Department of Agricultural Economics & Statistics
Faculty of Agriculture
Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur-273009

COURSE CURRICULUM AND SYLLABUS
of
M. Sc. (Ag.) in Agricultural Economics

Nomenclature and Credit hour
[(On the recommendations of the members of National Core Group, 19 Broad Subject Matter Area (BSMA), ICAR]

Nomenclature	Credit hours
Major Courses	20
Minor Courses	09
Supporting Course	06
Common Courses	05
Credit Seminar	01
Research work or Research Methodology	30
Total	71

Major courses: From the discipline in which a student takes admission.

Minor courses: From the subjects closely related to a student's major subject. It is suggested that the student may choose minor courses as these are related to policy advocacy and aim to build larger understanding of the subject. The final choice of the minor courses should be mandatorily approved by the Student Advisory committee/HOD.

Supporting courses: The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree programme:

1. Library and Information Services
2. Technical Writing and Communications Skills
3. Intellectual Property and its Management in Agriculture
4. Basic Concepts in Laboratory Techniques
5. Agricultural Research, Research Ethics and Rural Development Programmes

Some of these courses are already 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 Head of Department (HoD)/ Board of Studies (BoS).

NAME OF COURSE OFFERED BY ARICULTURAL ECONOMICS DISCIPLINE

[(On the recommendations of the members of National Core Group, 19 Broad Subject Matter Area (BSMA), ICAR]

Course Code	Course Title	Credit Hours
Courses offered to the students who pursuing M. Sc. (Ag.) in Agricultural Economics		
A.	**Major courses**	**Credit 20**
AEC-501*	Micro Economic Theory and Applications	3 (3+0)
AEC-502*	Agricultural Production Economics	2 (1+1)
AEC-503*	Agricultural Marketing and Price Analysis	3 (2+1)
AEC-504*	Macro Economics and Policy	2 (2+0)
AEC-505*	Econometrics	3 (2+1)
AEC-507*	Agricultural Finance and Project Management	3 (2+1)
AEC-508*	Linear Programming	2 (1+1)
AEC-509*	Research Methodology for Social Sciences	2 (1+1)
B.	**Minor Courses**	**Credit 09**
AEC-506	Agricultural Development and Policy Analysis	2 (2+0)
AEC-513	Natural Resource and Environmental Economics	2 (1+1)
AEC-514	Commodity Future Trading Credits	2 (2+0)
EXT-506**	ICTs for Agricultural Extension and Advisory Services	3 (2+1)
C.	**Supporting Courses**	**Credit 06**
STAT 502	Statistical Methods for Applied/Social Sciences	3(2+1)
STAT-512	Basic Sampling Techniques	3(2+1)
D.	**Common Courses**	**Credit 05**
PGS-501	Library and Information Services	1 (0+1)
PGS-502	Technical Writing and Communications Skills	1 (0+1)
PGS-503	Intellectual Property and its Management in Agriculture	1 (1+0)
PGS-504	Basic Concepts in Laboratory Techniques	1 (0+1)
PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes	1 (1+0)
E.	**Seminar**	**Credit 01**
AEC-591	Master's Seminar	1(0+1)
F.	**Thesis Research**	**Credit 30**
AEC-599	Master's Research (*Thesis)*	30 (0+30)
	OR	
	Research Methodology (*Special Paper)*	30 (30+0)
	Total (A+B+C+D+E+F)	**Credit 71**

*Courses to be taken compulsorily
**This course will be offered by Department of Agriculture Extension.

Semester wise distribution of offered courses

COURSE CODE	COURSE TITLE	CREDIT HOURS
SEMESTER I		
PGS-501	Technical Writing and Communications Skills	1 (0+1)
PGS-502	Library and Information Services	1 (0+1)
AEC-501	Micro Economic Theory and Applications	3 (3+0)
AEC-502	Agricultural Production Economics	2 (1+1)
AEC-503	Agricultural Marketing and Price Analysis	3 (2+1)
AEC-513	Natural Resource and Environmental Economics	2 (1+1)
STAT-502	Statistical Methods for Applied/Social Sciences	3 (2+1)
AEC-599	Master's Research (*Thesis*)	3 (0+3)
	TOTAL CREDIT	**18**
SEMESTER II		
PGS-503	Intellectual Property and its Management in Agriculture	1 (1+0)
PGS-504	Basic Concepts in Laboratory Techniques	1 (0+1)
AEC-504	Macro Economics and Policy	2 (2+0)
AEC-505	Econometrics	3 (2+1)
AEC-514	Commodity Future Trading	2 (2+0)
STAT-512	Basic Sampling Techniques	3 (2+1)
AEC-599	Master's Research (*Thesis*)	6 (0+6)
	TOTAL CREDIT	**18**
SEMESTER III		
PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1 (1+0)
AEC-507	Agricultural Finance and Project Management	3 (2+1)
AEC-508	Linear Programming	2 (1+1)
AEC-509	Research Methodology for Social Sciences	2 (1+1)
AEC-506	Agricultural Development and Policy Analysis	2 (2+0)
EXT-506*	ICTs for Agricultural Extension and Advisory Services	3 (2+1)
AEC-599	Master's Research (*Thesis*)	5 (0+5)
	TOTAL CREDIT	**18**
SEMESTER IV		
AEC 591	Master's Seminar	1 (0+1)
AEC 599	Master's Research (*Thesis*)	16 (0+16)
	TOTAL CREDIT	**17**
OR		
AEC 599	Research Methodology (*Special Paper*)	**30 (30+0)**

*This course will be covered by Department of Agriculture Extension.

Course Contents of M. Sc. (Ag.) in Agricultural Economics

A. Major courses

Course Title	: Micro Economic Theory and Applications
Course Code	: AEC-501
Credit Hours	: 3 (3+0)

Why this course?

Markets form an integral part of the economy. They are governed by demand and supply mechanism with profit making its ultimate goal. Thus, it is imperative to expose the students towards how the markets function, their types and how the buyers and sellers behave. That will help them make correct decision when it comes to price setting and choice of product.

Aim of the course

The course envisages the concepts and principles embodying micro-economics. The economic problems, functioning of price mechanism, theory of household behaviour and consumer's demand function. Theory of firm, supply determinants, determination of price under different market structures and factor pricing (micro economic components).

Theory

Block 1: Introduction to micro-economics

Unit 1: Basic Concepts: A review

Scarcity and Choice; Production possibility frontier, Positive and normative economics; concepts of opportunity cost, Demand and Supply: determinants of individual demand/supply; demand/ supply schedule and demand/supply curve; market versus individual demand/ supply; shifts in the demand/ supply curve

Block 2- Insight of consumer, production and cost involved

Unit 1: Consumer Choice

Cardinal Utility Approach–Ordinal Utility Approach-Budget sets and Preferences under different situations–Hicks and Slutsky income and substitution effects–Applications of Indifference curve approach–Revealed Preference Hypothesis–Consumer surplus–Derivation of Demand curve–Elasticity of demand–Demand and supply together; how prices allocate resources; controls on prices–price floor and price ceiling–applications in agriculture.

Unit 2: Production and Cost

Production functions: single variable - average and marginal product, variable proportions, stages of production. Two variables –iso-quant's, returns to scale and to a factor; factor prices; Technical progress; cost minimization and output maximization; Elasticity of substitution. Expansion path and the cost function Concept of economic cost; Short run and long run cost curves; increasing and decreasing cost industries; envelope curve; L-shaped cost curves; economies of scale; revenue and

expenditure, elasticity and marginal revenue; Firm equilibrium and profit.

Block 3: Overview of market

Unit 1: Market Forms

Behaviour of profit maximizing firms and the production process- Perfect competition: Equilibrium of the market. Long run industry supply, applications: effects of taxes and subsidies; Monopoly: Equilibrium; supply; multiplant firm; monopoly power; deadweight loss; price discrimination; Monopolistic Competition: Product differentiation; equilibrium of the firm in the industry-with entry of new firms and with price competition. Comparison with pure competition. Duopoly: Cournot model and reaction curves; Stackelberg 's model, Bertrand model; Oligopoly.

Unit 2: Factor Markets

Labour and land markets - basic concepts (derived demand, productivity of an input, marginal productivity of labour, marginal revenue product); demand for labour; input demand curves; shifts in input demand curves; competitive labour markets; Economic rent and quasi-rent.

Learning outcome

- After completion of the course the student will be able to:
- Get acquainted with the basic concepts of market functions.
- Build up vision towards how consumers make choices and market reaches the equilibrium.
- Develop decision making skill for firms about product selections and scale of production to ensure maximum profit.
- Understand about different types of markets existing in the real world, their principles and where abouts.

Suggested Reading

- Koutsoyiannis A. Modern Micro Economics. Macmillan Press Ltd Social Sciences: Agricultural Economics 189
- Ferguson and Gould. Micro Economic Theory. Richard D Erwin Inc., USA
- Richard A. Bilas, Micro Economic Theory.
- Leftwich Richard H. The Price System and Resources Allocation
- Allen C. L. A Frame Work of Price Theory

Course Title	: Agricultural Production Economics

Course Title : **Agricultural Production Economics**

Course Code : **AEC-502**

Credit Hours : **2 (1+1)**

Why this course?

Production in agriculture is the outcome of the input factors involved. In this competitive and uncertain market, it is important that the farmers take the right decision about the combination of inputs that will result in higher income. Thus, as an economist it is a pre-requisite that the students understand the interaction between output and input. And workout them out effective production plan.

Aim of the course

To expose the students to develop the concept, significance and uses of production economics. To understand the relationships between factors and output. To learn how to decide the combination of inputs to be used as per the resources available. Ensure that the production process works efficiently.

Organization of the course

Theory

Block 1: Introduction to Production Economics Unit 1: Concepts of production economics

Nature, scope and significance of agricultural production economics- Agricultural Production processes, character and dimensions-spatial, temporal - Centrality of production functions, assumptions of production functions, commonly used forms - Properties, limitations, specification, estimation and interpretation of commonly used production functions.

Block 2: Factors and costs

Unit 1: Factors and theory of production

Factors of production, classification, interdependence, and factor substitution, Determination of optimal levels of production and factor application -Optimal factor combination and least cost combination of production - Theory of product choice; selection of optimal product combination.

Unit 2: Concepts of cost

Cost functions and cost curves, components, and cost minimization -Duality theory, cost and production functions and its applications -Derivation of firm's input demand and output supply functions -Economies and diseconomies of scale.

Block 3: Assessment

Unit 1: Dynamics of economic assessment

Technology in agricultural production, nature and effects and measurement - Measuring efficiency in agricultural production; technical, allocative and economic efficiencies - Yield gap analysis-concepts-types and measurement - Nature and sources of risk, modeling and coping strategies.

Practical

- Different forms of production functions

- Specification, estimation, and interpretation of production functions

- Returns to scale, factor shares, elasticity of production

- Physical optima-economic optima

- Least cost combination

- Optimal product choice

- Cost function estimation, interpretation

- Estimation of yield gap

- Incorporation of technology in production functions

- Measuring returns to scale-risk analysis.

Learning outcome

After the successful completion of the course the student will be able to: Understand how the factors and output interact with each other. - Work out whether the production system is working efficiently and point out the loop holes.- Apply the knowledge of costs and profits to work out the demand and supply functions. This will result into more efficient decision making.

Suggested Reading

- E. O. Heady. Economics of Agricultural Production and Resources use.

- John P Doll and Frank Orazem. Production Economics: Theory with application.

- Heady E. O. & Dillon J. L. 1961. Agricultural Production functions. Kalyani Publishers, Ludhiana, India. 667 p.

- Baumol W. G. 1973. Economic theory and operations analysis. Practice Hall of India Private Limited, New Dehli 626 p.

- Gardner BL & Rausser G. C. 2001. Handbook of Agricultural Economics Vol. I Agricultural Production. Elsevier

Course Title	: Agricultural Marketing and Price Analysis
Course Code	: AEC-503
Credit Hours	: 3(2+1)

Why this course?

The ultimate aim of production process is to sell the produce in the market and generate income. Markets serves as platform where this exchange takes place. Agriculture markets are different from other markets due to the nature of the commodity. Thus, it is important to develop a strong foundation of agricultural marketing, its components and issues. The student needs to know about the multi- pronged ways of marketing the produce, agencies involved. In this modern era, it   is important to understand how technology is transforming this sector.

Aim of the course

The course is designed to acquaint the students about the basics of dynamics of agricultural marketing. The content includes supply, demand and marketing of farm production, marketing functions and channels, marketing costs, margins and efficiency, agricultural prices, new marketing formats like e-marketing, e-NAM future trading, supply chain management, market intelligence etc.

Organization of the course

Theory

Block 1: Introduction to Agricultural Marketing

Unit 1: Introduction to agricultural marketing

New Concepts in Agricultural Marketing-Characteristic of Agricultural product and Production–Problems in Agricultural Marketing from Demand and Supply and Institutions sides. Market intermediaries and their role - Need for regulation in the present context-Marketable & Marketed surplus estimation. Marketing Efficiency-Structure Conduct and Performance analysis-Vertical and Horizontal Integration-Integration over-space, time and form-Vertical co-ordination.

Block 2: Agricultural Markets

Unit 1: Aspects of agricultural marketing

Different Forms of marketing: Co-operatives Marketing–APMC Regulated Marketing-Direct marketing, Farmer Producer Companies, e-NAM and marketing under e-NAM, e-marketing Contract farming and Retailing, Organized retailing-Supply Chain Management-State trading, Warehousing and other Government agencies -Performance and Strategies -Market infrastructure needs, performance and Government role-Value Chain Finance.

Unit 2: Future marketing and government

Introduction to Commodities markets and future trading - Basics of commodity futures - Operation Mechanism of Commodity markets–Price discovery-Hedging and Basis-Fundamental analysis-Technical Analysis–Role of Government/SEBI in promoting commodity trading and regulatory measures.

Block 3: Advances in Agricultural Marketing

Unit 1: Use of Information Technology

Role of Information Technology and Market Intelligence in marketing of agricultural commodities, -electronic auctions (e-bay), e-CHAUPALS, AGMARKNET and Domestic and Export market Intelligence Cell (DEMIC).

Unit 2: Dynamics of price

Price forecasting–time series analysis–time series models–spectral analysis. Price policy and economic development–non-price instruments.

Practical

- Supply and demand elasticities in relation to problems in agricultural marketing.
- Price spread and marketing efficiency analysis.
- Marketing structure analysis through concentration ratios.
- Performance analysis of Regulated market and marketing societies. Analysis on contract farming and supply chain management of different agricultural commodities, milk and poultry products.
- Supply Chain Analysis - quantitative estimation of supply chain efficiency.
- Market Intelligence–Characters, Accessibility and Availability Price forecasting.
- Online searches for market information sources and interpretation of market intelligence reports – commodity outlook.
- Technical Analysis for important agricultural commodities.
- Fundamental Analysis for important agricultural commodities.
- Presentation of the survey results and wrap-up discussion.

Suggested Reading

- Acharya S. S. & Agarawal N. L. 2004. Agricultural Marketing in India. Oxford and IBH Publishing company Pvt. Ltd. New Delhi.
- Acharya S. S. & Agarawal N. L. 1994. Agricultural Prices-Analysis and Policy. Oxford and IBH Publishing company Pvt. Ltd. New Delhi.
- Richard H Kohls and Joseph N. Uhl: Marketing of Agricultural products by Collier MacMillan International

Course Title	: Macro Economics and Policy
Course Title	: **Macro Economics and Policy**
Course Code	: **AEC-504**
Credit Hours	: **2(2+0)**

Why this course?

The economy of the nation is governed by certain rules, regulation and principles. The students have to gain knowledge of the mechanism through which the large economies are controlled and ensure that welfare prevails. They are entitled to know the transactions between different markets and policies framed to keep value of money under control.

Aim of the course

The course envisages the concepts and principles of macroeconomics from classical to Keynesian theories. The other component deals with the monetary system- money, credit and banking system, value of money and economic activities, national income accounting and approaches to estimate national income theory of income and employment determination and inflation.

Theory

Block 1: Conceptualising Macro Economics

Unit 1: Introduction: Measurement and Concepts

Basic concepts and scope of Macro-economics, National Income Accounting: Methods of measurement of key macro-economic aggregates, relationship of national income and other aggregates (with numerical exercises), real and nominal income.

Block 2: Theories of macroeconomics

Unit 1: Classical Macroeconomics

Say's Law, Quantity Theory of Money, aggregate labour supply and demand oflabour, Classical theory of determining output, wages and prices.

Unit 2. Income and Spending: Keynesian Framework

Simple Keynesian model of income determination; Keynesian Multiplier- aggregate spending, taxation, transfer payments, foreign spending, balanced budget; budget surplus (with numerical exercises).

Block 3- Money, Consumption and Inflation Unit 1: Money, Interest and Income

Goods market equilibrium-IS curve; Demand for Money, the Liquidity Preference Theory – Liquidity Trap; asset market equilibrium- LM curve; simultaneous equilibrium in goods and asset market- effect of fiscal and monetary policy

Unit 2: Theories of Aggregate Consumption and Investment

Absolute Income Hypothesis, Relative Income Hypothesis, Fisher 's Inter-temporal Choice Model, Life-Cycle and Permanent Income Hypotheses; Profits and Accelerator Theory.

Unit 3: Inflation and Unemployment

Inflation: Nature, Effects and control; Types of inflation – demand pull, cost push- stagflation, core inflation, hyperinflation; Phillips's curve.

Suggested Reading

- Stonier & Hegue. A Text Book of Economic Theory
- Samuelson P. A. 1948. Foundation of Economic Analysis. Harvard University Press
- M. C. Vaish Allid. 1983. Macro-Economics Theory
- Gardner Ackley. 1961. Macro-Economics Theory: Macmillan, New York.
- T. F. Dernburg & DM Mcdougali-Macro Economics
- G. Sirkin – Introduction to Macro-Economics Theory
- RL Heibroker-Understanding Macro–Economics
- JK Mehta –Macro Economics
- Michael R Edgemand – Macro-Economics: Theory & Policy
- David' W Pearce –The dictionary of modern Economic

Course Title	: Econometrics
Course Code	: AEC-505
Credit Hours	:3(2+1)

Why this course?

Development of analytical skills is imperative to make students proficient in conducting quality research work. The knowledge of variables, their models, and problems encountered when dealing with variables will build up a compatibility with the analytical aspects.

Aim of the course

The course provides knowledge of the econometric methods like time-series analysis, linear regression models and their application in economic analysis. The course provides an insight into the econometric problems in analyzing time-series and cross-section data.

Theory

Block 1: Introduction to Econometrics

Unit 1: Introduction

Relationship between economic theory, mathematical economics, models and econometrics, methodology of econometrics-regression analysis.

Block 2: Classical Regression

Unit 1: Classical Linear Regression

Basic two variable regression–assumptions estimation and interpretation approach to estimation–OLS and their properties–extensions to multi-variable models-multiple regression estimation and interpretation.

Unit 2: Breaking down of Classical assumptions

Violation of assumptions–identification, consequences and remedies for Multicollinearity, heteroscedasticity, autocorrelation–data problems and remedial approaches–model misspecification.

Block 3: Qualitative Variables

Unit 1: Qualitative variables and simultaneous equation models

Use of dummy variables- Introduction to simultaneous equations- identification problem

Practical

- Single equation two variable model specification and estimation
- Hypothesis testing transformations of functional forms and OLS application
- Estimation of multiple regression model
- Testing and correcting specification errors
- Testing and managing Multi-collinearity
- Estimation of regressions with dummy variables

Suggested Reading

- Dorfman R. 1996. Linear Programming and Economic Analysis. McGraw Hill.
- 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.
- Maddala GS. 2002. Econometrics. Mc Graw-Hill.
- Pinndyck RS and Rubinfeld DL. 1990. Econometric Models and Econometric Forecasts. McGraw Hill.

Course Title : Agricultural Finance and Project Management

Course Code : AEC-507

Credit Hours :3(2+1)

Why this course?

Money is the fuel of driving all the economic activities. India is a land of small and marginal farmers. The financial conditions of the farmers are not so strong that they can finance themselves. They require credit to meet the requirements of inputs. Thus, the student should know the sources, principles involved and types of credit available. The institutions involved and on what grounds the finance is given to the farmer. What are the risks involved and how to overcome them.

Aim of the course

This course is designed with an objective to deliver knowledge of the principles, procedures, problems and policies relating to financing agricultural firms. In addition to this the students are also given knowledge about the research developments in the subject. The approach is analytic.

Theory

Block 1: Introduction to Agricultural Finance Unit 1: Basic concepts: A Review

Role and Importance of Agricultural Finance. Financial Institutions and credit flow to rural/priority sector. Agricultural lending–Direct and Indirect Financing-Financing through Co-operatives, NABARD and Commercial Banks and RRBs. District Credit Plan and lending to agriculture/priority sector. Micro-Financing and Role of MFI's-NGOs, and SHG's.

Block 2: Credit and Financial Analysis

Unit 1: Credit and its aspects

Lending to farmers–The concept of 3C's, 7P's and 3R's of credit. Estimation of Technical feasibility, Economic viability and repaying capacity of borrowers and appraisal of credit proposals. Understanding lenders and developing better working relationship and supervisory credit system. Credit inclusions–credit widening and credit deepening.

Unit 2: Financial analysis

Financial Decisions–Investment, Financing, Liquidity and Solvency. Preparation of financial statements-Balance Sheet, Cash Flow Statement and Profit and Loss Account. Ratio Analysis and Assessing the performance of farm/firm.

Block 3- Project and Risk Management

Unit 1: Project Overview

Project Approach in financing agriculture. Financial, economic and environmental appraisal of investment projects. Identification, preparation, appraisal, financing and implementation of projects. Project Appraisal techniques–Undiscounted measures. Time value of money–Use of discounted measures - B-C ratio, NPV and IRR. Agreements, supervision, monitoring and evaluation phases in

appraising agricultural investment projects. Network Techniques–PERT and CPM.

Unit 2: Risk and its Management

Risks in financing agriculture. Risk management strategies and coping mechanism. Crop Insurance programmes–review of different crop insurance schemes-yield loss and weather-based insurance and their applications.

Practical

- Development of Rural Institutional Lending;
- Branch expansion, demand and supply of institutional agricultural credit and Over dues and Loan waiving;
- An overview, Rural Lending Programmes of Commercial Banks, Lead Bank Scheme;
- Preparation of District Credit Plan, Rural Lending Programmes of Co-operative Lending Institutions;
- Preparation of financial statements using farm/firm level data, Farm credit appraisal techniques and farm financial analysis through financial statements;
- Performance of Micro Financing Institutions;
- NGO's and Self-Help Groups, Identification and formulation of investment projects;
- Project appraisal techniques – Undiscounted Measures and their limitations;
- Project appraisal techniques – Discounted Measures;
- Network techniques – PERT and CPM for project management;
- Case Study Analysis of an Agricultural project;
- Financial Risk and risk management strategies – crop insurance schemes;
- Financial instruments and methods – E banking, Kisan Cards and core banking.

Suggested Reading

- E Die Sollem H and Heady EO. (Ed.). *Capital and Credit Needs in Changing Agriculture*, Bauman.
- Hopkins A Barry, Peter Jo and Baker CB. *Financial Management in Agriculture*.
- MurrayWGandNelsonAG.1960.*AgriculturalFinance.*IowaStateUniversity
- Chanona C. 1969. *Agricultural Finance in India: Role of Commercial Banks*. Marketing and Economics Research Bureau, New Delhi.
- Gittinger JP. 1972. *Economic analysis of agricultural projects*, John Hopkins Univ. Press, Baltimore.
- Little IMD and JA Mirrless. 1974, *Project appraisal and planning for developing countries*, Oxford and IBH publishing Co. New Delhi.
- Arnold CH. 1972. *Project Evaluation, collected papers*, Macmillan.

Course Title	: Linear Programming
Course Code	: AEC-508
Credit Hours	:2(1+1)

Theory

Unit I

Decision Making- Concepts of decision making, introduction to quantitative tools, introduction to linear programming, uses of LP in different fields, graphic solution to problems, formulation of problems. Simplex Method: Concept of simplex Method, solving profit maximization and cost minimizations problems. Formulation of farms and non-farm problems as linear programming models and solutions.

Unit III

Extension of Linear Programming models: Variable resource and price programming, transportation problems, recursive programming, dynamic programming.

Unit IV

Game Theory- Concepts of game theory, two-person constant sum, zero sum game, saddle point, solution to mixed strategies, the rectangular game as Linear Programming.

Practical

• Graphical and algebraic formulation of linear programming models.

• Solving of maximization and minimization problems by simplex method.

• Formulation of the simplex matrices for typical farm situations.

Suggested Reading

- Baker CB. Research Methodology in Agricultural Economics

- Cohen MR and Nagel R. An Introduction to Logic and Scientific Method

- Devey J Logic. The Theory of Enquiry

- Dhondhyal SP. Social Science Research and Thesis Writing

- Ezekiel M. Correlation Analysis

- Heady EO. Linear Programming Methods

- Willson ER. An Introduction to Scientific Research

- Kumar A. 2008. Research Methodology: A Survey. Alts, New Delhi

Course Title	**: Research Methodology for Social Sciences**
Course Code	**: AEC-509**
Credit Hours	**: 2 (1+1)**

Why this course?

Planning of research is very crucial to conduct successful research. There is need to give an insight to the student about how to conduct research, right from data collection to analysis and finally writing the references.

Aim of the course

The course deals with scientific methods of research, the initiation of an inquiry, formulation of research problems and hypotheses, the role of induction and deduction in research, collection and analysis of date and interpretation of results.

Theory

Block 1: Concepts of research methodology

Unit 1: Concepts of research methodology

Importance and scope of research in agricultural economics. Types of research – Fundamental vs. Applied. Concept of researchable problem – research prioritization- Selection of research problem. Approach to research– research process.

Block 2- Building up hypothesis and sample selection Unit 1: Hypothesis: Framing and Testing

Hypothesis–meaning–characteristics–types of hypotheses–review of literature setting of Course Objective and hypotheses–testing of hypothesis.

Unit 2: Sampling

Sampling theory and sampling design–sampling error-methods of sampling–probability and non-probability sampling methods-criteria to choose. Project proposals–contents and scope–different types of projects to meet different needs trade-off between scope and cost of the study. Research design and techniques, Types of research design.

Block 3- Data Collection and Analysis

Unit 1: Data Collection

Data collection–assessment of data needs–sources of data collection–discussion of different situations. Mailed questionnaire and interview schedule–structured, unstructured, open ended and closed-ended questions. Scaling Techniques. Preparation of schedule–problems in measurement of variables in agriculture. Interviewing techniques and field problems-methods of conducting survey– Reconnaissance survey and Pre testing.

Unit 2: Data Analysis

Data coding, tabulation, cleaning–Multivariate analysis–factor analysis' PCA' cluster analysis.

Universal procedures for preparation of bibliography–writing of research articles.

Practical

- Exercises in problem identification.

- Project proposals – contents and scope.

- Formulation of Objective and hypotheses.

- Assessment of data needs – sources of data – methods of collection of data.

- Methods of sampling–criteria to choose–discussion on sampling under different situations.

- Scaling Techniques – measurement of scales.

- Preparation of interview schedule.

- Field testing. Method of conducting survey.

- Exercise on coding, editing, tabulation and validation of data.

- Preparing for data entry into computer.

- Hypothesis testing – Parametric and Non-Parametric Tests.

- Exercises on format for Thesis/ Report writing and Presentation of their results.

Suggested Reading

- Baker CB. *Research Methodology in Agricultural Economics*

- Cohen MR and Nagel R. *An Introduction to Logic and Scientific Method*

- Devey J Logic. *The Theory of Enquiry*

- Dhondhyal SP. *Social Science Research and Thesis Writing*

- Ezekiel M. *Correlation Analysis*

- Heady EO. *Linear Programming Methods*

- Willson ER. *An Introduction to Scientific Research*

- Kumar A. 2008. *Research Methodology: A Survey.* Alts, New Delhi

B. Minor Courses

Course Title   **: Agricultural Development and Policy Analysis**

Course Code   **: AEC-506**

Credit Hours   **:2(2+0)**

Why this course?

The ultimate aim of the economies is to attain a satisfactory level of development. Development ensures that there is not only increase in income but also the distribution is such that lesser inequalities exist. The students need to know what is development and its related concepts. All the policies framed are with one sole objective of increasing the welfare. Thus, once concept of development is built up, students can better understand policies and their genesis.

Aim of the course

Concept of economic development and policy, theories of development, performance of Indian agriculture. The process and implementation of policies over a period of time.

Theory

Block 1: Introduction

Unit 1: Introduction

Role of agriculture in economic/ rural development – Evolution of thinking on agriculture and development; Agricultural development – meaning, stages and determinants – Population and food supply – need for sound agricultural policies

Block 2: Theoretical Concepts

Unit 1: Theories of Agricultural Development

Resource exploitation model-Conservation model-Location (Urban impact) model-Diffusion model- High pay-off input model-Induced Innovation Model- Agricultural R&D and Linkages.

Block 3: Performance and policies

Unit 1: Performance of Indian Agriculture

Agrarian structure and land relations; trends in performance and productivity; agrarian structure and technology; credit, commerce and technology; capital formation; subsidies; pricing and procurement; Post Green Revolution agriculture; Production and productivity crisis in agriculture; Regional differences; Food Security, PDS system and Malnutrition.

Unit 2: Agricultural Policy: Process and Implementation

Instruments of Agricultural Policy; Process of agricultural policy formulation, implementation, Monitoring and Evaluation in India; Global experiences in participatory approach to Agricultural policy process; critical review of various elements of Indian agricultural policy-resource policies– credit policies–input and product marketing policies–price policies; WTO–Agreement on Agriculture; Planning models. Planning for utilization of resources and Indian Five-Year Plans.

Suggested Reading

• Albert O. Hirschman 1958. Strategy of Economic Development. New Man Yale University

• Simon Kuznets 1965. Economic Growth and Structures. Oxford New Delhi.

• Das Gupta AK. 1965. Planning and Economic Growth. George Allen and Unwin London

• Robert E. Baldwin 1966. Economic Development and Growth. John Willey, New York

Course Title : Natural Resource and Environmental Economics

Course Code : AEC-513

Credit Hours : 2(1+1)

Why this course?

Sustainable development is the need of the hour. The economic activities affect not only the society but also the environment. Every activity has its social cost. The students, hence will be taught about the economic aspect of environment.

Aim of the course

To understand about economics of environment and social costs incurred due to economic development. Work out methods to maintain environment quality and reduce social costs.

Theory

Block 1- Introduction to natural resource and environmental economics

Unit 1: Basic Foundation

Concepts, Classification and Problems of Natural Resource Economics–Economy Environment interaction–The Material Balance principle, Entropy Law-Resources Scarcity-Limits to Growth-Measuring and mitigating natural resource scarcity–Malthusian and Recardian scarcity–scarcity indices-Resource Scarcity and Technical Change.

Block 2- Insights of the subject

Unit 1: Theories and economics of natural resources

Theory of optimal extraction renewable resources–economic models of oil extraction- efficiency - time path of prices and extraction-Hotelling's rule, Solow-Harwick's Rule. Theory of optimal extraction exhaustible resources–economic models of forestry and fishery.

Unit 2: Functioning of Market

Efficiency and markets–market failures-externalities–types-property rights–transaction costs–Coase's theorem and its critique-public goods-common property and open access resource management-Collective action.

Block 3- Dealing with the issues and sustainability

Unit 1: Environmental Issues

Environmental perspectives-biocentrism, sustainability, anthropocentrism–Environmental problems and quality of environment-Sources and types of pollution-air, water, solid waste, land degradation–environmental and economic impacts-Economics of pollution control-efficient reduction in environmental pollution.

Unit 2: Regulations

Environmental regulation–economic instruments-pollution charges–Pigouvian tax-tradable permits–indirect instruments–environmental legislations in India.

Unit 3: Sustainability aspects

Concept of sustainable development–Economic Perspective–Indicators of sustainability Relation between development and environment stress-Environmental Kuznet's curve Environmental Accounting–resource accounting methods–International Environmental Issues–climate change–likely impacts–mitigation efforts and international treaties.

Practical

- Exhaustible resource management – optimum rate of oil extraction.
- Renewable resource management – optimum harvest of Forestry/fishery.
- Exercise on pollution abatement-I.
- Exercise on pollution abatement-II.
- Concepts in valuing the environment.
- Taxonomy of valuation techniques.
- Productivity change method – substitute cost method – Hedonic price method – Travel cost method – Contingent valuation methods.
- Discount rate in natural resource management.
- Environment impact assessment
- Visit to Pollution Control Board.

Suggested Reading

- Pearce DW and Turner RK. *Economics of Natural Resource and Environment*
- Kwak J. *Economism: Bad Economics and the Rise of Inequality*
- Tietenberg T and Lewis L. *Environmental and Natural Resource Economics*
- Schwarz PM. *Energy Economics*

Course Title	: Commodity Future Trading
Course Code	: AEC-514
Credit Hours	: 2(2+0)

Why this course?

Risk is involved in marketing. Price fluctuation is a very common phenomenon in agriculture marketing. In such situation selling of commodity in future market serves as a resort to insulate from this uncertainty. Thus, knowledge of futures market is helpful in…

Aim of the course

To disseminate the knowledge about risk mitigating measures especially future trading. The future trading in agricultural commodities is increasing day by day therefore the roles of SEBI, functioning of commodity exchanges are discussed.

Theory

Block 1- Introduction to commodity market Unit 1: Concepts of commodity future trading

History and Evolution of commodity markets–Terms and concepts: spot, forward and futures Markets–factors influencing spot and future markets. Speculatory mechanism in commodity futures.

Block 2- Techniques and Risks in Commodity Market

Unit 1: Technical aspects

Transaction and settlement–delivery mechanism-role of different agents-trading strategies -potential impact of interest rate, Foreign Exchange, FDI in Commodity Markets.

Unit 2: Risk and its Management

Risk in commodity trading, importance and need for risk management measures-managing market price risk: hedging, speculation, arbitrage, swaps-pricing and their features.

Block 3- Commodity exchange and market analysis

Unit 1: Commodity Exchange–A review

Important global and Indian commodity exchanges - contracts traded–special features-Regulation of Indian commodity exchanges-FMC and its role.

Unit 2: Analysis of commodity market

Fundamental Vs Technical analysis–construction and interpretation of charts and chart patterns for analyzing the market trend–Market indicators–back testing. Introduction to technical analysis software–analyzing trading pattern of different commodity groups.

Suggested Reading

• Kaufman PJ. The Concise Handbook of Futures Markets: Jhon Wiley & Sons

• Purcell WD. Agricultural Futures and Options: Principles and Strategies: MacMillan Publications

• Wasendorf RR &McCaffery All About Commodities from the Inside Out. McGraw Hill

Course Title	: ICTs for Agricultural Extension and Advisory Services
Course Code	: EXT-506
Credit Hours	: 3 (2+1)

Why this course?

Information and Communication Technologies (ICTs) are continuously evolving. More ICT applications having better relevance to extension and advisory services (EAS) are currently available considering the human and other resource constrains faced by EAS, ICTs can supplement and complement EAS extension efforts in a cost-effective way. Extension professionals should have sound knowledge of ICTs and comprehensive understanding on its various applications for effectively deploying these in EAS provision. This course will provide knowledge and hands-on experience on ICT applications relevant for EAS.

Theory

Block 1: Introduction to Information and Communication Technologies (ICTs) and E-extension

Unit 1: ICTs-Concepts and Status

ICTs-meaning, concepts, basics of ICTs, global and national status, types and functions of ICTs, innovations, meaning of e-Governance, e-learning, mLearning, advantages and limitations of ICTs.

Unit 2: ICTs in Knowledge Management

Knowledge management-meaning, approaches and tools. Role of ICTs in Agricultural Knowledge Management.

Unit 3: e-Extension initiatives in Agriculture and allied sectors

e-Extension, overview on Global and national e-extension initiatives, Inventory of e-Extension initiatives in Agriculture and allied sectors from Central and State governments, ICAR, SAUs, private sector and NGO initiatives in India.

Block 2: Application of ICTs in Extension and Advisory Services

Unit 1: ICT Applications

Knowledge centres (tele centres), digital kiosks, websites and web portals, community radio, farmers call centres, mobile phone based advisory services and mobile applications (mExtension, mLearning), Self-learning CDs on Package of practices, social media, digital videos, Market Intelligence and Information Systems-ICT enabled Supply-Chains and Value-Chains/e-Marketing (e-NAM, AGMARKNET, *etc*.).

Unit 2: ICT Expert Systems

Expert System/ Decision Support System/ Management Information Systems, Farm Health Management & Intelligence System for Plant Health, Animal Health, Soil Health, Fishery, Water, Weather, etc.

Unit 3: ICT Networks

Global and regional knowledge networks, international information management systems, e- Learning platforms (MOOCS, Course CCRA, EduEx, *etc*), e-Governance Systems; digital networks among extension personnel, Farmer Producers Organisations (FPOs)/SHGs/Farmers Groups.

Block 3: Knowledge Management and Standards

Unit 1: Policies in Knowledge Management

Global policy/ Standards on e-Governance, National policy on e-governance, Open Data / Open Gov Standards and Open Source etc; Language Technology Applications; National e-Agriculture policy/Strategies/ guidelines.

Unit 2: Web Standards

Web standards, creating and writing for web-portals, development of mobile applications, developing digital videos- story board- video recording- video editing, types of blogs and writing guidelines.

Unit 3: Social Media Applications to engage audience

Video conference, live streaming and webinars, types and functions of social media applications, guidelines for preparing social media content, engaging audience and data-analytics.

Block 4: Smart and Disruptive Technologies and Advanced Analytics for Agricultural Extension

Unit 1: Smart Technologies

Open technology computing facilities, System for data analytics/ mining/ modelling/ Development of Agricultural simulations; Remote Sensing, GIS, GPS, Information Utility (AIU); disruptive technologies- Analysis; Internet of Things (IoTs), Drones, Artificial intelligence (AI), block chain technology, social media and Big Data analytics for extension.

Unit 2: Human Computer Interactions

Human Centered Learning/Ergonomics/ Human Computer Interactions-Meaning; Theories of multimedia learning - Sweller's cognitive load theory, Mayer's cognitive theory of multimedia learning, Schnotz's integrative model of text and picture comprehension, van Merriënboer's four component instructional design model for multimedia learning; Basic Principles of Multimedia Learning - Split-attention, Modality, Redundancy, Coherence, Signalling, segmenting, pre-training, personalisation, voice embodiment; Advanced principles - Guided discovery, worked examples, Self-explanation, drawing, feedback, multiple representation, Learner control, animation, collaboration, prior knowledge, and working memory. Designing ICT gadgets based on human interaction principles - Interactive design-Meaning, importance; Approaches of interactive design - user-centered design, activity- centered design, systems design, and genius design; Methods of interactive design - Usability testing methods.

Practical

• Content and client engagement analysis

• Designing extension content for ICTs

• Creating and designing web portals, blogs, social media pages

• Developing digital videos

• Live streaming extension programmes and organising webinars

• Working with Farmers call centres

• Engaging with professional digital networks

• Writing for digital media

C. Supporting Courses

Course Title : **Statistical Methods for Applied Sciences**

Course Code : **STAT-502**

Credit Hours : **3 (2+1)**

Aim of the course

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

Unit I

Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation.

Unit II

Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their application. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

Unit III

Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.

Unit IV

Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test.

Unit V

Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

Practical

- Exploratory data analysis, fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal.
- Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F.
- Confidence interval estimation and Correlation and regression analysis, fitting of Linear and Quadratic Model.
- Non-parametric tests. ANOVA: One way, Two Way, SRS.

Course Title	**: Basic Sampling Techniques**
Course Code	**: STAT-512**
Credit Hours	**: 3 (2+1)**

Aim of the course

This course is meant for students of agricultural and animal sciences other than Statistics. The students would be exposed to elementary sampling techniques. It would help them in understanding the concepts involved in planning and designing their surveys, presentation of survey data analysis of survey data and presentation of results. This course would be especially important to the students of social sciences.

Theory

Unit I

Concept of sampling, sample survey vs complete enumeration, planning of sample survey, sampling from a finite population.

Unit II

Simple random sampling with and without replacement, sampling for proportion, determination of sample size, inverse sampling, stratified sampling.

Unit III

Cluster sampling, multi-stage sampling, systematic sampling; Introduction to PPS sampling,

Unit IV

Use of auxiliary information at estimation, Ratio product and regression estimators. Double Sampling, sampling and non-sampling errors.

Practical

• Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.;

• Simple random sampling, determination of sample size, inverse sampling, stratified sampling, cluster sampling and systematic sampling;

• Estimation using ratio and regression estimators;

• Estimation using multistage design, double sampling.

Suggested Reading

- Cochran WG. 1977. Sampling Techniques. John Wiley.
- Murthy MN. 1977. Sampling Theory and Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
- Singh D, Singh P and Kumar P. 1982. Handbook on Sampling Methods. IASRI Publ.
- Sukhatme PV, Sukhatme BV, Sukhatme S and Asok C. 1984. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.
- Cochran WG. 2007. Sampling Techniques, 3rd Edition. John Wiley & Sons Publication.

D. Common Courses for PG programmes

Course Title   : **Library and Information Services**

Course Code   : **PGS 501**

Credit Hours   : **1(0+1)**

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; resources access methods.

Course Title   : **Technical Writing and Communications Skills**

Course Code   : **PGS 502**

Credit Hours   : **1(0+1)**

Objective

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical (Technical Writing)

• Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;

• Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);

• Writing of abstracts, summaries, précis, citations, etc.

• Commonly used abbreviations in the theses and research communications;

• Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;

• Writing of numbers and dates in scientific write-ups;

• Editing and proof-reading;

• Writing of a review article;

• Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);

• Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;

• Accentual pattern: Weak forms in connected speech;

• Participation in group discussion;

• Facing an interview;

• Presentation of scientific papers.

Suggested Readings

- Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Richard WS. 1969. Technical Writing.
- Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

Course Title	**: Intellectual Property and its Management in Agriculture**
Course Code	**: PGS 503**
Credit Hours	**: 1(1+0)**

Objective

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

- Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.

The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

Course Title   : **Basic Concepts in Laboratory Techniques**

Course Code   : **PGS 504**

Credit Hours   : **1(0+1)**

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

• Safety measures while in Lab;

• Handling of chemical substances;

• Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets;

• Washing, drying and sterilization of glassware;

• Drying of solvents/ chemicals;

• Weighing and preparation of solutions of different strengths and their dilution;

• Handling techniques of solutions;

• Preparation of different agro-chemical doses in field and pot applications;

• Preparation of solutions of acids;

• Neutralisation of acid and bases;

• Preparation of buffers of different strengths and pH values;

• Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;

• Electric wiring and earthing;

• Preparation of media and methods of sterilization;

- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Course Title   : Agricultural Research, Research Ethics and Rural Development Programmes

Course Code   : PGS 505

Credit Hours   : 1(1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Suggested Readings

- Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.

- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

E. Seminar

Course Title : **Master's Seminar**

Course Code : **AEC 591**

Credit Hours : **1(0+1)**

Mandatory requirement of seminars

• It has been agreed to have mandatory seminars one in Masters (One Credit).

• The students should be encouraged to make presentations on the latest developments and literature in the area of research topic. This will provide training to the students on preparation for seminar, organizing the work, critical analysis of data and presentation skills.

F. Master's Research *(Thesis)*

Course Title : **Masters' Research** *(Thesis)*

Course Code : **AEC 599**

Credit Hours : **30(0+30)**

<div align="center">OR</div>

Course Title : **Research Methodology** *(Special Paper)*

Course Code : **AEC 599**

Credit Hours : **30(30+0)**

Research Methodology (*Special Paper*: Research Methods and Techniques in Agricultural Economics)

UNIT I: Importance and scope of research in agricultural economics, types of research, fundamental vs. applied research, concept of researchable problem, research prioritization, selection of research problem, approach to research, research process, research design and techniques, types of research design, review of literature.

UNIT II: Sampling theory and sampling design, sampling error, methods of sampling, probability and non-probability sampling methods, hypothesis meaning, characteristics and its types, setting of hypotheses, testing of hypothesis.

UNIT III: Criteria to choose project proposals, contents and scope of different types of projects to meet different needs, trade-off between scope and cost of the study, identification, selection and formulation of agricultural project or case study of any agricultural enterprises' unit, ex-post and ex-ante appraisal, and basic data requirement, discounted and undiscounted measures of project, SWOT analysis, preparation of scientific reports and presentation.

UNIT IV: Visit to regulated market to study various marketing functions performed by different marketing agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report.

UNIT V: Visit to NAFED or cooperative marketing society and analysis of its performance with the help of secondary data by using analytical tools and techniques.