. Credit Hours: 2+1

IV. Why this course?

Economics not only deals with transaction taking place between human beings within and across national boundaries. Each economic activity has a price to pay to the environment. The activity causes loss to the environment in various ways. Thus, as a student of economics it is necessary to work out the costs and returns in terms of losses to environment while carrying out these development/production activities.

V. Aim of the course

To understand the economic outcomes of environmental degradation. Make students proficient in decision making regarding environment protection, resource use, and conservation policy.

VI. Organization of the course

The course is organised as follows:

No.	Block	Unit
1.	Overview	1. Overview of Environmental Economics
2.	Assessment and Development	1. Economic assessment Dynamics 2. Developmental Aspects
3.	Regulations and Issues	1. Accounting, Policies and Regulations 2. Environmental Issues

VII. Theory

Block 1: Overview

Unit 1: Overview of Environmental Economics

Environmental pollution as a consequence of market failure - Causes and consequences of market failure - Externalities - Public goods and externalities -Economics of pollution – Private vs. Social cost of environmental pollution – Property rights, environment and development – Theory of environmental policy.

Block 2: Assessment and Development Dynamics

Unit 1: Economic assessment

Environmental cost benefit analysis - Environmental impact assessment techniques Non-market valuation of environmental resources (WTP/WTA) - Environment, market and social welfare.

Unit 2: Developmental aspects

Economic growth and environmental cost - Growth oriented economic policies and their environmental impacts - Population and environmental quality - poverty and environmental degradation – Sustainable development – Indicators of sustainable development – Issues in sustainable development.

Block 3: Regulations and Issues

Unit 1: Accounting, Policies and Regulation

Environment, ecology and environmental accounting - Environmental pollution with respect to water and air - Land and forest resources related environmental pollution - Coastal externalities - Urbanization and environment - Basic approaches to environmental policy (Tax, subsidy, pollution permits, *etc*.) Green taxes – Political economy of environmental regulation and management.

Unit 2: Environmental Issues

Transboundary environmental problems - Economics of global warming, climate change and emission trading - Environment, international trade and development.

VIII. Practical

- Contemporary global environmental global environmental issues, movement, policies, programmes, laws and other regulatory mechanisms
- Criteria for evaluating the environment related projects and review of Environmental Impact Assessment (EIA) techniques
- Recreation demand models of environmental valuation
- Contingent valuation techniques
- Environmental Resource Accounting Techniques
- Discussion on the techniques dealing with air pollution and review of case studies on air pollution and its impacts - forest environment and wild life conservation
- Green GDP and Green house insurance
- Practical considerations and comparison of instruments of environmental policy
- Non-point source pollution control methodologies
- Environment in macroeconomic modelling
- Meta-analysis, economic valuation and environmental economics
- Multi-criteria methods for quantitative, qualitative and fuzzy evaluation problems related to environment
- Input output analysis, technology and the environment
- Computable general equilibrium models for environmental economics and policy analysis.

IX. Teaching Methods/ Activities

- Lectures.
- Case studies.
- Assignments (Group/individual).
- Group Discussions

X. Learning outcome

After the successful completion of the course, the student will be able to-Understand the concept of pollution and externalities caused by economic activity. Work out the economics of productions activities in terms of losses to environment. Learn about accounting of environmental costs and other issues related.

XI. Suggested Reading

• Hackett SC. 2001. *Environmental and Natural Resource Economics: Theory, Policy and the Sustainable Society.* ME. Sharpe, Armonk, NY.
• Hartwick JM and Olewiler ND. 1998. The Economics of Natural Resource Use. 2nd Ed. Addison-Wesley Educational Publ.
• Kerr JM, Marothia DK, Katar Singh, Ramasamy C and Bentley WR. 1997. *Natural Resource Economics: Theory and Applications in India.* Oxford & IBH.
• Pearce DW and Turner K. 1990. *Economics of Natural Resources and the Environment.* John Hopkins Univ. Press.
• Prato T. 1998. *Natural Resource and Environmental Economics.* Iowa State University Press.
• Sengupta R. 2000. *Ecology and Economy, an Indian Perspective*. Oxford University Press.
• Tietenberg T. 2003. *Environment and Natural Resource Economics*. 6th Ed. Addison Wesley.