The curriculum of Ph.D. Program will be constituted of 3 parts. Part A will have Research Methodology*, Review of Literature, Computer Applications and Research and Publication Ethics (RPE) to be taken by every Ph.D. candidate irrespective of the discipline under which he/she is registered. **Part B** is Electives from the specific discipline under which he/she is registered. Candidate can choose **any two** from part B. **Part C** is Dissertation to be taken by every Ph.D candidate under his / her specific discipline.
*PHDA101 for Management, Social Sciences, Arts; PHDAE101 for Engineering& Computer Applications; PHDAS101for Sciences & Maths

A. Syllabi of Common Courses
B. Syllabi of the Advanced/ Elective Courses
C. Dissertation

Sr. No.	Course	Course Code	Credit Hours
A.1.	**Research Methodology**	**PHDA101, PHDAE101 PHDAS101**	**3.0**
A.2.	**Review of Literature**	**PHDA102**	**2.0**
A.3.	**Computer Applications**	**PHDA103**	**2.0**
A.4.	**Research and Publication Ethics (RPE)**	**PHDA104**	**2.0**
B.1.	**Area Specific 1**		**2.0**
B.2.	**Area Specific 2**		**2.0**
C.1.	**Dissertation**		**3.0**

A.1.Research Methodology (PHDA101)

Course Overview: *The course has been designed to enable the students irrespective of their discipline in developing the most appropriate methodology for their research studies and to make them familiar with the art of using different research methods and techniques.*

Examination Scheme:

The faculty member will award internal marks out of 40 based on the assignments and minor project. The end semester examination will be worth 60 marks .There will be 8 questions out of which students will have to answer 5 questions.

Course contents

Module 1: Introduction to Research Methods: Role and objectives of business research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design. Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling , Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Review of statistical tools/methods for business research – for univariate and bivariate analysis. Significance of correlation coefficient, significance of regression coefficient. Simple Concept of Probability and Theoretical Frequency Distribution, (Binomial, Normal & Poisson). Hypothesis and Hypothesis testing Parametric & non-parametric tests, introduction to sample tests for univariate and bivariate analysis using normal distribution, f-test, t-test, z-test, , chi-square test. Interpretations and Report Writing: Meaning of interpretation, techniques of Interpretation, precautions in interpretation, significance of report writing, steps in report writing, layout of report and precautions in writing research reports.

Reference Books:

- Bryman, Allan and Bell Emma **(2003). Business Research Methods.** Noida: Oxford.
- Kerlinger Fred. N.(2002). **Foundations of Behavioral Research.** USA: Holt and Rinehalt.
- Kothari, C. R. (2004). **Research Methodology: Methods and Techniques**.New Delhi:New Age International
- Murthy, S. N. and Bhojanna,U.(2008). **Business Research Methods.** New Delhi: Excel
- Sekaran, Uma(2006). **Research Methods for Business: A Skill Building Approach**. New Delhi: John Wiley& Sons.

A 1.Research Methodology (PHDAE101)

Module 1: Introduction to Research Methods: Role and objectives of business research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design.Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in

measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling , Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Probability Theory inresearch: General concepts of probability theory, Discrete and continuous random variables,Differentprobability distributions, Introduction to discrete time Markov chainand continuous timeMai'kov chain. Hypothesis formulation and Testing: Null &Research.ParametricTests.RegressionAnalysis.Simulation inresearch;Meaning of Simulation, Need of simulation. Appropriateness of simulation, Its advantagesanddisadvantages.Itsapplicationsinengineering, Simulationofqueuingsystems.

References

- Bryman, Allan and Bell Emma **(2003). Business Research Methods.** Noida: Oxford.
- Kothari, C. R. (2004). **Research Methodology: Methods and Techniques**.New Delhi:New Age International
- Banks,J.; Carson, J.C. Nelson, B. L.; Nicol,D.M.(2006). **Discrete Event System Simulation.** New Delhi:Prentice Hall .
- Trivedi,R.S.(2002).**Probability and Statistics with Reliability, Queuing and ComputerScienceApplications.** New York:JohnWiely
- Krishanaswamy,K.N.Sivakumar,AppaIyer andMathiranjanM. (2006).**ManagementResearchMethodology: Integration of Principles, Methodsand Techniques.**NewDelhi: Pearson Education

A1.Research Methodology (PHDAS101)

Module 1: Introduction to Research Methods: Role and objectives of research, types of research and various research design (exploratory, descriptive, experimental and diagnostic research), research process: Overview, Problems encountered by researcher. Experimental research design will comprise of Completely Randomized Design, Latin Square Design and Factorial Design.Limitations of RM: Ethics in Research, Philosophical issues in Research.

Module 2: Data and their Collection: Collection, Organization, Presentation, Analysis and Interrelation of Primary and Secondary Data. Measurement in research, measurement scales, sources of errors in measurement, Techniques of developing measurement tools, classification and testing (reliability, verification and validity) scales, Designing questionnaires and interviews Sampling , Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions : Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors.

Module 3: Numerical Methods and Statistical Analysis Curve fitting (least square), solution of polynomial equation, numerical integration (Trapezoidal rule, Simpson's rule, Gaussian qudrature), solution of ordinary differential equations (Euler's method, Runge-Kutta method, predictor-corrector method), matrix multiplication, inversion and diagonalisation.

References

- Kumar,R.(2006).**Research Methodology-A Step- By- Step Guide for Beginners**,Delhi: Pearson Education.
- Montgomery, D. C. (2007).**Design & Analysis of Experiments**. India: Wiley.
- Kothari, C. R. (2004). **Research Methodology: Methods and Techniques**.New

Delhi:New Age International

A.2.Review of Literature (PHDA102)

Course Overview:*The objective of this course is to help the candidate to comprehend his/her broad field of research and be academically sound to carry out his research work. Understand the basic philosophical assumptions underlying research literature reviews for different purposes, including what, why, when, for whom, and how? Be able to manage the process of conducting a literature review, including reading, note taking strategies, coding/reference management, synthesizing and writing literature results. Be able to write a quality literature review with variations in references*

Examination Scheme:

The candidate is required to write a Review paper based on the review of literature on his/her area of research in consultation with his supervisor. The paper has to be evaluated and approved by the panel constituted by Faculty of Doctoral studies and Research besides the assignments.

Course Content

Module 1: **Understanding Review of literature:** Relevance, Approach and Applications; Developing an outline for the literature review; Formulate key questions for a review. Organizing a literature search**:** Identify which literature bases to search; Developing the theoretical basis for the Research Question; Searching for, locating and organizing relevant professional literature

Module 2: **Conducting the Review:** Abstract relevant information from appropriate studies in a systematic manner; critically reviewing the literature; Rate the scientific quality of each study and the level of evidence for each question;

Module 3: **Synthesizing the Review:** Create evidence tables and summary tables; interpret the pattern of evidence interms of strength and consistency; Summarize the studies' findings.Writing the review: Writing a first draft; Writing references and citations; Obtaining, giving, and making productive use of feedback; the redrafting process; Professional formatting.

A.3.Computer Applications (PHDA103)

Course Overview: *The candidate should gain sufficient practical knowledge for use of computer and computer software for use in research work.*

Examination Scheme:

The faculty member will award internal marks out of 40 based on the assignments and minor project.The end semester examination will be 60 marks with weightage of (online exams 40% + practical 60%)

Contents

Module 1: Basic knowledge of application software's in MS- Office with focus on MS-Word- its features and applications related to presentation of text in decent format and saving the same for further use. The practical knowledge of this software should enable the candidate to type and prepare the thesis in a presentable format.MS-Excel- construction of worksheet and inserting data according to its characteristics, use of statistical tools and their presentation in the form of charts and graphs.

Module 2: Use of Internet for research work and exploring various websites and search engines for collecting quality literature review and secondary data etc. related to thesis work.

Module 3: MS- Power point – create power point presentation on a topic related to the theme of thesis and use of different presentation techniques. Use of SPSS – method of preparing data sheet and entering data according to its characteristics , use of various statistical tools on SPSS.

A.4. Research and Publication Ethics (RPE) (PHDA104)

Module 1: Philosophy And Ethics-Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.
Scientific Conduct- Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP).Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data

Module 2: Publication Ethics-Publication ethics: Definition, introduction and importance.
Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.Conflicts of interest.
Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals.
Open Access Publishing- Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies. Software tool to identify predatory publications developed by SPPU. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

Module 3: Publication Misconduct, Group Discussions-Subject specific ethical issues, FFP, authorship. Conflicts of interest. Complaints and appeals: examples and fraud from India and abroad. Software tools- Use of plagiarism software like **Tumitin, Urkund And Other Open Source Software Tools. Data Bases And Research Metrics,** Databases- Indexing databases Citation databases: Web of Science, Scopus, etc.Research Metrics- Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score. Metrics: h-index, g index, i10 index, altmetrics

- **The/Elective courses in Management are categorized under four Broad Areas.**

    1. **OB and HR Area**
    2. **Marketing Area**
    3. **Finance Area**
    4. **Operations Area**

	Management		
Sr. No.	**Course**	**Course Code**	**Credit Hours**
B.1.	**Organizational Behaviour**	**PHDHR101**	**2.0**
B.2.	**Strategic Human Resource Management**	**PHDHR102**	**2.0**
B.3.	**International Human Resource Management**	**PHDHR103**	**2.0**
Sr. No.	**Course**	**Course Code**	**Credit Hours**
B.4.	**Consumer Behaviour**	**PHDMM201**	**2.0**
B.5.	**Integrated Marketing Communication**	**PHDMM202**	**2.0**
B.6.	**Sales and Distribution Management**	**PHDMM203**	**2.0**
Sr. No.	**Course**	**Course Code**	**Credit Hours**
B.7.	**Strategic Financial Management**	**PHDFM301**	**2.0**
B.8.	**Financial Risk Management**	**PHDFM302**	**2.0**
B.9.	**Dynamics of Financial Planning**	**PHDFM303**	**2.0**
Sr. No.	**Course**	**Course Code**	**Credit Hours**
B.10.	**Service Operations Management**	**PHDOR401**	**2.0**
B.11.	**Supply Chain Management**	**PHDOR402**	**2.0**
B.12.	**Project Management**	**PHDOR403**	**2.0**
C.1.	**Dissertation**		**3.0**

B.1.HUMAN RESOURCE MANAGEMENT/ORGANIZATIONAL BEHAVIOUR AREA

Organizational Behaviour (PHDHR101)

Course Overview:*The course is designed to help the students to understand that organizational effectiveness is more than the sum of the individual and group effectiveness. Through synergistic effects, organizations obtain higher levels of effectiveness than sum of their parts. Managerial process is inherently a human process-people relating to people which establishes the importance of understanding human behaviour in the workplace. The focus of this course is on the characteristics common to all organizations: the behaviour of individuals, groups and the processes that give viability to organizations*

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Course contents

Module1. Introduction to Organizational Behavior: Globalization, Diversity and Ethics; Cognitive processes of individual behavior: Personality, Perception, Attitudes, Motivation and its application.

Module2. Managing and Leading For High Performance: Johari Window, Positive Organizational Behavior and Psychological Capital. Dynamics of Group behavior: Groups and Teams, Communication, Transactional Analysis, FIRO-B, Leadership, Power and Politics, Stress and Conflict.

Module3. Organizational Context: Organizational Structure and Design, Learning Organizations Organizational Culture, Change Management.

Reference Books

- Don Hellriegel and John W. Slocum,Jr.(2004). **Organizational Behavior.**India: Thompson
- James L. Gibson. John M.Ivancevich(2006) **Organizations.** Singapore: McGraw- Hill
- Jerald Greenberg and Robert A. Baron (2008). **Behavior in Organizations**. New Delhi: Pearson Prentice Hall
- Luthans, Fred (2011). Organizational Behaviour: Evidence- Based Approach. Singapore: McGraw Hill.
- Stephen P. Robbins & Timothy Judge (2010)**. Essentials of Human Behavior.** New Delhi:Pearson Education

B.2. Strategic Human Resource Management (PHDHR102)

Course Overview: *The course aims at developing an understanding of how the human resource management function can become a strategic partner in organization and business management. It would help to learn to define the deliverables of a strategically aligned human resource function in organizations and give an exposure to research in the field of strategic human resource management practices.*

Course Contents

Module 1: Understanding the Human Resource Management Function. Understanding the Human Resource Management Roles, Strategy and Human Resource Management. Strategic Human Resource Management, Organization Environments, Organizational Effectiveness, Work Design.

Module 2: Building Organizational Capability through People, Strategic Performance Management, Aligning Compensation Strategy and Business Strategy, Strategic Compensation Designs, Employee Relationship Management, HR Systems and Organization Performance.

Module 3: Human Resource Strategy for a Competitive Advantage, Human Resource Strategy in the Global Economy, Human Resource Strategy for the Service Sector, Human Resource Strategy in the Knowledge Society, Monitoring Performance of the HRM Function, Measuring the performance of HRM.

Reference Books:

- Armstrong Michael and Baron Angel (2005), Handbook of Strategic Human Resource Management : The Key to Improved Business Performance, Mumbai: Jaico Publishing House (AB)
- Boxall Peter & Purcell John (2 ed.) (2008), **Strategy and Human Resource Management**, New York :Palgrave Macmillan, (BP)
- Hall Richard H. (1999), Organisations – Structures, Processes and Outcomes, 7th Edition, New Delhi: Pearson Eduction Asia (HR)
- Hatch Mary Jo &Cunliffe Ann L. (2006), Organization Theory – modern, symbolic and post modern perspectives, 2nd Edition, Mumbai: Oxford University Press, (HC)
- Jeffry Mello A. (2001), Strategic Human Resource Management, New Delhi: Cengage Learning. (JM)
- Schuler Randall S. and Jackson Susan E. (1999), Strategic Human Resource Management, 2nd Edition,New York : Blackwell Publishing (JS)
- Schuler Randall S. and Jackson Susan E. (2007), Strategic Human Resource Management, 2nd Edition, New York: Black well Publishing (SJ).

B.3. International Human Resource Management (PHDHR103)

Course Overview: *The course is designed to make the students understand International HRM strategies and the trends and challenges in global work environment. The purpose of the course is to help the students to develop skills to work effectively in cross cultural environment, handle international assignments and find a place in global context.*

Course Contents:

Module 1.Introduction to International HRM;Difference between Domestic and International HRM Development of the International Business and Strategic HRM; Global Staffing; Dual Career Couples; Performance Management; Appraisal of HCN Employees

Module 2. Training and Development; International Compensation and Benefits; Repatriation; Union and Employee Relations for Multinational Firms; Organizational Dynamics and IHRM; Understanding Different Cultures, Cultural Diversity

Module3. HRM in International Joint Ventures; Managing Across Cultural Differences; Expatriate Management, Female Expatriates; Re-entry (Repatriation) & Career Issues;HRM Practices In other Countries; Issues, Challenges & Developments in International HRM.

Reference Books:

- Bhatia S.K. (2005), International Human Resource Management: A Global Perspective (1st edition), New Delhi: Deep and Deep Publications Pvt. Ltd.
- Briscoe Dennis R. and Schuler Randall S. (2004), International Human Resource Management (2nd Edition), New York: Routledge
- Dowling Peter J. and Welch Denice E. (2006), International Human Resource Management (4th Edition), New Delhi: Cengage Learning
- Gupta S.C. (2007), Text Book of International HRM (1st Edition), New Delhi: Macmillan India Ltd

- Harzing Anne-Wil and Ruysseveldt (2004), International Human Resource Management (2nd Edition), New Delhi: SAGE Publications Inc.
- Mendenhall Mark E., Oddou Gary R. and Stahl Gunter K. (2007), Readings and Cases in International Human Resource management (4th Edition), Noida: Routledge
- SenguptaNilanjana and Bhattacharya Mousumi (2007), International Human Resource Management (1st Edition), New Delhi: Excel Books
- **Web Resources**: www.kwintessential.co.uk, www.workforce.com, www.hrmguide.com, www.hrmreport.com, www.collegerecruiting.comwww.globaltrainingsystems.com, www.sourcingmag.com, www.pathlore.com

MARKETING AREA

B.1. Consumer Behavior (PHDMM201)

Course Overview: *The objective of this course is to familiarize the students with behavioral aspects of Consumer. The course aims to develop sound knowledge of various determinants of consumer behavior and buying process. To help participants understand the internal forces, external influences and processes that go on to affect consumer behavior, the challenges generated for the marketers and the strategies which could be implemented.*

Course Contents:

Module1:Scope and applications of Consumer Research. Culture, Subcultures, Social Class, Reference Group and Family Influences. Personal Influences and Diffusion of Innovation

Module2: Consumer Motivation, Personality Traits, and Consumer Perceptions; Theories of Consumer Learning, Consumer Attitude Formation and Change, Consumer Decision Making Process.

Module3: Customer Relationship Management – Customer Life Time Value, Customer Acquisition Development and Retention, Brand and Customer Equity.

Reference Books

- Evans,Martin (2009).**Consumer Behavior.**Wiley Indian Edition

- Hawkins,Delbert I ;Best, Roger J. and Coney, Kenneth(2003). **Consumer Behavior**. New Delhi :Tata McGraw-Hill
- Loudon, David L.&Bitta, Albert J. Della (1993).**ConsumerBehaviour.** New Delhi:Tata McGraw-Hill
- *Peter*,J. Paul *Olson*,Jerry C.(2008).**Consumer Behavior &Marketing Strategy.** New Delhi:TataMcGraw-Hill
- Majumdar, Ramanuj(2010).**Consumer Behavior: Insights from Indian Markets**.NewDelhi:PHI
- Schiffman, Leon and Kanuk, Leslie (2014).**Consumer Behavior.** New Delhi: Pearson Education

List of Journals/Periodicals/ Magazines/ Newspapers: Journal of Consumer behavior, Journal of Advertising (JOA), Journal of Advertising Research, Pitch, Brand reporter, Advertising express, USP age

The list of cases and specific references including recent articles and a detailed teaching plan will be announced at the beginning of the course.

B.2. Integrated Marketing Communication (PHDMM202)

Course Overview: *The objective of this course is to help students to learn various components of Integrated Marketing Communication and effectiveness of various communication disciplines like Advertising, Sales Promotion, Public Relations and Publicity, Personal Selling, Direct and Interactive Marketing, Events and Experiences*.

Course Contents:

Module 1: Integrated Marketing Communications- Objectives, Components and Effectiveness Communication Process, Integrated Marketing Communication (IMC) Components (Promotion Mix), IMC Planning Process, Communication Objectives and Budgeting.

Module2: Direct Marketing, Internet Marketing, Role of Events and Experiential Marketing, Ethical, Social and Legal Issues In IMC.

Module3: Media Strategies- Planning and Implementation, Message Strategies- Creative Strategy Planning, Development and Implementation. Evaluating Effectiveness of Marketing Communication.

Reference Books

- *Aaker*,David;A;*Batra*,Rajeevand*Myers*,John .(1992).**AdvertisingManagement.**Prentice hall.
- Belch,George;Belch, Michael &Purani,Keyoor(2013).**Advertising & Promotion-**

AnIntegrated Marketing Communications Perspective. New Delhi:Tata McGraw-Hill

- Clow,Kennethand Baack,Donald (2014).**Integrated Advertising, Promotion, and Marketing Communication.**New Delhi:Pearson
- Shah,Kruti and D'Souza,Alan(2008).**Advertising & Promotions: An IMC perspective**. New Delhi:Tata McGraw Hill
- Semenik RichardJ.(2001).**Promotion and Integrated Marketing Communications.** Thomson
- Terence A Shimp(2009).**Advertising and Promotion: An IMC Approach.**Thomson
- Thomas O'Guinn,Allen and Semenik**(2010).AdvertisingManagement- withIntegrated BrandPromotion.**New Delhi:CengageLearning

List of Journals/Periodicals/ Magazines/ Newspapers: Journal of Consumer behavior, Journal of Advertising (JOA), Journal of Advertising Research, Pitch, Brand reporter,
The list of cases and specific references including recent articles and a detailed teaching plan will be announced at the beginning of the course.

B.3.Sales and Distribution Management (PHDMM 203)

Course Overview: *The objective of this course is to help students understand the Sales & Distribution function and its role in overall Marketing Function. The concepts, models and techniques covered in the course will help participants become adapt at Sales and Distribution function and improve their Personal Selling Skills*.

Course Contents:

Module 1: Analyzing Market Demand and Sales Potential, Techniques of Sales Forecasting, Preparation of Sales Budget, Formulating Selling Strategies, Designing Sales Territories and Sales Quota**.**

Module 2: Sales Force Management, Organizing the Sales Force, Designing the Structure and Size of Sales Force, Recruitment and Selection of Sales Force, Leading and Motivating the Sales Force, Sales Force Training and Compensation, Sales Incentives and Review of Performance.

Module 3: Choice of Distribution Channels, Channel Structure, Channel Conflict and their Resolutions. Vendor Relationship Management, e-Retailing.

Reference Books

- Anne T. Coughlan, Erin Anderson,Louis W. Stern, Adel I El Ansary, R. C. Natarajan**Marketing Channels.**New Delhi: Pearson Education
- Donaldson B **Sales Management: Theory and Practice** Palgrave
- Jobber David and Lancaster Geoff **Selling and Sales Management** Pearson Education
- Krishna K. Havaldar,Vasant M. Cavale. **Sales & DistributionManagement.** New Delhi:Tata McGraw-Hill
- Panda Tapan K.,Sahadev Sunil **Sales &DistributionManagement.** Mumbai**:**Oxford
- Rosenbloom **Marketing Channels.** New Delhi:Cengage Learning
- Spiro **Sales Force Management.** New Delhi:Tata Mc Graw Hill
- Still Richard R, Cundiff Edward W. and Govoni Norman A. P.**Sales Management: Decisions, Strategies and Cases.** New Delhi:Pearson Education

List of Journals/Periodicals/ Magazines/ Newspapers: Professional selling, Journal of Personal Selling & Sales Mgmt., Journal of Marketing Channels, Journal of Supply Chain Mgmt., International Journal of Retail and Distribution Mgmt. etc.

The list of cases and specific references including recent articles and a detailed teaching plan will be announced at the beginning of the course.

FINANCE AREA

B.1. Strategic Financial Management (PHDFM301)

Course Overview: *This elective module is designed specifically to consider corporate strategic investment decisions and the underlying financial management issues relevant to these decisions. The module will focus on the allocation of funds within the business and the financial appraisal techniques used in evaluating strategic options. The financing of investment opportunities will then be considered and particular attention will be paid to sources of funds, the cost of those funds and alternative financing strategies. The module will be considered within the context of adding shareholder value.*

Course Contents

Module 1: Shareholder'sValue: Overview: Financial and Non-Financial Objectives of a Firm, Conflicts of Interest in a Firm, Long term and Short term Financial Planning in a Company. Corporate Valuation: Interface of Financial Policy and Strategic Management, Shareholder's Value Creation Value drivers,Financial Strategy for Capital Structure, Capital Structure Planning & Decision Making.

Module 2: Strategic Decision Making Framework: Overview, Investment Decision, Long Term Projects: Valuation of long term infrastructure, capital intensive Projects, Dividend Policy & Value Of

The Firm, Dividend Policy & Valuation of Firms Dividend Policies in Practice, Stability, Residual Payment, Lease financing & Hire Purchase, Financial evaluation of leasing, Economics/pros and cons of leasing,

Module 3: Restructuring: Overview, Objectives, Financial Engineering, Corporate Engineering, Mergers, Merger strategy, Acquisitions, Valuation under mergers and acquisition, Take over strategy, Takeover code- procedure for takeover, Takeover defense, Takeovers, 'MBO' Management buyout.

Reference Books

- Chandra, Prasanna(2004).Financial Management Theory &Practice, 6e . New Delhi:TataMcGrawHill.
- Damodaran, Aswath(2004).Strategic Risk Management . New York:John Wiley and Sons
- Landermann, Earl(2008).Corporate Financial Management – Strategies for Maximising Shareholders Wealth New York: John Willey & Sons
- Richard A / Myers, Stewart C.(2008).Principle of Corporate Finance, 5e .New Delhi: Tata McGraw Hill.

B.2.Financial Risk Management (PHDFM302)

Course Overview: *To develop expert knowledge on risk management in financial services.*

Course Contents

Module 1: Risk Management in Financial Services: Introduction: Uncertainty & risk, Types of risk, Implications of various risks for the firm, Managing Risk, limitations of risk management. Value at Risk, Concept and Applications, JP Morgan's Risk Metrics Methodology for measuring market Risk, Computing value at risk for forex common shares/stocks/fixed income securities etc. estimating value at risk in ALM.Corporate Risk Management: Total risk and Expected cash flows, Approaches to risk management, Risk Management process, Hedging, forwards, and futures, options and swaps and Hybrids; and Risk management in practice.

Module 2: Derivatives: Exchanges the Mechanics of derivative markets, the role of clearing houses, market players and trading techniques, .Futures: The fundamentals of futures contract; Overview, Types of futures, Mechanics of future trading, Major characteristics, Exchange organization, Trading process, Price quotations, Hedging and Speculation with Commodity futures, Interest rate futures, Currency futures and Stock Index futures. Optimal hedge ratio, Pricing of Index Futures Contracts,

Stock Index Arbitrage, Applications of Index Futures and Beta Management. Options: Overview, Generic options, factors affecting option prices, Types of options; Interest rate options, Currency options and Trading strategies, Option pricing models, Options on futures contracts and Exotic options

Module 3: Use of Derivatives in Investment: Elementary Investment Strategies, Complex Investment Strategies, Covered Call Writing, Protective Put, Straddles and Strangles, Spreads, Evaluation of Option Based Investment Strategies, Risk Associated with Options, Options Sensitivities Swaps: Evolution of swap market, Swap terminology and structures of standard coupon and currency swaps, Motivations underlying swaps; Types of swaps,Mechanics of swap transactions, Valuation and Application of swaps.Credit Derivatives : Evolution , need for credit derivatives, Types credit default based, repackaged notes, total return swaps, and risks involved Weather Derivatives: Concept, Application in real life and recent developments.

Reference Books

- Edwards,Franklin R / M, Cindy W.**Futures and Options.**New Delhi:McGrawHill
- John C.**Introduction to Futures & Options.** Hull: Prentice Hall Options and Futures
- Kolb, Robert W. **Understanding Options.** John Wiley & Sons Inc.,
- Redhed, Keith.**Financial Derivatives.** New Delhi: Prentice Hall India

B.3. Dynamics of Financial Planning (PHDFM303)

B.3. Dynamics of Financial Planning (PHDFM303)

Course Objective: *To develop insights in the new age financial planning process at personal level.*

Course Contents

Module 1: Financial Planning: Introduction to the Financial Planning, Financial Planning Process, Life Cycle Planning, Personal Financial Statements and Budgeting, Emergency Fund Planning, Credit and Debt Management Buying vs. Leasing.

Module 2: Investment avenues and Tax consequences: Introduction to Fixed Income Securities, Formula Investing and Investment Strategies, Asset allocation and portfolio diversification, Efficient Market Theory (EMT), Tax consequences of Sale of Assets-, Short- and Long-term Capital Gain Tax.

Module 3: Personal Financial Planning: Retirement Planning and Employee Benefits: Retirement needs analysis, Social Security, Medicare, Types of retirement plans, Investment considerations for retirement plans, Employee benefit plans, Employee stock options, Estate Planning: Methods of property transfer at death, strategies, Gift taxation and compliance, Inflationary considerations on investment strategy.

Reference Books:

- Mohapatra, R.K. (2016) ***Retirement Planning. Publisher: A Simple Guide for Individuals***: Kindle Edition.
- Gorman, E. & Raymond, F. (2012). ***Personal Finance.*** Publisher: Southwest-Western Cengage Learning.
- The course will be covered by referring to web-based materials, journals, magazines, research papers and varied sources.

The course will be covered by referring to web-based materials, journals, magazines, research papers and varied sources.

OPERATIONS AREA

B.1. Service Operations Management (PHDOR401)

Course Overview: *The course is designed to give the students understanding about the tools and techniques to manage operations of service organizations.*

Course Contents

Module 1: Service Strategy: the strategic service concept, classifying services for strategic insights,

competitive service strategies; The service delivery system**:** service blueprinting, strategic positioning through process structure, generic approaches to service system design.

Module 2:The Supporting Facility: Design, Layout, process flowcharting, Walk Through-Audit; The service encounter: the service encounter triad- Encounter Dominated by the Service Organization, Contact Personnel-Dominated Encounter, Customer-Dominated Encounter, the service profit chain; Service facility location**:** location considerations, facility location techniques, breaking the rules-competitive clustering, saturation marketing, intermediaries, transportation.

Module 3:Service Quality: defining service quality, measuring service quality- SERVQUAL, quality service by design, Taguchi methods, Poka Yoke, quality function deployment; achieving service quality- cost of quality, tools for achieving service quality; programs for service quality assurance-zero defects, Deming's 14 point program, Malcolm Baldrige quality award, Productivity and quality improvement: Making continual improvement a competitive strategy, Data envelopment analysis: measuring service productivity, The DEA model- definition of variables, objective function, constraints, DEA and strategic planning.

Reference Books:

- Cengiz Haksever, Barry Render, Roberta S Russell and Robert G Mudrick. **Service Management and Operations.** New Delhi: Pearson Education
- James A Fitzsimmons and Mona J Fitzsimmons. **Service Management.**NewDelhi:McGraw Hill.
- Richard Metters, Kathryn KingMatters and Madeleine Pullman. **Service Operations Management.**Thompson-South

B.2. Supply Chain Management (PHDOR402)

Course Overview: *This course introduces the concept of logistics, models for planning inventory and transportation, models for managing uncertainty, management of logistics across different companies, and applications of supply chain management in different kinds of industries. This course provides an integrated view of purchasing, production, distribution and logistics function.*

Course Contents

Module 1:Introduction: What is Supply Chain Management – Global Optimization –Key Issues in Supply Chain Management- Supply Chain Performance- Achieving Strategic Fit; **Logistics Network**

Configuration: Data Collection – Data Aggregation – Transportation Rates – Mileage Estimation – Warehouse Costs – Warehouse Capacities – Potential Warehouse Locations – Service Level Requirements – Future Demand – Model and Data Validation –Solution Techniques

Module 2: Inventory Management and Risk Pooling: Single Warehouse Inventory– The Economic Lot Size Model – The Effect of Demand Uncertainty – Supply Contracts – Multiple Order Opportunities – Continuous Review Policy – Variable Lead Times – Periodic Review Policy – Risk Pooling – Centralized Versus Decentralized Systems –Forecasting Techniques. The Value of Information: The Bullwhip Effect – Quantifying the Bullwhip Effect – Methods for Coping with the Bullwhip Effect - Information and Supply Chain Trade-offs

Module 3: Supply Chain Integration: Push, Pull and Push-Pull Systems –The Impact of the Internet on Supply Chain Strategies –Distribution Strategies – Direct Shipment – Cross-Docking Transshipment – Centralized Versus Decentralized Control – Central Versus Local Facilities. International Issues in Supply Chain Management**:** Global Market Forces – Technological Forces – Global Cost Forces – Political and Economic Forces – Risks and Advantages of International Supply Chains – Issues in Global Supply chain Management

Reference Books

- David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi(2004).**Designing and Managing the Supply Chain.** New Delhi: Tata McGraw Hill.
- Donald Walters. Palgrave(2003). **Logistics: An Introduction to Supply Chain Management.** New York: Macmillan
- David A Taylor (2004). **Supply Chains: A Manager's Guide.** Delhi: Pearson Education.
- G. Raghuram and N. Rangaraj(2000.).**Logistics and Supply Chain Management.** Delhi: Macmillan India.
- Robert B Handfield and Ernest L Nicholas, Jr.(2004). **Supply Chain Redesign**. Delhi: Pearson Education.
- Ronald H Ballou(2004). **Business Logistics/ Supply Chain Management.** Delhi: Pearson Education.
- Sunil Chopra and Peter Meindl. **Supply Chain Management.** Delhi: Pearson Education.

B.3. Project Management (PHDOR403)

Course Overview: *The course is designed to enable the students to have an understanding about the concepts, tools & techniques of Project Management and to know applications oft MS Projects Software.*

Course Contents

Module 1:The Project Management Systems, Methodologies & Systems Development Cycle: Systems approach, project feasibility, project life cycle, project appraisal, project contracting, the phases of systems development cycle; Project Feasibility Study**:** Developing a project plan, market & technical analysis, financial analysis, evaluation of project proposals, risk analysis, sensitivity analysis, social cost benefit analysis

Module 2:Project Planning: Planning fundamentals, project master plan, work breakdown structure & other tools of project planning, work packages project organization structure & responsibilities, responsibility matrix Project Scheduling: Introduction- Use of Gantt Charts & network diagrams; PERT, CPM, Resource Allocation & GERT**:** Tools & techniques for scheduling development, crashing of networks, time-cost relationship, resource leveling multiple project scheduling, GERT

Module 3:Cost Estimating & Budgeting: Cost estimating process elements of budgeting, project cost accounting ;Managing Risks in Projects**:** Risk concept & identification, risk assessment, risk priority, risk response planning, risk management methods; Project Control: Information monitoring, internal & external project control, performance analysis, variance limits.Project Evaluation, Reporting & Termination**:** Project reviews & reporting, closing the contract

References

- C. gray & E Larson (2002).**Project Management.** NewDelhi:McGraw Hill.
- Dennis Lock (2003).**Project Management.** New York: Gower, 8th Edition
- Gido & Clements (2003). **Successful Project Management.** Thomson, II Edition.
- John M. Nicholas(2001).**Project Management for Business &Technology(Principles & Practice).**New Delhi: Pearson Education.
- Jack R Meredith, Samuel J Mantel (2000).**Project Management – A Managerial Approach.** JW & Sons.

- Norman, R Howes (2001).**Modern Project Management**. New York: Amacom
- Prasanna Chandra (2004).**Projects:Planning, Analysis, Selection, Implementation &Review.**New Delhi: Tata McGraw Hill, 5th Edition.

	Psychology		
	COMMON COURSES		
Sr. No.		**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0

Sr. No.	**ELECTIVE COURSES**		
B.1.	Psychology of Current Trends and Social Issues	PHDPSY101	2.0
B.2.	Educational Psychology	PHDPSY102	2.0
B.3.	Guidance and Counselling	PHDPSY103	2.0
C.1.	**Dissertation**		3.0

B.1.Psychology of Current Trends in Social Issues(PHDPSY101)

Module1. Indian social structure, caste, class, ethic and family change,Modernization and post – modernization.

Module 2. Marriage, dowry, divorce, social consciousness and cyber world.. Psychology of corruption: causes, types, effects and remedies,Naxalism and terrorism, types, effects. Psychology of values.

Module 3: Women and caste empowerment and related problem, urbanization,Sanskritization.Gerentological problems.

References

- Singh S.K., (2010). **Foundation, Feminisms and Naturalism the third World**, M.D. PublicationPvt. Ltd., New Delhi.
- Singh S.K., (2010), **Rethinking embodiment in Feminist Media in Media Studies**, M.D.Publication Pvt. Ltd., New Delhi.
- Toch H. (1966), **The Social Psychology of Social Movem**ents, Methuas & Co.
- Shoslak A.B. (1978**), Modern social Problems**, Holt

B 2.Educational Psychology (PHDPSY102)

Module 1: Personality – approaches to the study of personality definitions, types and measurement of personality.Adjustment – nature of adjustment, adjustment and society, normality vs. ale normality. Determinations of adjustment.

Module2: Intelligence – meaning, theories and measurement of intelligence. Creativity – creativity and intelligence, identification of the creative individual. Education for encouraging creativity.

Module 3: Cognitive development, Bruner and Piaget's work on cognitive development and their application to class room situations.

References

- Dand Pani, A. (1988).**A Text Book Of Advanced Educational Psychology**, New Delhi, Amol Publication.
- Dr. S.S. Mathur (2010).**Shiksha Manovigyan**, Shri Vinod Pustak Mandir, Agra
- Ellis, (1965), (2010).**Educational Psychology**, Princeton, N.J., New York.
- Dandeker (1995).**Educational Psychology**, Mcmillan.
- Woolfolk, A. (2004).**Educational Psychology**. Singapore: Pearson Education

B.3. Guidance and Counseling (PHDPSY103)

Module 1: Guidance & Counseling
(A). Guidance: Nature, Functions and Scope(B). Guidance services: Appraisal Service, Orientation service, Remedial Service, Follow-up, Program Evolution service.(C). Guidance Services in institutions: Primary, secondary and college, university levels.(D). Counseling: Definition and Goals of Counseling.(E). Relationship between Guidance and Counseling.

Module 2: Counseling Process: (A). Stages of the Counseling Process.(B). Building the Relationship between and in depth exploration.(C). Psychological assessment and diagnosis in counseling.(D). Factors affecting the Counseling Process.(E) Intervention Strategies in the Counseling Process
.
Module 3: Approaches And Skills of Counseling(A). Directive and Non-directive Approaches.(B). Counseling Skills: Listening questioning challenging, monitoring.(C). Counseling and psychotherapy:

transactional analysis, rational emotive behavior therapy, reality therapy, multimodal therapy.(D). Counseling in Indian Context.(E). Some special forms of counseling: old age counseling, children counseling and adolescents, family counseling's.

References

- Feltham, C. & Hortan, I.E. (ed.) (2006).**The Sage Handbook Counseling & Psychotherapy** (2ndEdition) London: Sage Publication.
- Rao, S.N. (2006).**Counseling & Guidance** (2nd Edition). New Delhi: Tata McGraw Hill Pub. Co.Ltd.
- Gibson, R.L. Mitchell M.H. (2005).**Introduction to Counseling & Guidance** (6th Edition) NewDelhi: Pearson's education Pvt. Ltd.
- Nelson R. Jones (2000).**Introduction to Counseling Skills, Texts and Activities**. London: SagePublications.
- Gelso C.J.; Fertz, B.R. (1995).**Counseling Psychology**. Bangalore prism Book Pvt. Ltd.

- Cohen R.J.;Swedrick, M.E. (2005).**Psychological testing and Assessment** (6th Edition) NewDelhi: Tata McGraw Hill Pub. Co. Ltd.

	SOCIOLOGY		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
Sr. No.	**Electives Courses**		
B.1.	Sociology of Religion	PHDSOCIO101	2.0
B.2.	Industrial Sociology	PHDSOCIO102	2.0
B.3.	Social Problems	PHDSOCIO103	2.0
C.1.	**Dissertation**		**3.0**

B1.Sociology of Religion (PHDSOCIO101)

Module1. Religion: Definition, Functions and Dysfunctions. Perspectives on Religion**:** Frazer, Durkheim, Marx, Weber.

Module -2. Conceptual Categories: Beliefs, Rituals, Magic and Religion.Religion of India: Comparative Religion; Religious Demography--Hindu, Islam, Christianity, Bodh,Sikh, Jain religions.

Module -3. Contemporary Trends in Religions: Secularization, New Religious movements.

References

• Baird, Robert D. (ed.).(1995).**Religion in Modern India**. Delhi:Manohar.

• Clarke, P.B.(1988).**New Religious Movement : An introduction** in Ed. S.Sutherland, et al. **The World's Religion**, routtedge pp.907-11

• D'Souza, Lila (2005).**The Sociology of Religion: A Historical Review**, RawatDelhi
• Dube, S.C. (1990**), India Society**. New Delhi:National Book Trust

• Durkheim, Emile (1965), **The Elementary Forms of Religious Life**, New York:Free Press.

• Giddens, A. (2001).**Sociology** 4th Edition, Polity Press

• Johnson, H.M.(1988), **Sociology: A Systematic Introducti**on, Allied Publishers

• Madan, T.N. (ed.). (1992).**Religion in India**. New Delhi:Oxford University Press.

• Majumdar, H.T. (1986), **India's Religious Heritage**. New Delhi: Allied.

• Roberts, Keith A. (1984), **Religion In Sociological Perspe**ctive. New York:Dorsey Press.

• Turner, Bryan S. (1991), (2nd edition). **Religion And Social Theory**. London:Sage.

B 2.Industrial Sociology (PHDSOCIO102**)**

Module1. Concept: Nature and Scope of Industrial Sociology; Pace of Industrialization.Politico-Economic Frame of Industry:Factory as a System; Industrial Management.

Module2. Industrial Work-Force: Changing Character of Work-Force in India.Industry-Society Interface:Impact of Industry on Social Structure - Caste, Class, Family.

Module3. Socio-Ecological Problems: Growth of Slums, Environmental Degradation.

References

• Danial, Bell(1973).**The Coming of Post-Industrial Society**, New York;Basic Books

• Desai, A.R.(1978). Rise and Development of Modern Indian Industries Perspective

• Edwards, Paul(2003).**Industrial Relations**, Blackwell Publishing

• Faunce, William (1968).**Problem of Industrial Society**, McGraw Hill Book Company

• Giddens, A.(2001)**. Sociology** (4 th Ed.)

• Gisbert, S.J.(1972.**Fundamental of Industrial Sociology**, Mcgraw Hill

• Hoselitz, B. (2003).**Industrialization and Society.**Mcgraw Hill

• Ramaswamy, E.S.(1978) : **Industrial Relation in India: A Sociological Perspective.**Mcgraw Hill

B 3.Social Problems (PHDSOCIO103)

Module1. Social Problem: Concept and Meaning; Social Problem, Perspectives – Labeling Theory (Becker), Differential Association (Sutherland).

Module2. Group Context of Social Problems: Casteism, Communalism, Atrocities against Women. Gender Disadvantages and Women Protection**:** Gender discrimination, Domestic Violence, Remedies for Gender Problems.

Module3. Some Specific Social Problems: Untouchability, Dowry, Prostitution, Corruption. Deviant Behaviour**:** Organized Crime, White Collar Crime; Alcohol and Drug Addiction, Sex Offences.

References

• Ahuja Ram (1992).**Social Problems in India**. Jaipur:Rawat Publications
• Bardhan, P. (1984).**Land, Labour and Rural Poverty**. New Delhi: OUP

• Beteille, Andre. (1974).**Social Inequality**, New Delhi: OUP

• Beteille, Andre. (1992).**Backward Classes in Contemporary India.** New Delhi: OUP

• Berreman, GD(1979).**Caste and Other Inequalities: Essays in Inequality**, Meerut:Folklore Institute.

• Ghurye, G.S. (1968).**Social Tensions in India**. Bombay: Popular Parkashan.

• Gill, S.S. (1998).**The Pathology of Corruption**. New Delhi: Harper Collin Publisher

• Inden, Ronald. (1990).**Imaging India**.Oxford: Brasil Blackward

• Lewis, Oscar. (1966)., **"Culture of Poverty**". Scientific American Vol. II & V, No.4.
• Merton R.K.(1972).**Social Theory and Social Structure**, New Delhi:Emrind P:ublishing Company.
• Mamoria, C.B. (1981).**Social Problems in India**, Kitab Mehal, Allahabad.

• Madan, G.K. (1973).**Social Problems**, Bombay:Allied Publications

	ECONOMICS		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Econometrics	PHDECO101	2.0
B.2.	Environmental Economics	PHDECO102	2.0
B.3.	Industrial Economics	PHDECO103	2.0
C.1.	**Dissertation**		3.0

B.1.Econometrics (PHDECO101)

Module 1. Economic Relationships and its verification: One Sample Statistics, Questions of Ontological, Functional, population and Estimable forms. Parametric, Semi and Nonparametric Models. Steps in Formulation of Econometric Models. The Data Question.

Module 2. Linear Regression Models: Assumptions, Properties and Estimation, Estimating Functions. Goodness of Fit and Testing of Hypothesis. Relaxing the Assumptions. Solutions to the Heteroscedasticity, Autocorrelation and Multicollinearity. Limited Dependent variables.Multivariate Analysis: The Data Aspect, Multivariate Normal Distribution, PrincipalComponent analysis. Factor and Discriminant Analysis.

Module 3. Analysis of Time Series Data: Data generating process, Stationarity, Auto Regressive, and Moving Average Processes, Auto correlation functions, Unit Root and StructuralBreak,

Cointegration, Error Correction, Volatility. Question of Forecasting.Analysis of Panel Data: The Data Aspect, Error Component Models, Testing ofHypothesis.

References

- Wooldridge, J. M. (2018). **Introductory Econometrics**: A modern approach, (7th Ed), CENGAGE.
- Wooldridge, J. M. (2010). **Econometric analysis of cross section and panel data**. MIT press.
- Gujrati, D.N.(1995). **Basics Econometrics** (2^{nd} Edition) MC Graw Hill, New Delhi
- Gupta, S.P.& Gupta, M.P. (2010). **Business Statistics**.New Delhi: Sultan Chand &Sons
- Shukla, S.S. & Sahay,S.P.(2008).**Statistical Analysis**. Agra: Sahitya Bhawan Publications
- Gupta, S.P. (2012). **Statistical Method**. New Delhi: Sultan Chand &Sons

B2.Environmental Economics(PHDECO102)

Module 1.Measuring of Environment & Ecology. Significances of Environmental balance. Role of Economic in Environment. Nature of Environmental Economics. Model of Market Failure – Environmental problems- A market failure Environmental quality A public good. Environmental problems Externalities Positive & Negative.

Module 2..Conventional solutions to Environmental Problems : The command and control Approach. Economic solutions to Environmental problems The market approach pollution charges. Environmental Subsidies Deposit/Refund System pollution permit trading system.

Module 3. Assessing benefits for Environmental Decision making. Cost benefit Analysis in Environmental decision making . Conflicts between Environment Economic Development Population growth Environmental Law & their implementation.

References

- Baumol. W.J. and W.E.Oates(1988).**The Theory of Environmental Policy** (2ndEdition) CUP. Cambridge.
- Bhattacharya.R.N. ed. (2001).**Environmental Economics. An Indian Perspective**. Oxford University Press. New Delhi.
- Hanley. N.J.F.Shogren and B.White (1997).**Environmental Economics in Theory and Practice.** Macmillan.

- Kalpagram. (1998).**Environmental Economics**. Sterling Press.
- Kolstrad. C.D. (1999): **Environmental Economics**. Oxford University Press. New Delhi.
- Mehta. S. S. Mundle. and U.Sankar (1995): **Controlling Pollution: Incentives and Regulation.** Sage. New Delhi.
- Murthy. M.N.. A. James and S.Misra (1999): **The Economics of Water Pollution in India.** Oxford University Press. New Delhi.
- Pearce. D.W and R. Turner (1991): **Economics of Natural Resource Use and Environment**. John Hopkins Press. Baltimore.
- .Rao. O.K. (2000): **Sustainable Development. Economics and Poli**cy. Blackwell Publishers. UK.
- Sankar. U ed (2001): **Environmental Economics**. Oxford University Press. New Delhi.
- Saxena. H.M. (2000): **Environmental Management**. Rawat Publishers. New Delhi.
- Sengupta. R.P. (2000**): Ecology and Economics: An Approach to Sustainable** D**evelopment** Oxford University Press. New Delhi.

B 3.Industrial Economics (PHDECO103)

Module 1. Investment Expenditure. Methods of Evaluating Investment Expenditure. Mergers and Acquisition (M & As) and Diversification. Global Competitiveness of Indian Industries. Growth and current problems of selected large scale industries in India Iron & steel. Cotton textiles. Jute. Cement. Sugar and engineering goods. Development of Small Scale and Cottage Industries in India.

Module 2. Sources of Industrial finance Equity (owned). debt (external) Role & growth of major funding agencies lOBI. IFCI. SFDs. SIDS and Commercial banks etc.. in the Indian Industrial development. Role of FDls in Industrial development.

Module3. Regional Distribution of Industries and Regional disparities in Industrial Growth along with Special Reference to Industrial Development of Madhya Pradesh. Man Power Planning

References

- Cherunilam. F (1994).**lndustrial Economics in Indian Perspective** 3'" Edition). Himalaya Publishing House. Mumbai.
- Jalan B (1996) .**India's Economic Policy**. Viking. New Delhi
- Naidu K.M.(1999). Industrialization & Regional Development in India
- Divine P.J. & R.M. James et.al. (1976) .**In Introduction to Industrial Economics** George Allen and Unwin Ltd. London.
- Hay D. & D.J. Morris -**Industrial Economics Theory & Evidence**. Oxford University Press. New Delhi
- Ahuliwalia. I.J. (1985).**Industrial Growth in India**. Oxford University Press. New Delhi.

- Barthwal. R.R. (1985).**Industrial Economics.** Wiley Eastern Ltd.. New Delhi.
- Desai. B. (1999).**Industrial Economy in India** (3rd Edition.) Himalaya Publishing House. Mumbai.
- Hay. D. and D.J.Morris (1979**). Industrial Economics: theory and evidence**. Oxford

	English Literature		
	COMMON COURSES		
Sr. No.		**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses(Any Two)		
B.1.	Literary Theory and Criticism	PHDEL101	2.0
B.2.	New Literatures in English	PHDEL102	2.0
B.3.	English Language Teaching	PHDEL103	2.0
C.1.	**Dissertation**		**3.0**

B.1.Literary Theory and Criticism (PHDEL101)

Module I: Introduction to literary theory. basic literary terms and overview.Traditional Approaches. Humanisttheory– Plato to Mathew Arnold.Historical & Formalist. NewHistoricismStructuralism– Ferdinand Sassure. Claude Levi Strauss Post-structuralism

Module II: Ideology and discourse – KarlMarx. Engels. Michel Foucault. Mikhail Bhakthin .AlthusserFeminism– Feministliterary theory–Luce Irigaray. Helene CixousQueertheory –Flexible sexualityPost-colonialismand Orientalism. ColonialismandEnglish. Homi Bhabha. HenryLouis gates Jr.Indian Poetics – A survey of Indian poetics. Causes.Definition and Aimand Purpose of Poetry. The souland essence of poetry. Natureof the different rasas.

ModuleIII: Reader-response criticism– Theories – Reader in the text.over the text and with the textcriticism– Sigmund Freud . Jacques LacaEco- criticism– Development of the ecologicalmovements and Concepts. Nature Writingand Writers

References

- Agger, Ben. (Latest ed)**Cultural Studies as Critical Theory**. London: The Palmer Press.
- Dr. Christine Siegel, **Introduction to Modern Literary Theory** –
- Literary Theory: A Guide For The Perplexed (Paperback) by MaryKlagesPublisher:Continuum(Jan 2007)
- Long J, David, (2001).**Modern Criticism and Theory: A Reader**. London: Longman,.
- M.H.Abrams ,**A Glossary of Literary Terms** –
- Nicol, Bran, (Latest ed). Postmodernism and the Contemporary Novel: A Reader. Edinburg: Edinburg Univ Press
- Patricia Waugh, **Literary Theory and Criticism**: An Oxford Guide 1st Edition
- Rafey Habib (2005). **A HistoryofLiterary Criticism: fromPlato to the present**, John Wiley & Sons,
- Terry Eagleton (2008). **Literary Theory: An Introduction**. Minnesota Press.
- Ed. Mark Shackleton(2008).**Diasporic Literature and theoryWhere now?** Cambridge Scholars Publishing.

B.2. NewLiteraturesinEnglish (PHDEL102)

Module1:A Study o f them ajortrendsandmovements inAfrican.Caribbean. Australian. Canadian andIndianLiterature.

Module2:Poetry–SelectedPoemsfrom

Indian: Enterprise:NissimEzekiel;Obituary:A.K.Rmanujan

Australian: SurelyGodWasaLover:ShawNeilsonAustralia:A.D.opeClockand Heart:JudithWright

African: RefugeeMotherandChild:ChinuaAchebe

Canadian: TheSolitaryWoodsman:SirCharlesG.D.Roberts TheWinteLakes:WilfredCampbell;OdeontheDeathofW.B.Yeats:A.J.M.Sm ith

Module3:Drama: George Ryga : Ecstasy Of Rita Joe: Wole Soyinka: Kongi's Harvest

Prose: Susanna Moodie : Extracts from Roughing It In The Bush

Fiction: Atwood: Handmaid's Tale;Chinua Achebe: Things Fall ApartNgugi

Wa Thong'o: Birth of a Dream Weaver: Writer's Awakening;Vikram Seth: ASuitable Boy;John Updike: Rabbit, Run

B.3.EnglishLanguageTeaching (PHDEL103)

Module1:MajorTrendsinEnglishLanguageTeaching

a) ApproachesinEnglishLanguageTeaching

b) MethodsofTeachingEnglish

c) TechniquesofTeachingEnglish

Module 2:EnglishLanguageTeachinginIndia

a) HistoryofEnglishLanguageTeachinginIndia

b) EnglishasSecond Language(ESL)

c) EnglishforSpecificPurpose

d) TheProblemsofTeachingEnglish

e) Remedial teaching

Module 3:Structureof English

a) Phonetics&PhonologyofEnglish

b) SyntaxofEnglish

c) SemanticsofEnglish

Suggested Reading:

- DavidNunan(1998).**LanguageTeachingMethodology**.NJ:PrenticeHall
- Heaton, JB. 1975. **WritingEnglishLanguageTests**. NewYork:Longman.
- Doff,Adrian.(1988).**TeachEnglish–ATrainingCoursefor Teachers**.Cambridge,England:CambridgeUniversityPress
- Larsen-Freeman,Diane&Long,Long, MichaelH.(1991). **AnIntroduction To Second Language Acquisition Research**. NewYork:Longman
- Ur, Penny(1991). **A CourseIn LanguageTeaching**. Cambridge:CUP
- RaghubirSahaiGupta,KapilKapoor.(1991)**EnglishinIndia,IssuesandProblems**. NewDelhi:Academic Foundation
- Richards, Jack C &Rodgers, Theodore(1986). **Approachesand Methods in LanguageTeaching.**Cambridge: CUP
- Thirumala,M.S.(2002).**AnIntroductiontoTESOL**,Mysore:CentralInstituteofIndia nLanguage.

	Journalism and Mass Communication			
	COMMON COURSES			
Sr. No.		**Course Code**	**Credit Hours**	
A.1.	Research Methodology	PHDA101	3.0	
A.2.	Review of Literature	PHDA102	2.0	
A3.	Computer Applications	PHDA103	2.0	
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0	
	Elective Courses (Any Two)			
B.1.	Journalism Studies	PHDJMC101	2.0	
B.2.	International Communication	PHDJMC102	2.0	
B.3.	Advertising and Public Relations Research	PHDJMC103	2.0	
C.1.	**Dissertation**		**3.0**	

B 1.Journalism Studies (PHDJMC101)

Objective: To finalize scholars with current trends in journalism and enable them to relate propounded theories of journalism with practice; to instill in them deeper understanding of advanced journalism and make them understand the utility of research and studies in the field.

Course Content

Module 1: Current Trends in News Media
Collection of Data and Analysis of Facts and Figures, Writing for Print, TV, Radio and New Media, Interpretation of News for Readers, Audience , Understanding Audience to Meet their needs, Infographics.Theories Related to Journalism**;** Agenda Setting: Priming, Framing of News; Two Step Flow, Limited Effects, Spiral of Silence, Third Person Effect, Sociology of News, New Media-New Theory.

Module 2: Advanced journalism and Its Practices
Legislative, Development, Science, Sports, Conflict, human Rights, Law, Gender, Case, Politics, Economics, Coverage of Routine Stories; Interpretative and In-depth Analysis, Investigative Journalism.

Module 3: Research and Studies in Journalism
Normative Phase, Empirical Phase, Sociological Phase, Global Comparative Phase, Review of Notes by Noam Chomsky, An Overview of the Writings of Indian Journalists like P. Sainath, Pratap Bhanu Mehta, Hartosh Bal, Mrinal Pandey and Others.

Recommended Readings:

- Becher, Tony and Paul Trowler (2001). Academic Tribes and Territories: Intellectual Enquiry and the Culture of Disciplines (2nd ed.). Buckingham: Open University Press.
- Conboy, Martin (2013). Journalism Studies: The Basics. London: Routledge.
- Franklin, Bob, Martin Hamer, et al (2005). Key Concepts in Journalism Studies. London: Sage.
- Heinrich, A. (2011). Network Journalism: Journalistic Practice in interactive Spheres. New York: Routledge.
- Mcquail, D (2010). McQuail's Mass Communication Theory. London: Sage
- Peters, Chris and Marcel J. Broersma (ed). (2013). Rethinking Journalism: Trust and Participation in a Transformed News Landscape. Oxon: Routledge.
- Russell, A. (2013). Networked: A Contemporary History of News in Transition. Cambridge: Polity Press.
- Tumber, H. (ed.) (2008). Journalism Oxon: Routledge.
- Wahl-Jorgensen, Karin and Hanitzsch, T. (ed.) (2009). Handbook of Journalism Studies Oxon: Routledge.
- Zelizer, B. (2004). Taking Journalism Seriously: News and the Academy London: Sage.

B.2. International Communication (PHDJMC102)

Module 1: International communication: concept and Definition; Functions and Importance of International communication; Cultural Dimensions of international communication; Political dimensions of International communication; Economic Dimensions of international communication

Module 2: Communication as a tool of Equality and Exploitation; Communication as Human Right; Transnational media and issues of sovereignty, security and integrity; Effect of globalization on media system

Module 3: International intellectual property rights; New World information and communication order; Global Homogenization; Globalization and Modernity; Internet as tool of International Communication; New media and International communication

Suggested Readings:

- Akinfeleye, Ralph. (2008). **Contemporary issues in mass media for development and national security,** Lagos: Malthouse Press Limited

- Akinfeleye, R., Amobi, T. I., Okoye, I. & Sunday, O. (2009). **The continued dominance of international news agencies: Comparing the coverage of 2008 US and Ghana elections by Nigerian media,** Journal of African communication research, vol. 2 (3)

- Akinfeleye, R., Amobi, T. I., & Sunday, O. (2011). **Unending imbalance in global news flow, direction and intensity: Comparing global media coverage of 2008 US and Ghana presidential elections.** Saarbruken, Germany: LAP Lambert Academic Publishing

- Alleyne M.O. (1997). **News Revolution: Political and Economic Decisions about Global Information.** New York: St Martins Press.

- Mojaye, E. M., Oyewo, O. O., M'Bayo, R. T. & Sobowale, I. A. (2008). **Globalization and Development Communication in Africa**, Ibadan: University Press

- Morley, M (2002).**How to manage global reputation: A guide to the dynamics of international public relations**, New York, NY New York: University Press.

- Mowlana, H. (1986).**Global information and world communication: New frontiers in international relations.** New York: Longman

- M'Bayo, R.T (Undated). **Genesis of the New World Information order, In Peter Nwosu, Chuka Onwumechili and Ritchard M'Bayo** (Eds.). Communication and the transformation of society, New York: University Press of America

- Thusssu, D. K.(2006**). International Communication: Continuity and Change**. New York; Oxford

B3. Advertising and Public Relations Research (PHDJMC103)

Objective: To integrate the understanding of various research areas in the field of advertising and public relations with social, cultural and market effects; to review the existing knowledge on executions, planning and evaluation of promotional communication; to bring in awareness regarding ethical issues and regulatory mechanism.

Detailed Course Content

Module 1: Advertising as a Socio-Cultural System
Contemporary Approaches in Marketing Communications;Advertising Uses and Gratifications; Reflections on (Un)intended Consequences of Advertising, Laws and Self- Regulation; Advertising Literacy and Advertising Effects Research; Issues regarding use of Children in Advertising, Pester Power, Surrogate Advertising.Deep Insights into Consumer Research & Semiotics in Global and Indian Practices; Deconstructing Advertising Messages: Reading Ads vis-à-vis Making Ads; Postmodern Advertising (Texts and Visuals): Gender Agenda, Representation of Classes, Race, Colour, Region, and Rights; Debates on Changes in Advertising with New Media.

Module 2: Composite Study of Public Relations
Public Relations Methods. Challenges and Opportunities: Conceptual Approaches: Functional Approaches: Image and Reputation Management: Strategies and Functions, Theories of Rhetoric: Gaps in PR Research.

Module 3: PR, Society & Technology

PR and Social Responsibility: Researches into Corporate Citizenship, CSR: Case Studies on Public Affairs and Corporate Affairs in India Post Globalization: Public Relations- Laws and Ethics. Independence of PR and Media; Practices and Developments in Public Relations and the New Media.

Recommended Readings:

- Berger, A. A. (2011). Ads, Fads and Consumer Culture, United Kingdom: Rowman and Little field publishers.
- Davis, J. J. (2011). Advertising Research: Theory and Practice (2nd ed:) London: Person.
- Dyer. G. (1982). Advertising as Communication. London: Routledge.
- Goldman, R. (1992). Reading Ads Socially. London Routledge
- Hackley, C. (eds.) (2010). Advertising Management, Vol 1-2. London: Sage.
- Jethwaney, J. (2010). Corporate Communication. New Delhi: OUP.
- Cornelissen, Joep (2004). Corporate Communication, Theory and Practice, London: Sage.
- Jugenheimer, Donald W.et al. (2010). Advertisement and public Relations Research (2nd ed). London: Routledge.
- Leiss, W. Kline, S. and Jhally, S. (1990). Social Communication in Advertising, Toronto: Methuen.

	Civil Engineering		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Environmental Impact Assessment	PHDCE101	2.0
B.2.	Simulation and modeling	PHDCE102	2.0
B.3.	Intelligent Techniques in Engineering	PHDCE103	2.0
C.1.	**Dissertation**		3.0

B.1 Environmental Impact Assessment (PHDCE101)

Module 1: Introduction: Human concern; Need for environmental impact assessment (EIA); Requirements and levels of EIA; Potential impacts of water resource development projects.

Module 2:EIA Procedure: Screening, baseline data, scoping, terms of reference (TOR)
Environmental Clearance: Guidelines, acts and legislations, codes and country practices.

Module 3: Rehabilitation: Submergence effects, rehabilitation guidelines, planning, and procedures. Monitoring: Parameters to be monitored, frequency of monitoring, reporting procedures

References

- Govt. of India, "Environmental Impact Assessment of Development Projects", Ministry of Environment and Forests. 1989
- Canter, L. W., "Environmental Impact Assessment", Mc.Graw Hill. 1996
- Govt. of India, "EIA Notification 2006", Ministry of Environment and Forest. 2006
- Bureau of Indian Standards, "Parameters for EIA of Water resources Project", IS 5442:2004. 2004

B.2 Simulation and Modeling (PHDCE102)

Module 1: Introduction**,** Purpose, uses and benefits of system modeling, Use of models for design, real time training and optimization, Types of model: first principles versus stochastic, heuristic, empirical, etc. Physical equations of systems: algebraic and differential, Constraint equations: equality and inequality. Time domain solutions: steady state and dynamic.

Module 2: System models: Modeling of control loop elements, Integration of process and control models, System block diagrams, Validation of models, Zero capacity systems, Hydrodynamic and electromechanical models, Models of reacting systems, Multiloop systems, State space modeling of multi variable systems, Models of distributed parameter systems, Discrete event modeling. Process models, Dynamic models of a variety items of plant: eg stirred tanks, jacketed vessels, pressure systems, heat exchangers, packed columns. Models of a variety of operations: eg mixing, heating, blending, pumping, reaction, distillation

Module3: Simulation: Use of continuous simulation languages, Simulation of linear & non-linear dynamic systems, Selection of numerical integration routines, Choice of step length & run time, Setting up initial and boundary conditions, Applying forcing functions and disturbances, Use of discrete event simulation languages (e.g., State flow), Documentation & flow charts, Interpretation of error messages & debugging, Functional testing and validation.

References

- Fishwick P.(1995). **Simulation Model Design and Execution**, PrenticeHall, , ISBN 0-13-098609-7
- Law A., Kelton D.(1991).**Simulation Modelling and Analysis**, McGraw-Hill. ISBN 0-07-100803-9

B.3.Intelligent Techniques in Engineering (PHDCE103)

Module1. Mathematical of fuzzy control: fuzzy sets, fuzzy set theory, properties of fuzzy sets, Operations of fuzzy sets, fuzzy relations.Nonlinear fuzzy control: The control problem, FKBC as non linear transfer element PID & sliding mode type FKBC, some typical application of fuzzy based control systems. Adaptive Fuzzy control: Introduction, design & performance evaluation, performance monitor, main approaches to design.

Module2. Adaptive Fuzzy control: Introduction, design & performance evaluation, performance monitor, main approaches to design. Stability of fuzzy control system: state space approach, stability and robustness indices, input-output stability. FKBC design parameters: Structure of FKBC fuzzification and defuzzification module, rule based choice of variable and contents of rules, derivation of rule data based, choice of membership function and scaling factors.

Module3. Artificial neural systems: Preliminaries, fundamental concepts & models of artificial system, neural networks learning rules, Hebbian, perception, delta Windrow-Hoff learning rules; Single layer perception classification: Classification model, features & decision regions training & classification using discrete perception, algorithm & examples, single layer continuous perception networks for linear separable classification; Multilayer feedback work networks: Generalized delta learning rule, feedforward recall & error back propagation training, learning factors. Single layer feedback networks

References:

- ZuradaJ.M.(1997). **Introduction of artificial neural systems**, Jaico publication House
- McMillian S H.(1994).**Neural networks: comprehensive foundation** ,College Publishing company inc.
- Omatu.S, Khalid M, Yusof R,(1996).**Neuro control and its application ,** Spring Verlag London Ltd.
- Driankov D, Hellendoorn H. and ReinfrankM.(1997).**An introduction to fuzzy control**, Narosa Publication House, 2nd reprint .

	MECHANICAL ENGINEERING		
	Common Courses		
Sr. No.		**Course Code**	**Credit Hours**
A.1	Research Methodology	PHDA101	3.0
A.2	Review of Literature	PHDA102	2.0
A.3	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
Elective Courses			
Thermal Engineering			
B. 1	Renewable Energy Sources	PHDME101	2.0
B. 2	Advanced Fluid Mechanics	PHDME102	2.0
B. 3	Advanced Thermodynamics	PHDME103	2.0
Industrial Engineering			
B. 4	Industrial Engineering	PHDME104	2.0
B. 5	Operation Research and Supply chain management	PHDME105	2.0
B. 6	Statistical Quality Control and TQM	PHDME106	2.0
C.1.	**Dissertation**		**3.0**

Renewable Energy Sources (PHDME101)

Course Overview - The students will be able to understand the various sources of renewable energy and its fundamental application used in research.

Module 1: Solar Radiation: Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions.Solar thermal conversion**:** Basics, flat plate collectors-liquid and air type. Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration.Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices;

Module 2: Wind energy characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh and Normal distribution, Measurement of wind data, Energyestimation of wind regimes. Wind Energy Conversion System**:** introduction,principles, Types and classification of WECS, Application of wind energy. Introduction and classification of biomass,different typesbiomass gasification.

Module 3: Overview of micro, mini andsmall hydro system; hydrology.Ocean energy resources, principle of ocean thermal energy conversion system, principles of ocean wave energy and tidal energy conversion. Origin and types of geothermal resources. Hydrogen as a source of energy, Hydrogen production and storage.Types of fuel cell, fuel cell system and sub-system.

References:

- Kothari D. P., Singal K. C. and Rakesh R. (2011).Renewable Energy Sources and Emerging Technologies", PHI Learn, Fourth Addition.
- Khan B. H. (2010). Non Conventional Energy Sources, TMH, Fourth Reprint.
- Rai G. D. (2010). Non-conventional Energy Sources", Fourth Edition, Tenth Reprint.
- Abbasi T., and Abbasi S. A. (2010). "Renewable Energy Sources(Their impact on global warming and pollution)", PHI Learning,

B.2.Advanced Fluid Mechanics (PHDME102)

Course Overview - The students will be able to correlate the fundamentals of fluid mechanics, understand statics, dynamics and various approaches of fluid mechanics which can be applied in the research.

Module 1: Definition and properties of Fluids,Fluid as continuum, Langragianand Eulerian description, Velocityand stress field, Fluid statics,GoverningEquations ofFluid MotionReynolds transport theorem, Integral and differential forms ofgoverning equations: mass,momentum and energyconservation equations, Navier-Stokes equations, Euler'sequation, Bernoulli's Equation.

Module 2: LaminarBoundaryLayersBoundary layer equations,Boundary layer thickness, Boundary layer on a flat plate,similarity solutions, Integral form ofboundary layer equations, Approximate Methods, Flowseparation, Entry flow into a duct.Elements ofStability TheoryConcept of small-disturbancestability, Orr-Sommerfeld equation,Inviscid stability theory, Boundarylayer stability, Thermal instability,Transition to turbulence.

Module 3: Water Turbines: Impulse turbine, Reaction turbine,Specific speed, Unit quantities, Performance characteristics for water turbines,Centrifugal pumps: Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps.IntroductiontoComputationalFluid Dynamics(CFD)Boundary conditions, Basicdiscretization, Finite differencemethod, Finite volume method andFinite element method.

References:

- Modi P. N. and Seth S. M. (2009**).Hydraulics and Fluid Mechanics(Including Hydraulic Machines)**. Standard Book House, Delhi, Seventeenth Edition (Revised and Enlarged).
- Yunus A. Cengel and John M. Cimbala (2016). **Fluid Mechanics,** TMH, Third Edition Seventh Reprint.
- Kumar D. S. (2014). **Fluid Mechanics and Fluid Power Engineering**, Eight Edition.

B.3.Advanced Thermodynamics (PHDME103)

Course Overview - The students will be able to understand concepts and applications of thermodynamics used in the research.

Module 1: Concept of an Ideal gas, Gas laws, Avogadro's hypothesis, Heat and work transfer. First law of thermodynamics and its limitations, Second law of thermodynamics and consequence of second law, Availability and Irreversibility. Real gas, Deviation with ideal gas, Vander-wall's equation, evaluation of its constants,limitations of the equation.

Module 2: Air standard cycles, Carnot, Otto, Diesel, Dual cycles and there comparison, two stroke and four stroke engines, Brayton cycle, nonreactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures, Enthalpy of gas-mixtures.

Module 3: Gas dynamics: speed of sound, in a fluid mach number, mach cone, stagnation properties, one-dimensional isentropic flow of ideal gases through variable area duct-mach number variation, area ratio as a function of mach number, mass flow rate and critical pressure ratio, effect of friction, velocity coefficient, coefficient of discharge, diffusers, normal shock.

References:

- Nag P. K. (2009). **Engineering Thermodynamics.** TMH, Fourth Edition, Fifth reprint.
- Domkundwar, K., and Domkundwar (2006). **A Course in Thermal Engineering**. First Revised and Enlarged Edition.
- Yadav R. (2010). **Steam & Gas Turbines and Power Plant Engineering**. Seventh Revised Edition.

B.4.Industrial Engineering (PHDME104)

Course Overview - The course aims at developing an understanding industrial engineering decisions that result in well-reasoned, value-added solutions, Contributions to team goals through effective team interactions and leadership, new skills and knowledge that advance professional practice and enable career advancement.

Module 1: Definition and scope of Industrial engineering role of an industrial engineer in industry, functions of industrial engineering department and its organization, qualities of an Industrial engineer. Productivity concept and definition: Introduction, definitions of productivity, Productivity measurement at national, industrial and enterprise level, Benefits of higher productivity.Productivity measurement approaches at the enterprise level, Productivity of materials, Techniques for productivity improvement: Work content and ineffective time, improving productivity for reducing work contentandineffective time, Management of productivity.

Module 2: Introduction, basic procedure, prerequisites of conducting a work study, factors affecting working conditions, occupational safety and health, fire prevention and protection, layout and housekeeping, lightning and climate conditioning, noise and vibrations, ergonomics, arrangement of working time ,Method study, procedure of method study. Flow and handling of materials: Plant layout, developing the new layout, the handling of materials. String diagram, flow process chart, travel chart, multiple activity chart, Motion economy, classification of movements, machine controls and displays of dials, the two handed process chart, Simo chart.

Module 3: Purpose of workmeasurement andits basic procedure, the techniques of work measurements. Work samplingbasic concept and procedure, Time study, the quality worker, standard rating and standard performance. Predetermined time standards (PTS), advantages of PTS system, Criticisms of PTS system, different forms of PTS system, use of PTS system, and application of PTS system.

References

- Barnes, Raeph. M. (1990). **"Motion and Time Study – Design and Measurement of Work"**.Wiley & sons, New York.
- McCormick, E.J., (1992).**Human Factors in Engineering and Design.** Mc.Graw Hill.
- ILO, (2010).**Introduction to Work study**, Second Edition, Oxford and IBH Publishing.
- Khanna O.P. (2010). **Industrial Engineering and management**. Dhanpat Rai Publisher.
- Telsang M.(2006).**Industrial Engineering and Production management**". S.Chand Publisher.

B.5.Operation Research and Supply Chain Management (PHDME105)

Course Overview - The course aims at developing an understanding of howstudents will be well grounded in the mathematical, engineering, and modeling skills that are the basis for operations research, and they will be prepared to apply those skills to the efficient design, analysis, operation and control of complex systems.

Module 1: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy

Module 2: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q-system periodic review, base stock P-system; service level, lead time variance and safety stockABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Module 3: Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues.

References

- Taha H. M., (2001).**Operations Research, An introduction.** 6th Prentice Hall of India, New Delhi.
- Philips D. T., Ravindram A. and Soleberg J. (1992).**Operations Research, Principles & Practice.** John Wiley & sons.
- Panneerselvam ,R, (2002**).Operations Research.** Prentice – Hall of India, New Delhi

- Chopra, S., and Meindl, P. (2004).**Supply chain Management: Strategy, Planning and Operations.** Second Edition, Pearson Education (Singapore) Pte. Ltd,
- Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E. (2003).**Designing & Managing the Supply Chain: Concepts, Strategies & Case studies**. Second Edition, Tata McGraw-Hill Edition.
- Doebler, D.W. and Burt, D.N. (1996).**Purchasing and Supply Chain Management: Text and Cases**. McGraw-Hill Publishing Company Limited, New Delhi.

B.6.Statistical Quality Control and TQM (PHDME106)

Course Overview - The aim of this subject is to provide a student with a broad and in depth knowledge of a range of operation research models and techniques, which can be applied to a variety of industrial applications.

Module 1: The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

Module 2: Mean, Median, Mode, Standard deviation, Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, significance of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, Average Run Length-ARL)Control Charts for X-Bar and R- Charts, Type I and Type II errors, the probability of Type II error.

Module 3: Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality, Six sigma.

References

- Rose,J.E.,(1993).**Total Quality Management.** Kogan page Ltd .
- Juran, J.M. and Gryna,F.M (1988).**Quality Control Handbook**.Prentice Hall publications.
- Feignbaum, (1989).**Total Quality Control.**Addison Wesley Publication Co.
- Douglas C. Montgomery (1996). **Introduction to Statistical Quality Control**. 3rd Edition,John Wiley and Sons.
- Duncan A.J. (1974). **Quality Control and Industrial Statistics**. fourth edition, John Wiley & Sons, Inc.

	Computer Science Engineering and Information Technology		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Software Engineering	PHDCSE101	2.0
B.2.	Simulation and modeling	PHDCSE102	2.0
B.3.	Design patterns	PHDCSE103	2.0
B.4.	Advanced Computer Network	PHDIT104	2.0
C.1.	**Dissertation**		3.0

B.1.Software Engineering (PHD**CSE**101)

Module-1: Software process Models and lifecycle. Project Management Concepts & Project Metrics. Software Project Planning. Scheduling and Tracking. Software Requirements Specification. Analysis Modeling. Software Design Concepts and Principles. Architecture Design. Distributed System Architectures. Application Architectures

Module-2: Object Oriented Design. Real time Software Design. User Interface Design. Component Level Design. Rapid software development. software Reuse. Component based software Engineering. Critical system development. Risk Analysis & Management. Coding.

Module-3;Software Testing Techniques & Software Testing Strategies. Software Quality Assurance and Configuration Management. Emerging and advanced topics in Software Engineering. Security Engineering. Agile Methods. Client Server Software Engineering. Aspect Oriented Software Development. Software Engineering Aspects of Programming Languages. Reverse Engineering. Re-engineering. Web Engineering. CASE.

References

- Pressman,R. S.(2002). **Software Engineering – A practitioner's approach",** McGraw Hill Int. Ed
- Pankaj Jalote(2002). **Software Engg** Narosa Publications.
- Ian Summerville(2001). **Software Engineering** 6/e (Addison-Wesley)
- Richard Fairley(2005). **Software Engineering Concepts** (TMH)
- Elis Awad(2001). **System Analysis & Design**. Galgotia publications
- Jessica Keyes(2003). ***"Software Engineering Handbook**", Auerbach Publications (CRC Press.
- Hans van Vliet(1999). **Software Engineering: Principles and Practice** . Wiley.

B.2.Simulation And Modeling(PHD**CSE**102)

Module -1: Introduction**.**Purpose. uses and benefits of system modeling. Use of models for design. real time training and optimization. Types of model: first principles versus stochastic. heuristic. empirical. etc. Physical equations of systems: algebraic and differential. Constraint equations: equality and inequality. Time domain solutions: steady state and dynamic.

Module -2: Modeling techniques: Formation of lumped parameter models. Classical assumptions. Accumulation equals input minus output. Analogies with electrical and mechanical systems. Significance of capacity for energy storage. Absolute and deviation variables. Linearization. Scope for approximation. Laplace transformations. Conversion into transfer function models. Translation into block diagrams.

System models: Modeling of control loop elements. Integration of process and control models. System block diagrams. Validation of models. Zero capacity systems. Hydrodynamic and electromechanical models. Models of reacting systems. Multiloop systems. State space modeling of multi variable systems. Models of distributed parameter systems. Discrete event modeling. Process models. Dynamic

models of a variety items of plant: eg stirred tanks. jacketed vessels.pressure systems. heat exchangers. packed columns. etc. Models of a variety of operations: eg mixing. heating. blending. pumping. reaction. distillation. etc.

Module3: Simulation: Use of continuous simulation languages. Simulation of linear & non-linear dynamic systems. Selection of numerical integration routines. Choice of step length & run time. Setting up initial and boundary conditions. Applying forcing functions and disturbances. Use of discrete event simulation languages (eg State flow). Documentation & flow charts. Interpretation of error messages & debugging. Functional testing and validation.

References

- Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim(2000).**Theory of Modeling and Simulation: Integrating Discrete Event and Continuous Complex Dynamic Systems**.2nd edition, Academic Press,
- S.M. Ross(2005).**Simulation**. India Elsevier Publication.
- A.M.Law and W.D.Kelton(1998).**Simulation Modeling and Analysis**, T.M.H. Edition.
- Edward A. Bender(1999).**An Introduction to Mathematical Modeling**
- J. N. Kapoor(2001). **Mathematical Modeling,** Wiley eastern limited.
- John A. Sokolowski, Catherine M. Banks(2009).**Principles of Modeling and Simulation: A Multidisciplinary Approach.** Hoboken, NJ:John Wiley & Sons

B.3.Design Patterns(PHD**CSE**103)

Module -1: Design Pattern Definition. Design Patterns in Small Talk MVC. Describing Design Patterns. Catalog of Design Patterns. Organizing the Catalog. Solving of Design Problems using Design Patterns. Selection of a Design Pattern. use of Design Patterns.

Module -2: Designing A Document Editor: A Case Study Design problems. Document structure. Formatting. Embellishing the User Interface. Supporting Multiple Look and Feel standards. Supporting Multiple Window Systems. User Operations. Spelling Checking and Hyphenation Design Patterns Catalog Creational Patterns. Abstract Factory. Builder. Factory Method. Prototype. Singleton.

Module 3: Discussion of Creational Patterns. Structural Patterns- Adapter. Bridge Composite. Decorator Structural Patterns & Behavioral Patterns Structural patterns: Façade. Flyweight. Proxy. Discuss of Structural Patterns. Behavioral Patterns: Chain of Responsibility Command. Interpreter. Behavioral Patterns Iterator. Mediator Observer State. Strategy Template Method.Visitor Discuss ion

of Behavioral Patterns Behavioral Patterns State Strategy Template Method Visitor Discussion of Behavioral Patterns Expectations from Design Patterns

References

- Erich Gamma, Richard Helm, Ralph Johnson and John M. Vlissides(1994).**Design Patterns:**
- **Elements of Reusable Object-Oriented Software**. Addison Wesley Publishing.

- Elisabeth Freeman, Eric Freeman, Bert Bates and Kathy Sierra(2004).**Head First Design Patterns**.O'Reilly Publishing.

- John M. Vlissides(1998).**Pattern Hatching: Design Patterns Applied**. Addison Wesley Publishing, First edition,

- Steve Holzner(2006).**Design Patterns for Dummies**.John Wiley & Sons Inc.,

- Joshua Kerievsky(2004).**Refactoring to Patterns**.Addison Wesley.

- Martin Fowler(2002).**Patterns of Enterprise Application Architecture**.Addison Wesley

B.4. Advanced Computer Network (PHDIT104)

Module-1: Review of Networking Concepts. MAC layer issues, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR.

Module-2: End to End protocols TCP connection establishment and termination, Sliding window concepts, other issues: wraparound, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. Congestion and flow control, Queuing theory, TCP flavors: Tahoe, Reno, New-Reno, TCP-SACK, TCP-RED and TCP-Vegas. Transport protocol for real time (RTP), Quality of service: Integrated Services, Differentiated services.

Module-3: Routing and Multicast. Structure of internet: Autonomous systems, Intra-domain routing: OSPF and RIP, Inter-domain routing: BGP.
Multicasting: Group Management (IGMP), Internet scale multicasting: Reverse path broadcast, MOSPF, DVMPRP, PIM.

Module-4: Peer to peer and overlay networks. Concept of overlays, Unstructured Overlays: Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry.

Module-5: Introduction, Uniform Resource Locator/uniform resource identify, HTTP, Cookies, Web security problem, Penetration Testing, Firewalls:- functionality, Polices and Access Control, Packet filters, Application level gateway, Encrypted tunnel, Security architecture, Introduction to intrusion detection system.

References:

- Computer Networks: A Systems Approach, by Peterson and Davie, 5 th Ed. Morgan Kauffman, 2011.
- .Computer Networking: Top Down Approach, by Kurose and Ross, 6 th Ed. Pearson,2011

	Electronic Engineering		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Introduction to Embedded System	PHDELECT.E101	2.0
B.2.	Quantum Dot And Nano Computing System	PHDELECT.E 102	2.0
B.3.	Simulation and Modeling	PHDELECT.E103	2.0
C.1.	**Dissertation**		3.0

B1.Introduction to Embedded System (PHDELECT.E101)

Module -1: Introduction to Embedded Systems: Definition of Embedded System. Embedded Systems Vs General Computing Systems. History of Embedded Systems. Classification. Major Application Areas. Purpose of Embedded Systems. Characteristics and Quality Attributes of Embedded Systems.

Module -2: Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors. ASICs. PLDs. Memory: ROM. RAM. Memory according to the type of Interface. Memory Shadowing. Memory selection for Embedded Systems. Sensors and
Actuators. Communication Interface: Onboard and External Communication Interfaces.

Module -3: Embedded Firmware: Reset Circuit. Brown-out Protection Circuit. Oscillator Unit. Real Time Clock. Watchdog Timer. Embedded Firmware Design Approaches and Development Languages.RTOS Based Embedded System Design: Operating System Basics. Types of Operating Systems. Tasks. Process and Threads. Multiprocessing and Multitasking. Task Scheduling. Task Communication. Shared Memory. Message Passing. Remote Procedure Call and Sockets. Task Synchronization

References

- Shibu K.V.(2009).**Introduction to Embedded Systems.**New Delhi: Mc Graw Hill.
- Kamal ,Raj(2009).**Embedded Systems.** New Delhi: TMH.
- Frank, Vahid. Givargis,Tony(2010).**Embedded System Design.** New York: John Wiley.
- Lyla **(2013).Embedded Systems. New Delhi:** Pearson.
- Simon,David E.(2011).**An Embedded Software Primer.**New Delhi: Pearson Education.

B2.Quantum Dot and Nano Computing System (PHDELECT.E102)

Module1:Introduction: Recent past. the present scenario of Computing and its challenges. Future. Overview of basic Nano electronics. Quantum Mechanical Tunnel Devices: Overview of current research in nano-scale electronics and devices.

Module 2: Semiconductor and Device: Photonic Device and Materials. CMOS Device. Limit of CMOS technology-Scaling Theory. Quantum Dots & Quantum wires. Quantum computing: Basics and examples: introduction. axioms. quantum states and notation. unitaries. Measurement. Quantum circuits: classical reversible circuits. quantum circuits. universality.

Module 3: Quantum DOT cellular Automata (QCA): Introduction to nano-electronic and nano-computers. Quantum DOT cellular Automata (QCA). molecular circuits. Nano-computer Architecture. Defect analysis and Reliability: purpose of defect analysis in nano computing and Challenges. Reliability measurement in nano scale computing. Different soft computing tool for reliability analysis like Bayesian Network. Neural Network

References

- Wolfgang Prodog(2012).**Quantum -dot Devices and Quantum-dot Cellular automata**. Elsevier Science.
- Kouwenhoven,Leo P.(2009).**Electronic Transport in Quantum dot Cellular Automata**.Elsevier Science
- Macucci, M.(2008).**Quantum-dot Cellular Automata. Theory. Experimentation and Prospects.** New York :Wiley

- Boyden,Edward Stuart(2008).**Quantum Computation: Theory and Implementation.** New York : Wiley

B3.Simulation and Modeling(PHDELECT.E103)

Module1:Introduction**.**Purpose. uses and benefits of system modelling. Use of models for design. real time training and optimisation. Types of model: first principles versus stochastic. heuristic. empirical. etc. Physical equations of systems: algebraic and differential. Constraint equations: equality and inequality. Time domain solutions: steady state and dynamic. Modelling techniques: Formation of lumped parameter models. Classical assumptions. Accumulation equals input minus output. Analogies with electrical and mechanical systems. Significance of capacity for energy storage. Absolute and deviation variables. Linearisation. Scope for approximation. Laplace transformations. Conversion into transfer function models. Translation into block diagrams.

Module 2: System models: Modelling of control loop elements. Integration of process and control models. System block diagrams. Validation of models. Zero capacity systems. Hydrodynamic and electromechanical models. Models of reacting systems. Multiloop systems. State space modelling of multi variable systems. Models of distributed parameter systems. Discrete event modeling. Process models. Dynamic models of a variety items of plant: eg stirred tanks. jacketed vessels. pressure systems. heat exchangers. packed columns. etc. Models of a variety of operations: eg mixing. heating. blending. pumping. reaction. distillation. etc.

Module 3: Simulation: Use of continuous simulation languages. Simulation of linear & non-linear dynamic systems. Selection of numerical integration routines. Choice of step length & run time. Setting up initial and boundary conditions. Applying forcing functions and disturbances. Use of discrete event simulation languages (eg State flow). Documentation & flow charts. Interpretation of error messages & debugging. Functional testing and validation.

References

- Fishwick P.(1995).**Simulation Model Design and Execution**. New Delhi:PrenticeHall.. ISBN 0-13-098609-7
- Law A.. Kelton D.(1991).**Simulation Modelling and Analysis**. McGraw-Hill. ISBN 0-07-100803-9

	Electrical Engineering		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A .3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Advanced Power Converters	PHDELEC.E101	2.0
B.2.	FACTS	PHDELEC.E102	2.0
B.3.	Intelligent Techniques in Engineering	PHDELEC.E103	2.0
C.1.	**Dissertation**		**3.0**

B.1.Advanced Power Converters (PHDELEC.E101)

Course Overview: *The course is designed to help the students to understand concept of advanced power electronics converters in Electrical Engineering.*

Course contents

Module1. Control Methods for Power Converters: Control using State-Space Averaged Models. Sliding-Mode Control. Fuzzy Logic Control. Multilevel ConvertersBasic concepts of Switched Mode power converters. DC-DC converters Characteristics. constituent elements. operating principles. Steady state analysis. stress and sizing of elements. control methods. duty ratio. current programmed. frequency programmed and sliding mode control. Dynamic analysis and frequency domain models.

Module2. Resonant and Soft-Switching Converters: Classification. Basic resonant circuit concepts. Quasi-Resonant Converters. Load resonant converters. Resonant switch converters. Zero voltage

switching. Design of feedback compensators. unity power factor rectifiers. resistor emulation principle and applications to rectifiers

Module3. Working and operating principle of High frequency ac link converters. matrix converter. space vector modulation

References:

- Course Notes(2004).**Switched Mode Power Conversion.**CCE. IISc .
- Batarseh, Issa (2004).**Power Electronic Circuits**. John Wiley.
- Philip, T Krein(2005).**Elements of Power Electronics**. Oxford Press.
- Bose K.Bimal(2006). **Power Electronics and Motor Drives: Advances and Trends.**Academic Press
- Rashid.M.(2005).**Power Electronics Circuits. Devices and Application.** Pearson Third Edition

B.2.FACTS (PHDELEC.E102)

Course Overview: *The course is designed to help the students to understand concept of FACTS devices used in power system transmission.*

Course contents

Module1. The phenomenon of voltage collapse. the basic theory of line compensation. Static excitation system; static VAR compensators

Module2. Static phase shifters; Thyristor controlled series capacitors. Co-ordination of FACTS devices with HVDC links.

Module3. The FACTS optimization problem transient and dynamic stability enhancement using FACTS components. Advanced FACTS devices- the STATCON and unified power flow controller.

References:

- Mathur. M. Varma R.K.Thyristor(2002). **Based FACTS Controllers for Electrical Transmission System**. IEEE press and John Wiley & Sons. Inc.

- Padiyar K R.(2008).**FACTS Controllers in Power Transmission and Distribution**.Delhi:New Age International.

- Hingorani N G. Gyugyl L.(2001).**Understanding FACTS Concepts and Technology of Flexible AC Transmission System**. Delhi:Standard Publishers.

B.3.Intelligent Techniques in Engineering (PHDELEC.E103)

Course Overview: *The course is designed to help the students to understand concept of soft computing and intelligent techniques in Electrical Engineering.*

Course contents

Module1. Mathematical of fuzzy control: fuzzy sets. fuzzy set theory. properties of fuzzy sets. Operations of fuzzy sets. fuzzy relations .Non linear fuzzy control: The control problem. FKBC as non linear transfer element PID & sliding mode type FKBC. some typical application of fuzzy based control systems. Adaptive Fuzzy control: Introduction. design & performance evaluation. performance monitor. main approaches to design.

Module2. Adaptive Fuzzy control: Introduction. design & performance evaluation. performance monitor. main approaches to design. Stability of fuzzy control system: state space approach. stability and robustness indices. input-output stability. FKBC design parameters: Structure of FKBC fuzzification and defuzzification module. rule based choice of variable and contents of rules. derivation of rule data based. choice of membership function and scaling factors.

Module3. Artificial neural systems: Preliminaries. fundamental concepts & models of artificial system. neural networks learning rules. Hebbian. perceptron. delta Widrow-Hoff learning rules; Single layer percepton classification: Classification model. features & decision regions training & classification using discrete perception. algorithm & examples. single layer continuous perceptron networks for linear separable classification; Multilayer feedback work networks: Generalized delta learning rule. feedforword recall & error back propagation training. learning factors. Single layer feedback networks

References:

- ZuradaJ.M.(1997).**Introduction of artificial neural systems**. Jaico publication House
- McMillian S H.(1994).**Neural networks: comprehensive foundation**.College Publishing company inc.
- Omatu.S. Khalid M.Yusof R.(1996).**Neuro control and its application .**London:Spring Verlag Ltd.

- Driankov D.Hellendoorn H and Reinfrank M.(1997).**An introduction to fuzzy control**.Narosa Publication House.
- Hagan,T.**NeuralNetwork Design**ebook available at http://hagan.okstate.edu/NNDesign.pdf
- Jang JSR(1997)..**Neuro-fuzzy and soft computing**. PHI publication.

	Textile Engineering		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A .3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Advances In Yarn & Fabric Manufacturing Processes	PHDTX101	2.0
B.2.	Engineering of Textile Structure	PHDTX 102	2.0
B.3.	Advances In Polymer & Fibre Science and Textile Chemical Processing	PHDTX 103	2.0
C.1.	**Dissertation**		3.0

B 1.Advances in Yarn & Fabric Manufacturing Processes (PHDTX101)

Module 1*:* Blow room: Role of air current, Opening intensity, Carding: Carding theories, fiber behavior through carding machine, factor responsible in designing card wires, transfer efficiency, Draw frame: Doubling and drafting principle, Drafting force, Comber: Factors responsible for good lap preparation, Noil theory, Speed frame and ring frame: Design and development in flyer, Spinning geometry, defects and remedies in yarn. Optimum clearing of yarn; Classimate Faults, Control of ends break in warping, warp beam quality requirements; quality control in size recipe, size pick-up control, Development trends in winding, warping and sizing process. Kinematics of loom sley, Principles underlying shuttle less weaving mechanisms and their functioning: projectile, rapier; air-jet, Waterjet,

multiphase; Developments in shuttle less looms, developments in multiphase weaving, electronic let off and take-up , use of electronics in fabric manufacturing processes.

Module 2: Causes leading to the advent of unconventional systems of spinning; Principle and engineering design of rotor spinning, effect of rotor machine variables and fibre properties on the properties of rotor spun yarns. Limitation of rotor spinning, advances in rotor spinning, Study of other unconventional spinning systems, viz. friction spinning, air-jet spinning etc; Advances in these systems.Introduction to Non-woven fabrics, classification, non-woven field – its uses and future growth. Web preparation: requirements, properties of different web types. Needle Punching: technology, Spun-lacing technology, Spun Bonding and melt blown techniques and its applications. Chemical bonding: technology, binders – their types and properties, binder application techniques, Thermal bonding: technology, machineries (hot calendaring, hot-air systems).

Module 3: Structure & properties of yarns spun by various unconventional spinning systems; effect of raw material and machine variables on yarn characteristics; Plying of these yarns. Electrostatic, air-vortex spinning; Mechanism of yarn formation, properties and end uses of yarns spun on these systems. Other unconventional spinning systems, viz. Self twist, Twist less, Integrated, Disc, Parafil, Wrap etc – their working principles, properties and end use of yarns spun on these system. Weft knitting: manufacturing of single jersey, rib, purl and interlock weft knit fabrics and properties of these fabrics. Warp knitting: manufacturing of tricot and raschel fabrics and properties of these fabrics.
Subject Specific Assignment

References

- Sabit A, “Hand Book of Weaving”, CRC Press, 2000.
- Lawrence C A, “Fundamentals of Spun Yarn Technology”, CRC Press, 2002.
- Ormerod A, Sondhelm W S, “Weaving: Technology and Operations”, Textile Institute,1995.
- Ajgaonkar D B, Talukdar M K, Wadekar V R, “Sizing: Materials, Methods, Machines”, Textile Trade Press, 1982.
- Smith J B, “The Technology of Warp Sizing”, Columbine Press, London, 1964.
- Marks R, Robinson A T C, “Principles of Weaving “, Illustrated (Ed.),The Textile Institute, 1976.
- Lord R P, Mohamed H, “Weaving: Conversion of yarn to Fabric” Illustrated (Ed.), Woodhead Publishing Ltd., England, 1982.
- Krecma R, “Nonwoven Textiles”, Textile Trade Press, 1967.
- Krecma R, “Manual of Nonwovens“, Illustrated (Ed.), Textile Trade Press, 1971.
- Gulrajani M L, “Book of Papers of International Conference on Nonwovens”, The Textile Institute, UK, 1992.
- “Handbook of Nonwovens”, Russell S (Ed.) Woodhead Publishing Ltd., 2006.
- Spencer D J, “Knitting Technology”, 3rd Ed., Woodhead Publishing Ltd., 2001.
- Ajgaonkar B D, ”Knitting Technology”, Universal Publisher, 1998.
- Raz S, “Warp Knitting Production”, Melliand Textilberichte, 1987.
- Gajjar G J, “Handbook of Warp Knitting Technology”, Gajjar B J (Ed.) Woodhead Publishing Ltd., 2004.
- “Spinning in 70s”, Lord P R (Ed.), The Textile Institute, 1971.
- Oxtoby E, “Spun Yarn Technology”, Revised (Ed.), Butterworth-Heinemann, 2013
- Dyson E, "Rotor Spinning, Technical and Economics Aspects ", Textile Trade Press, New Mills, Stock Port, 1975.
- Salhotra K R, Ishtiaque S M, " Rotor Spinning; its advantages, limitations and prospects in India”, ATIRA, Ahmedabad, 1995.

- Lord P R, " Yarn Production; Science, Technology and Economics ", The Textile Institute, Manchester, 1999.
- Trommer G, "Rotor Spinning", Meliand Textilebenchte GmbH, Rohrbacher, 1995.
- Lawerence C A, Chen K Z, "Rotor Spinning", Textile Progress, The Textile Institute, England, 1984.
- Lawrence C A, "Advances in yarn spinning technology" Wood head publishing, 2010.
- Grosberg P, Iype C, "Yarn Production-Theoretical Aspects", 1st Ed., The Textile Institute, UK, 1999.
- Chattopadhyay R, "Advances in Technology of Yarn Production", 1st Ed., NCUTE, New Delhi, 2002.
- Rao M V S, Talele A B, "A Guide to Crimping / Texturing Technology", 1st Ed., Nasnal Printers and its associates, Surat, 1992.
- Klein W, "Manual of Textile Technology- New spinning Systems", Vol.5, 1st Ed., The Textile Institute, UK, 1993.

B 2.Engineering of Textile Structure (PHDTX102)

Module 1: Yarn diameter and count, density, specific volume, Yarn count and twist Factor, Twist Angle and helix angle, twist contraction and retraction packing of fibers and packing fraction, close packing and open packing of fibres, optimum level of twist. Effect of twist on yarn strength, Stress-stain curve, Young's modulus, tenacity, RKM etc. Ideal yarn geometry assumptions various relationship and related calculations.

Module 2: Mechanics of yarn structure, tensile behavior of staple yarn, and tensile behavior of continuous filament yarn, low strain and large stain model. Migration of fibre, Migration factors controlling and effect of migration in yarn structure, Morton's view of fiber migration in yarn. Various models examples and solutions.

Module 3: Woven cloth setting theories, elements of woven fabric geometry- ends and picks count cover factor, crimps and weight. Cover factors and its relations with fabric weight. Pierce's simple geometry of plain weave, derivation of basic equations, practical application of cloth geometry, crimps interchange, fabric assistance. Drape of fabric and drape coefficient.

References

- Behera B K, Militky J, Mishra R, Kremenakova D, "Modeling of Woven Fabrics Geometry and Properties", Pierce paper on fabric geometry, Jeon H-Y(Ed.), InTech, 2012, Available from: http://www.intechopen.com/books/woven-fabrics/modeling-of-woven-fabrics-geometry-and-properties.
- Grosberg P, Iype C, "Yarn Production: Theoretical Aspects", Illustrated (Ed.), Textile Institute, 1999.
- Goswami B C, Martindale J G, Scardino F L, "Textile Yarns: Technology, Structure, and Applications", Illustrated (Ed.), Wiley, 19774.
- Hearle J W S, Grosberg P, Backer S, "Structural mechanics of fibers, yarns, and fabrics- Vol. – 1", Illustrated (Ed.), Wiley-Interscience, 1969.
- Structure and Mechanics of Textile Fibre Assemblies", Schwartz P (Ed.), Elsevier, 2008.
- "Modelling and Predicting Textile Behaviour", Chen X (Ed.), Elsevier, 2009.
- Das D, Pourdeyhimi B, "Composite Nonwoven Materials: Structure, Properties and Applications", Elsevier, 2014

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B 3.Advances in Polymer & Fibre Science and Textile Chemical Processing(PHDTX103)

Module 1: Synthesis and characterization of advanced polymeric materials. Polymer Physics and Chemistry, Structure property correlation, Functional polymers and systems, Stimuli responsive polymers and Phase change materials for heat storage. Modification of natural and synthetic fibres, Nanofibers by electrostatic spinning, Polymeric Nanocomposites, Nanoclay based coatings and composites, Nano engineered fire resistant composite fibres

Module 2: Biomedical applications of Textiles, Sustainability and polymer recycling, High stress elastic Materials (ropes/braided structures), Chitosan Chemistry and Application, Isolation And Application of Sericin, Surface Functionalisation by Plasma And UV Excimer Lamp, Micro-Encapsulation And Nano Encapsulation, Processing of Bamboo Fibres.

Module 3: Natural Dyes, Dyeing and Finishing, Conducting Fabrics, Bio Active Fabrics, Textile Ecology and Environment.Subject Specific Assignment

References

- Vaidya A A, "Production of Synthetic Fibres", 1st Ed., Prentice Hall of India, New Delhi, 1988.
- Gupta V B and Kothari V K, "Manufactured Fibre Technology", 1st Ed., Chapman and Hall, London,1997.
- Mark H F, Atlas S M and Cernia E, "Man Made Fibre Science and Technology", Vol. 1 - 3, 1st Ed., Willey Inter Science Publishers, New York, 1967.
- Macintyre J E, "Synthetic Fibres", Woodhead Fibre Science Series, UK, 2003.
- Fourne F, "Synthetic Fibres: Machines and Equipment, Manufacture, Properties", Hanser Publisher, Munich, 1999.
- Manufactured Fibre Technology, http://nptel.ac.in/courses/116102010/#.
- Jassal M and Ghosh S, "Aramid fibres – An overview", IJFTR, 2002, 27, 290-306.
- Dasgupta S, Hammond W B and Goddard III W A, "Crystal structures and Properties of Nylon Polymers from Theory", J Am Chem Soc, 1996, 118, 12291-12301.
- Wyatt T P, Chien A-T, Kumar S and Yao D, "Development of a Gel Spinning Process for High-Strength Poly(ethylene oxide) Fibres", Polym Eng Sci, 2014, DOI 10.1002/pen.23842
- Shennai VA, "Technology of Textile Processing– Vol.1", 2 nd Ed., Sevak Publication, 1977.
- "Textile Fibres: Developments and Innovations", Kothari V K (Ed.), IAFL Publications, 2000.
- Murthy HVS, "Introduction to Textile Fibres", CRC Press, Woodhead Publishing India Pvt. Ltd., 2016.
- Moncrieff R W, "Man Made Fibres (Formerly entitled: Artificial fibres)", 3 rd Ed., National Trade Press, 1959.
- Nakamura A, "Fibre Science & Technology", Illustrated Ed., Science Publishers, 2000.
- Mishra S P, "A Text Book of Fiber Science & Technology", 1 st Ed., New Age International (P) Ltd., 2000.
- Hongu T, Philips G O, "New Fibers", 2 nd Ed., Wood head Publishing Ltd., England, 1997.
- "Advances in Fibre Science", Illustrated Ed., Mukhopadhyay S K (Ed.), Textile Institute, Manchester, England, 1992.
- "Reference book for Composite Technologies", Lee S M (Ed.), CRC Press, Technocomic Publishing Company, Inc., (USA), 1989.

- McKenna H A, Hearle J W S, O'Hear N, “Handbook of Fibre Rope Technology”, Textile Institute, CRC Press, Wood Head Publishing ltd., England, 2004.
- “Handbook of Textile and Industrial Dyeing: Principles, Processes and Types of dyes”, Clark M (Ed.), Wood Head Publishing Ltd., England, 2011.
- Thresh R, Thresh C, “An introduction to natural dyeing”, Iillustrated (Ed.), Thresh Publications, USA, 1974.
- Cardon D, “Natural Dyes: Sources, Tradition, Technology and Science”, Illustrated (Ed.), Archetype, 2007.
- “Medical Textile Materials”, Qin Y (Ed.), Textile Institute, Wood Head Publishing ltd., England, 2016.
- Belitskus D, “Fibre and Whisker Reinforce Ceramics for Structural Applications”, CRC Press, Marcel Dekker Inc., 1993.
- Hennen W J, “Chitosan: Woodland Health Series”, Woodland Publisher, 1996.
- Muthu S S, “Assessing the Environmental Impact of Textiles and the Clothing Supply Chain”, The Textile Institute, Wood Head Publishing ltd., Elsevier, England, 2014.
- Slater K, “Environmental Impact of Textiles: Production, Processes and Protection”, The Textile Institute, Wood Head Publishing ltd., England, 2003.
- Gulrajani M L, “Advances in the dyeing and finishing of technical textiles: 12. The use of nanotechnology in the finishing of technical textiles”, Elsevier Inc., 2013.
- “Hand book of nonwovens”, Russell S J (Ed.), Woodhead 2007
- Geosynthetics in civil engineering, R. W. Sarsby, Woodhead Publishing, 2006.
- “Handbook of Technical Textiles”, Horrocks A R and Anand S C (Ed.), The Textile Institute, Wood Head Publishing ltd., England, 2002.

	Computer Science		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAE101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Software Engineering	PHDCS101	2.0
B.2.	Simulation and modeling	PHDCS102	2.0
B.3.	Advanced Operating System	PHDCS103	2.0
C.1.	**Dissertation**		3.0

B1.Software Engineering(PHD**CS**101)

Module1. Software process Models and lifecycle. Project Management Concepts & Project Metrics. Software Project Planning. Scheduling and Tracking. Software Requirements Specification. Analysis Modeling. Software Design Concepts and Principles. Architecture Design. Distributed System Architectures. Application Architectures

Module2. Object Oriented Design. Real time Software Design. User Interface Design. Component Level Design. Rapid software development. software Reuse. Component based software Engineering. Critical system development. Risk Analysis & Management. Coding.

Module3. Software Testing Techniques & Software Testing Strategies. Software Quality Assurance and Configuration Management. Emerging and advanced topics in Software Engineering. Security Engineering. Agile Methods. Client Server Software Engineering. Aspect Oriented Software Development. Software Engineering Aspects of Programming Languages. Reverse Engineering. Re-engineering. Web Engineering. CASE.

References:

- R. S. Pressman(2002).**Software Engineering – A Practitioner's Approach**". McGraw Hill.
- Pankaj Jalote(2003).**Software Engg**. Narosa Publications.
- Ian Sommerville(2005).**Software Engineering**.New York:Addison-Wesley
- Richard Fairley(2004).**Software Engineering Concepts.** New York:Thompson
- Elis Awad(2001).**System Analysis & Design**. New Delhi:Galgotia publications

B2.Simulation and Modeling(PHDCS102)

Module1: Introduction: Purpose. uses and benefits of system modeling. Use of models for design. real time training and optimization. Types of model: first principles versus stochastic. heuristic. empirical. etc. Physical equations of systems: algebraic and differential. Constraint equations: equality and inequality. Time domain solutions: steady state and dynamic.

Module2:Modeling techniques: Formation of lumped parameter models. Classical assumptions. Accumulation equals input minus output. Analogies with electrical and mechanical systems. Significance of capacity for energy storage. Absolute and deviation variables. Linearization. Scope for approximation. Laplace transformations. Conversion into transfer function models. Translation into block diagrams.

System models: Modeling of control loop elements. Integration of process and control models. System block diagrams. Validation of models. Zero capacity systems. Hydrodynamic and electromechanical models. Models of reacting systems. Multiloop systems. State space modeling of multi variable systems. Models of distributed parameter systems. Discrete event modeling. Process models. Dynamic models of a variety items of plant: eg stirred tanks. jacketed vessels. pressure systems. heat exchangers. packed columns. etc. Models of a variety of operations: eg mixing. heating. blending. pumping. reaction. distillation. etc.

Mathematical Model: types of Mathematical models and properties. Procedure of modeling. Basic optimization. Basic probability.

Module3: Simulation: Use of continuous simulation languages. Simulation of linear & non-linear dynamic systems. Selection of numerical integration routines. Choice of step length & run time. Setting up initial and boundary conditions. Applying forcing functions and

disturbances. Use of discrete event simulation languages (eg State flow). Documentation & flow charts. Interpretation of error messages & debugging. Functional testing and validation.

References

- Edward A. Bender(1999).**An Introduction to Mathematical Modeling**
- S.M. Ross(2005). **Simulation**. India Elsevier Publication
- J. N. Kapoor(2001). **Mathematical Modeling,** Wiley eastern limited.

B3. Advanced Operating System (PHDCS103)

Module 1: Introduction: Basics of Operating Systems. Processes: Definition . Process Relationship . Process states . Process State transitions . Process Control Block .Context switching – Threads – Concept of multithreads . Benefits of threads – Types of threads Process Scheduling: Definition . Scheduling objectives .Types of Schedulers .Scheduling criteria : CPU utilization. Throughput. Turnaround Time. Waiting Time. Response Time (Definition only) . Scheduling algorithms : Pre emptive and Non . pre emptive . FCFS – SJF – RR . Multiprocessor scheduling : Types . Performance evaluation of the scheduling.

Module2-: Memory Management Basic Memory Management: Definition .Logical and Physical address map . Memory allocation : Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction . Paging : Principle of operation – Page allocation – Hardware support for paging –.Protection and sharing – Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference. Page fault . Working Set . Dirty page/Dirty bit – Demand paging (Concepts only) – Page Replacement policies : Optimal (OPT) . First in First Out (FIFO). Second Chance (SC). Not recently used (NRU) and Least Recently used (LRU)

Module3:Interprocess Communication: Race Conditions. Critical Section. Mutual Exclusion. Hardware Solution. Strict Alternation . Peterson's Solution. The Producer Consumer Problem. Semaphores. Event Counters. Monitors. Message Passing. Classical IPC Problems:

Reader's & Writer Problem. Dinning Philosopher Problem etc.. Scheduling . Scheduling Algorithms.

Deadlocks: Definition. Deadlock characteristics. Deadlock Prevention . Deadlock Avoidance :banker's algorithm. Deadlock detection and Recovery.

References:

- Deitel. H.M.(1984).**An Introduction to Operating Systems**. Addison Wesley
- Publishing Company
- Milenkovic. M.(1992).**Operating Systems - concepts and Desig**n.McGraw Hill International Edition-Computer Science series
- Galvin P.. J.L. Abraham Silberschatz(1982).**Operating System Concepts.** John Wiley & Sons
- Tanenbaum. A.S.(1995).**Modern Operating System** Prentice Hall of India Pvt.Ltd.
- William Stallings **Operating Systems**.. Prentice Hall of India Pvt. Ltd.

	Physics		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Plasma Physics	PHDPHY101	2.0
B.2.	X-ray Absorption	PHDPHY102	2.0
B.3.	Spectroscopic Tools and Techniques	PHDPHY103	2.0
B.4.	Polymer and Characterization Techniques	PHDPHY104	2.0
B.5.	Material Science	PHDPHY105	2.0
C.1.	**Dissertation**		3.0

B1. Plasma Physics (PHDPHY101)

Module1: Plasma Physics Occurrence of Plasma in Nature: Criteria for plasmas. Single particle motion in uniform and non uniform electric (E) and magnetic (B) fields. Time varying E and B field. Adiabatic invariants magnetic mirrors. Fluid equation of motion. Fluid drifts parallel and perpendicular to B. Plasma Oscillations

Module2: Electrostatic electron and ion perpendicular to B. Electromagnetic waves with B0=0. Propagation Vector (K) perpendicular and parallel to B0. Alfven waves. Diffusion in weakly and fully ionized plasmas. Decay of Plasma by Diffusion

Module3: Two stream instability. Gravitational Instability. Weibel instability. Equations of kinetic theory. Derivation of the Fluid equations Landau damping . Plasma Echoes. The Problem of controlled Fusion. Magnetic confinement-Torous. Mirrors. Pinches. Plasma Heating Laser induced Fusion. Plasma Processing.

References:

1.:F.F.Chen(2008**). Introduction to Plasma Physics and Controlled Fusion**
2.D.R. Nicholson(2009). **Introduction to Plasma Theory**

B2.-X-ray Absorption (PHDPHY102)

Module1: Physics of X-ray Absorption. Recording of X ray Absorption Spectra. X-ray Absorption Edges. X-ray Fluorescence. Measurement of X-ray Absorption Spectra. Applications of XAS.

Module2:X-Ray Absorption Near Edge Structure(XANES). Sensitivity of XANES to Oxidation State. Multiple Scattering and XANES. Bound State Transitions in XANES. Multi-electron Transitions in XANES. Applications of XANES to Coordination Chemistry

Module3: Extended X-Ray Absorption Fine Structure (EXAFS). Theoretical Description of EXAFS Spectra. Single Scattering. Multiple Scattering. Other corrections to the EXAFS equation. Limitations of EXAFS. Applications of EXAFS to Coordination Chemistry.

References:

- James. R. W(1982).**The Optical Principles of the Diffraction of X-ray**; Ox Bow Press.

  Markowicz. A. A**.(2002). In Handbook of X-ray Spectrometry**; 2nd ed.;
- Thompson. A. C.; Vaughan. D. Eds(2001). **X-ray Data Booklet.** 2nd edLawrence Berkeley

  National Laboratory: Berkeley.

B.3.Spectroscopic Tools and Techniques (PHDPHY103)

Spectrometer
XRD: X-ray Diffraction Concepts and Applications.
XPS: X-ray Photon Spectroscopy.
NMR: Nuclear Magnetic Resonance
IR: Infrared Spectroscopy
UV: Ultra-Violate Spectroscopy
SEM: Scanning Electron Microscopy
SIMS: Secondary Ion Mass Spectroscopy
EDX: Energy Dispersive X-ray Spectroscopy
MBS: Micro Balance Spectroscopy
RGA: Residual Gas Analyzer
Computer programming Mat-Cad. origin. C++

B-4: Polymer and Characterization Techniques (PHDPHY104)

Module1- Introduction to Polymer: Basic concepts on polymers: basic terms, Biopolymers, Molecular weight and distribution, Polymerization principles and processes: step, chain and other polymerizations, polymer kinetics, Polymer characterization, Polymer applications: Biodegradable polymers, biomedical polymers, conducting polymers, Electrochemical Applications

Module I1 Thin Film Preparations: Introduction, Fabrication of Thin Films, Solution Cast Technique, Thermal Evaporation Techniques, Resistive heating, Flash evaporation, Electron beam evaporation, Pulsed Laser deposition, RF heating, Basic concept of sputtering– ion surface interaction, sputtering yield, Chemical Vapour Deposition

Module III Characterization Techniques: Production and properties of X-rays, X-ray diffraction, Braggs equation, FTIR, Impedance Spectroscopy, NMR, Thermal Analysis: DSC, TGA, Microscopic Analysis: OPM, SEM, TEM

References:

1. Fred W. Billmeyer, Jr., Textbook of Polymer Science, 3rd Edition, John Wiley & Sons, Singapore, 1994.

2. George Odian, Principles of Polymerization, Second Edition, John Wiley & Sons, New York, 1981.

3. Charles E. Carraher, Jr., Seymour/Carraher's Polymer Chemistry, 5th Edition, Marcel Dekker, Inc., New York, 2000.

4. Premamoy Ghosh, Polymer Science and Technology, Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2002.

5. Gowariker V R, Viswanathan N V and Sreedhar J, Polymer Science, 2nd Edition, New Age International (P) LTD, India, 2005

6. Rui Yang, Analytical Methodes for Polymer Characterization, CRC Press, Taylor & Frances Group, 2017.

7. Nicholas P. Cheremisinoff, Polymer Characterization: Laboratory Techniques and Analysis, Noyes Publications, 1996.

B-5: Materials Science (PHDPHY105)

Module I -Introduction to Materials Science: Classification of Materials, Advanced Materials, Atomic Structure and Interatomic bonding, Crystalline and Non-crystalline Materials, Crystallographic points, directions and planes, Imperfections in Solids, Concept of Stress and Strain, Phase diagram, Density of States, 3D, 2D, 1D and 0D Materials, Nano materials, Thin films and Multilayer, Surface and Interface, Nano composites.

Module II -Material Synthesis and Processing: Kinetics of nucleation and growth of thin films, effect of deposition parameters (substrate, vacuum, temperature, pressure etc); Physical Vapor Deposition (PVD) techniques: Thermal evaporation, e-beam evaporation, Molecular Beam Epitaxy, Sputtering, Chemical Vapor Deposition (CVD) techniques; Wet methods: Spin coating, Dip coating,

sol gel, spray pyrolysis, hydrothermal growth, Electrochemical Methods, electrospinning; Solid State Reaction method, Ion implantation and irradiation.

Module III - Material Characterization Techniques: X-ray diffraction, X-ray reflectivity, Transmission & scanning electron microscopy, Atomic probe microscopy, Differential Scanning Calorimetry, Hall Effect, VSM/SQUID, Nuclear Magnetic Resonance, UV-VIS spectroscopy, Photoluminescence, FTIR, Raman spectroscopy, XPS, EXAFS/XANES, IV/CV measurements, Indentation, RBS/ERDA.

Reference Books:

1. William D. Callister, Jr. and David G. Rethwishch, Materials Science and Engineering: An Introduction, 10th Edition, John Wiley & Sons, 2018.
2. K. L. Chopra, Thin Film Phenomena, McGraw-Hill, New York, 1969.
3. Narendra Kumar and SunitaKumbhat, Essentials in Nanoscience and Nanotechnology, John Wiley & Sons, 2016.
4. Milton Ohring, Materials Science of Thin films, 2nd Edition, Academic Press, 2001.
5. John E. Mahan Physical Vapor Deposition of Thin Films, , John Wiley & Sons, 2000.
6. J. Allen Bard Larry R. Faulkner, Electrochemical Methods: Fundamentals and Applications, Wiley, 1980.
7. David B. Mitzi Solution Processing of Inorganic Materials, , John Wiley & sons, 2009.
8. D. K. Avasthi & G. K. Mehta, Swift Heavy Ions for Materials Engineering and Nanostructuring, Springer/ Capital Publishing Company, 2011.
9. Surender K Sharma, Handbook of Materials Characterization, Springer International Publishing, 2018.
10. Bipin K. Agarwal, X-Ray Spectroscopy: An Introduction, Springer International Publishing ,1991.

	Nano Technology		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	**3.0**
A.2.	Review of Literature	PHDA102	**2.0**
A.3.	Computer Applications	PHDA103	**2.0**
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	**Nanostructures and Nanomaterials**	PHDNANOT101	**2.0**
B.2.	**Nanostructures & Industrial Nanotechnology**	PHDNANOT102	**2.0**
B.3.	**Spectroscopic Tools andTechniques**	PHDPHY103	**2.0**
C.1.	**Dissertation**		**3.0**

B1.Nanostructures and Nanomaterials

Module 1: Background to Nanotechnology Scientific revolution- Atomic structures-Molecular and atomic size-Bohr radius – Emergence of Nanotechnology – Challenges in Nanotechnology - Carbon age–New form of carbon (from Graphene sheet to CNT). Nucleation Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio.

Module 2: Types of Nanostructures Nanomaterial and properties Carbon Nanotubes (CNT) - Metals (Au. Ag) - Metal oxides (TiO2. CeO2. ZnO) - Semiconductors (Si. Ge. CdS. ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor- Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical. Physical and Chemical properties.

Module 3: Applications of Nanomaterial Molecular electronics and nanoelectronics. CNT based transistor and Field Emission Display. Low Pressure Phase Chemical Vapour Deposition. Thermal Chemical Vapour Deposition. Scanning Electron Microscope. Micro-Raman Spectrometer. ECR-Plasma Etching system. ECR-Chemical Vapour Deposition. I-V Characteristics. F.T.I.R. Fluorescence Spectrophotometer. Differential Scanning Calorimeter. R.F. Sputtering .PECVD

References:

- M. Wilson. K. Kannangara. G Smith. M. Simmons. B. Raguse(2005).**Nanotechnology: Basic science and Emerging technologies.** Overseas Press India Pvt Ltd.

- C.N.R.Rao. A.Muller. A.K.Cheetham (Eds)(2004**).. The chemistry of nanomaterials: Synthesis. properties and applications.** Wiley VCH Verlag Gmbh&Co. Weinheim

- Kenneth J. Klabunde (Eds)(2001).**Nanoscale Materials Science**. John Wiley & Sons. InC.

B2.Nanostructures & Industrial Nanotechnology

Module 1: Semiconductor fabrication techniques. Electronic structure and properties of semiconductor nanostructures. Principles and performance of semiconductor nanostructures based electronic and electro-optical devices. Photoinduced magnetism and spintronics. Nanomagnetic probes. Electronic magneto transport and micro magnetic modeling.

Module 2: Micro and nano electromechanical systems-fabrication process. choice of materials. calculations. performance of different nanostructures. magnetic. chemical and mechanical nanosensors and micro actuators. Optical waveguide SPR coupling-SPR dependencies and materials – plasmonics and nanoparticles. Thin film.Conducting and semiconducting polymers-hybridization. conjugation and excitations.

Module 3: Molecular crystals.Organic electroluminescent displays-injection. transport. exciton formation and light emission. Influence of supramolecular order- excimers. H and J aggregates. Liquid crystal display.Nanomaterials in bone substitutes & dentistry. Antimicrobial applications of nanomaterials. Food and cosmetic applications of nanomaterials. Application of nanomaterials in textiles. paints. catalysis. lubricants. fuel cells

References:

- Ajoy Ghatak and K. Thyagrajan **Optical electronics** Cambridge University Press.

- Z. Zhou. Z. L. Wang and L. **LinMicrosystems and nanotechnology**. Springer.

- H. Masuhara. S. Kawata and F. Tokunga. (2007). **anoBiophotoics"**. Elsevier Science.

- J. Verdeyen(1990.).**Laser Electronics**. II Edition. Prentice Hall.

- .C.W. Turner. T. Van Duzer (1981).**Principles of Superconductive Devices and Circuits.**

B3.Spectroscopic Tools and Techniques

Spectrometer
XRD: X-ray Diffraction Concepts and Applications.
XPS: X-ray Photon Spectroscopy.
NMR: Nuclear Magnetic Resonance
IR: Infrared Spectroscopy
UV: Ultra-Violate Spectroscopy
SEM: Scanning Electron Microscopy
SIMS: Secondary Ion Mass Spectroscopy
EDX: Energy Dispersive X-ray Spectroscopy
MBS: Micro Balance Spectroscopy
RGA: Residual Gas Analyzer
Computer programming Mat-Cad. origin. C++

	Chemistry		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Selected Topics in Inorganic Chemistry	PHDCHEM101	2.0
B.2.	Selected Topics in Organic Chemistry	PHDCHEM102	2.0
B.3.	Selected Topics in Physical Chemistry	PHDCHEM103	2.0
C.1.	**Dissertation**		3.0

B.1.**Selected Topics in Inorganic Chemistry(**PHDCHEM101)

Module 1: Inorganic Nanomaterials and Their Applications:
Introduction to nanomaterials. Physicochemical properties of nanomaterials (Optical. Electrical. Electronic Redox. Mechanical. Magnetic and catalytic).Synthesis and Preparation of nanostructured oxides and chalcogenides. Influence of nanomaterials on health. communication. Energy. Environment. safety. security and defence. Special applications of nanomaterials. sensor. energy storage. nanoelectronics and computing structural materials (Nanocomposites) catalysis communication. nanomedicine. Advanced nanomaterials . Si. C. Ag. Au. Pt nanoparticles.

Module 2: Co-Ordination Organometallic Complexes and Characterization Techniques:
Introduction to co-ordination complexes. synthetic methodology. ligational behavior types of ligands. spectroscopic characterization of complexes. magnetic and electrochemical behavior of complexes. Organometallic compounds: Types. synthetic methodology with special reference to metal acetylide and carbonyl compounds. spectroscopic characterization. applications of co-ordination and organometallinc compounds.

Module 3:
Characterization of Materials Material characterization: Basic principles and applications of IR. UV-VIS. NMR.XPS. UPS. AES. SEM. TEM. XRD. DTA-TGA. DSC.

References

- B. Viswanathan **Nanomaterials.**

.

- Daniel Minoli..**Nanotechnology applications**.
- K.C. Patil. M. S. Hegade. Tanu Rattan. S.T. Aruna.**Nanocrystalline oxide**
- **materials..Synthesis. properties and applications of oxide nanomaterials**.
- C. N. R. Rao**..Trends in Chemistry of materials.**
- Hollman Wiberg.**Inorganic Chemistry.**
- Eulem Smith. Geofferey Dent.**Modern Raman Spectroscopy**.
- Paulson. Arnold**.Organometalic Chemistry**.
- .
- Rochow. Reinhold**.Organometalic Chemistry**.
- **Organometalic Chemistry**. Reinhold. Zeiss.
- D. Max Roundhill and John P.Fackler..**Optoelectronic properties of Inorganic compounds**.
- .Banwell C. N.; McCash. E. M. (2006).**Fundamentals of Molecular Spectroscopy**. TataMcGraw Hill.Lampman.
- G. M.; Pavia. D. L.; Kriz. G. S.; Vyvyan(2010).**Spectroscopy.** 4thEd..Cengage Learning
- .Drago. R. S.((1999**). Physical Methods for Chemists**. Saunders Company
- .Dyer. J. R.((2004).**Applications of Spectroscopy of Organic Compounds**. PrenticeHall
- Kemp. W.((2011).**Organic Spectroscopy**. Macmillan

.

B.2: Selected Topics in Organic Chemistry(PHDCHEM102)

Module 1: New synthetic methodologies and applications of reagents:
Microwave and ultrasonic methods of synthesis. biocatalysts and biotransformations. phase transfer catalysts. electro-organic synthesis. Ionic liquids.Enantio and diastereoselective synthesis use of oxone. hyper valent iodine reagents. and complex metal hydrides. Organometilics compounds of Cu. Ni. Se Co and Organoboranes.

Module 2: Designing of Organic Synthesis (Retrosynthesis):
Retrosynthesis of heterocycles. agrochemicals. natural products. and perfumery Compounds,Synthesis and applications of the following drugs: Cardiovascular. antidiabetics. antineoplastics. and antiviral drugs. Computer aided drugs designing and molecular modeling

Module 3: Organic Photochemistry:

Photochemical processes. photo reactions of dienes. arenes and carbonyl compounds. Reactivity of singlet and triplet oxygen. Photorearrengements. Applications of photoreactions in laboratory and industrial synthesis. Stereochemistry of Chlolestane. Yohimbine and Reserpine.

References

- H.O.House: **Modern Synthetic Reaction**.
- M.B.Smith: **Principles of Organic Synthesis** (McGraaw Hill)
- Hendrikson. Cramand Hammond: **Organic Chemistry**
- E.L. Eliel: **Stereochemistry of Carbon Compounds**
- D. Nasipuri: **Stereochemistry of Organic Compound**.
- S.Warren: **Designing of Organic Synthesis**
- Warren ant Wyatt: **Organic Synthesis: Strategy and Control**
- Apsimon: **The Total Synthesis of Natural Products.**
- I. Finar: **Organic Chemistry Vol. II and I**
- J. Kagan: **Organic Photochemistry**
- H.Arora: **Organic Chemistry and Pericyclic Reaction**.
- J. Coxon and B. Hallon: **Organic photochemistry** Cambridge University Press.

B.3: Selected Topics in Physical Chemistry(PHDCHEM103)

Module 1: Preparation of Materials and applications:
a)Thin films and Langmuir- Blodgett Films: Preparation techniques; sol - gel. spin coating. Langmuir- Blodgett (LB) photolithography. properties and applications of films.
b) Materials of Solid State Devices: Organic and inorganic materials for rectictifiers. transistors. capacitors and their applications in optoelctronic and photovoltaic devices.

Module 2:Kinetics of redox reactions:
Outer and inner sphere reactions. kinetics and mechanism of oxidation reactions involving chromium. ruthenium and silver(III). Kinetics of catalyzed reactions: Homogeneous and heterogeneous. Positive. negative and auto catalysed reactions. Induced reactions. promoters and poisons. Theories of catalysis: intermediate compound formation and adsorption theory. characteristic of catalytic reaction and activation energy of catalyzed reactions.

Module 3: Thermodynamic and Dielectric Properties of Liquids and Solutions:
Structure of liquids. relationship between structure and the thermodynamics properties. molecular theory of monoatomic and polyatomic liquids. thermodynamics of phase equilibria. statistical molecular description of phase transitions. chemical potential and part ial molar quantities. mixing and excess thermodynamic properties of mixtures. statistical mechanical theories of nonelectrolyte and electrolyte solutions. influence of solute on structure of water. structure of water near a surface Static dielectric constant: Dipolar interactions. dipolar molecules in gases and in dilute solutions.

References

- N. W. Ashcrott and N. D. Mermin. **Solid State Physics.** Saunders College
- W. D. Callister**Material Science and Engineering. An introduction**.Willey.
- J. C. Anderson . K. D. Leaver. J. M. Alexander and R. D. Rawlings**Materials Science**.. ELBS
- K. J. Laidler**Chemical Kinetics**

- Frost and R. G. Pearson **Kinetics and Mechanism**

- Asim K. Das. (2004).**Kinetics and mechanism of chromium(VI) oxidation Of organic substrates** By Coordination Chemistry Reviews.Vol 248. p 81-89

- B.Sethuram(2003).**Some aspects of electron transfer reactions involving organic molecules**Allied Publishers.

- Bo Jonsson. Bjorn Lindman. Krister(2006).**Surfactants and polymers in aqueous solution**
- Daniel Minoli.(2008).**Nanomaterials.Nanotechnology applications**.

- K. C. Patil. M. S. Hegade. Tanu Rattan. S.T. Aruna(2009).**Nanocrystalline oxide materials**.
- Jose A. Rodriquez. M. F.Garcia(2010)..**Synthesis. properties and applications of oxide nanomaterials**.

	Forensic Science		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Forensic Physics with Computer Forensics, Documents and Impressions	PHDFS101	2.0
B.2.	Forensic Chemistry, Toxicology and Pharmacology	PHDFS102	2.0
B.3.	Forensic Biology and Serology	PHDFS103	2.0
C.1.	**Dissertation**		3.0

B 1.Forensic Physics with Computer Forensics, Documents and Impressions(PHDFS101)

Module1: Forensic Physics:Physical Evidences:Glass, Dust, Soil: Composition and their forensic examination.**Tool marks:** Types and their examination. **Speaker identification and tape authentication:Advanced Forensic Physical Techniques: Microscopy:** Comparison microscope, Phase contrast microscope, Stereoscopic microscope, polarizing microscope, Fluorescent microscopy, Infra-red microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM);VSC (Video spectral comparator);ESDA ;NIBIN (National Integrated Ballistic Information Network) ;Advanced Computer and Cyber Forensic Tools.

Module2: Documents & their types, Digital documents. **Writing instruments and surfaces:** Types and examination of ink and paper.**Handwriting based examination:** Class and individual characteristics of handwriting.Characteristics and examination of genuine and forged

signature.Disguised writing, Secret writing, Indented writing. **Mechanical Impression:** Examination of Typed and Printed Documents.

Module 3: Fingerprint & Other Impression: History and development of fingerprint, pattern types, pattern area. Classification of fingerprints. Preservation and development of latent prints.Fingerprint Comparators,Automated Fingerprint Identification System (AFIS), Modern methodologies in fingerprinting. **Impressions:** Foot print, Footwear Prints, Tyre impressions, casting and their Comparison. Gait pattern, Skid marks.Lip prints, Ear prints and their forensic significance.

Suggested Readings:

- C.E. O 'Hara and J.W. Osterburg; An Introduction to Criminalistic: Indiana University Press, Blomington, (1972)
- Albert S. Osborn ; Questioned documents, Second Ed; Universal Law publishing, Delhi; (1998)
- B. Caddy; Forensic Examination of glass and paints analysis and interpretation ISBN 0784 05749 (2001)
- Bengold & Nelson Moryson – Speech and Audio signal Processing; John Wiley & Sons, USA, (1999)
- Charles C. Thomas, Typewritting Identification I.S.Q.D. Billy Bates; Springfield, Illinois, USA, (1971)
- Chatterjee S.K., Speculation in Finger print Identification, Jantralekha Printing works, Kolkata, (1981).
- Cossidy, MJ.: footware Identification, Royal Canadian Mounted Police, Ontario, Canada (1980)
- Cowger, James F: Friction ridge skin: Comparison and Identification of fingerprints: CRC Press, Boca Raton, New York, (1993)
- David R. Ashbaugh : Quantitative and Qualitative Friction ridge analysis, CRS press, (1999)
- Dennis Shaw; Physics in the Prevention and Detection of Crime, Contem Phys. Vo U7; (1976)
- E. Ronald Menzel: Fingerprint Detection with Lasers, Second edition: Marcel Dekker, Inc. USA, (1999)

- Henry C. Lee & R.E. Ganesslen, Advance in Finger print Technology, ~ RC press, Boca Raton, London, (1991)
- Iannarelli, A V: Ear print Identification, Forensic Identification series, Paramount (1989)
- Kasprzak, J: Possibilities of Cheiloscopy in Forensic science (1980)
- Larinson Jay; Questioned documents, Acad Press, London (2001)
- Medlin H O: Ear print Identification, Solve Crime Military Police Journal (1967)
- Mehta M.K. : Identification of Thumb Impession & cross Examination of finger prints, N.M. Tripathi (P) Ltd. Bombay (1989)
- Morris, Ron, N: Forensic handwriting identification, Acad Press, London (2001)
- Nickolls, L.C.; Scientific Investigation of Crime, Bulterwest, London (1956)
- Philip Rose; Forensic Speaker Identification; Taylor and Francis Forensic Science Series, London (2001)
- R. Saferstein; Forensic Science Handbook, Vols. I, II; (Ed); Prentice Hall, Eglewood Cliffs, NJ; (1988)
- Raymond C Murray & John C.F. Tedrew; Forensic Geology; Prentice hall, New Jersey (1991)
- Rev. ED : Ordway Hilton ; Scientific Examination I of Questioned Documents, Elsevier, New York ; (1982)
- Wilson R. Harrison ; Suspect documents – Their Scientific Examination; Universal Law Publishing, Delhi. (1997)
- Working Procedure Manual: Physics BPR&D Publication (2000)

B 2.Forensic Chemistry, Toxicology and Pharmacology(PHDENV102)

Module1: ForensicChemistry: Classification of drugs: Narcotics,Hallucinogens,Depressants,Stimulants,Anabolicsteroids.PsychotropicandPsychedelicdrugsof abuse.**Sample treatment techniques:** Centrifuge, Filtration, evaporation, crystallization, solvent extraction technique like LLE, SPE etc.**Explosive:** Classification, detection and analysis of explosive **Beverages:** Analysis of alcoholic and non alcoholic beverages

Module2:Forensic Toxicology &Pharmacology:Poison: Classification of poison, Types of poisoning sign and symptoms of poisoning, mode of action, factor modifying the action of poisons, Isolation and extraction of poisons from various forensic exhibits, extraction methods.

Forensic Pharmacological studies: Absorption, Distribution, Metabolism, Pathways of drug metabolism.**Examination and analysis of:** Opium and opiates, Cannabis drugs, Stimulant drugs, Depressants.

Module 3. Instrumental Techniques :Chemical, Chromatographic techniques: Theory and classification of chromatography, general idea on PC, TLC, HPTLC, GC and HPLC. **Spectroscopic techniques:** Overview and Forensic applications of UV-Visible, IR and FTIR, Mass Spectrometry, AAS.**X-ray techniques in forensic analysis.**

Suggested Readings

- John A. Dean ; Analytical Chemistry Handbook McGraw Hill Inc. (1995)
- Boudreau JE, etal ;Arson & Arson Investigation Survey & Assessment National Institute of Law Enforcement, U.S. Deptt. of Justice, US Govt. printing press (1977)
- Brean S. Furniss etal : A.I. Vogel textbook of Practical Organic Chemistry, Addison Wesley Longman, Edinburgh.
- Burger : Medicinal Chemistry, Vol. II Wiley Interscience, NY (1970)
- Chatwal and Anand ; Instrumental Method of Chemical Analysis
- Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, (1986).
- Connors, K. :A Text Book of Pharmaceuticals analysis, Interscience, New York, (1975).
- Curry, A.S.: Poison Detection in Human Organs, C. Thomas Springfield, Illinois USA, (1963).
- Dettean J.D. Kirk's fire Investigation, 5th Ed., Practice Hall, Eaglewood Cliffs, N.J. (2002) w.e.f. 2005 – 2006
- F.G. Holfmann: Handbook of Drug and Alcohol Abuse.
- Gleason, M.N. et.al: Clinical Toxicology of Commercial products, Williams and Williams, Baltimore, USA, (1969).
- Hobart H. Willard, Lynne L. Merrett Jr. John A Dean Frank A. Settle Jr; Instumental Method of Analysis, 7th Edn, CBS pub. & Distributors (1986)
- I.L. Finar : Organic Chemistry Vol. II Pearson Education(Singapore)
- James W. Robinson ; Atomic spectroscopy, 2nd Edn. Revised & Expanded, marcel Dekkar, inc. NY. (1996)

- Modi, Jaishing P.: Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub., (2001).
- P.S. Kalri; Spectroscopy of Organic Compounds, 4th Edn, New Age International Pub. (2001) w.e.f. 2005 – 2006
- Parikh C.K. Textbook of Medical Jurisprudence, Forensic Medicines and Toxicology. CBS Pub. New Delhi (1999)
- R.S. Khandpur ; Handbook of Analytical Instruments, Tata McGraw Hill Pub. Co. New Delhi (2004)
- R.T. Morrison, R.N. Boyd : Organic Chemistry, 6th Ed. , Prentice Hall New Delhi(2003)
- Saferstein: Forensic Science Handbook, Vols. I, II; (Ed); Prentice Hall, Eglewood Cliffs, NJ; (1988)
- Sharma P.K.; Instrumental Method of Chemical Analysis
- Tiwari, S.N.: Analytical Toxicology, Govt. of India Publications, New Delhi, (1987)
- V.B. Patania ; Spectroscopy, Campus books International, (2004)
- Working Procedure Manual – Toxicology, BPR&D Publication, (2000).
- Yinon Jitrin : Modern Methods & Application in Analysis of Explosives, John Wiley & Sons, England (1993)

B 3.Forensic Biology and Serology (PHDFS103)

Module 1: Forensic Biology:Blood and other biological fluids: Composition and examination of blood and other biological fluid i.e., semen, saliva.**Hair and Fibers:** Structure and examination of hair and fibers**Forensic Botany:** Types and examination of diatoms and pollen grains**Forensic Entomology:** Significance of terrestrial and aquatic insects in forensic investigations and their role in crime detection**Forensic Odontology:** Role of teeth in forensic investigation**Wild Life Forensic:** Identification of Pug marks of various animals. Identification of feathers of various birds.

Module2: Forensic Serology;Biological molecule: Classification and detection of amino acid, protein, and carbohydrate.**Basic Concept of Genetics:** Mendelian genetics, genotypes, phenotypes, mutation, multiple alleles , Expression of Gene and Gene Mapping. Analysis of protein by electrophoretic methods **Serogenetic markers**:**Blood group**: ABO, Rh, Mn and other systems, blood group specific ABH substance, determination of secretors/non secretor status, Lewis antigen, Bombay blood group.**Polymorphic enzymes typing-** PGM, ESD, EAP, AK, etc., and their forensic

significance, HLA typing, role of serogenetic markers in individualization, paternity disputes etc.**DNA profiling:**Structure of DNA, Damage to DNA, variation in DNA, DNA as excellent polymorphic markers; **DNA typingtechnique** – RFLP, PCR, Amplification, PCR based typing methods such as HLA DQ_{A1} Amply- type $^{(R)}$ PM Polymarkers, D 1580, STR, Gender ID, mt- DNA methods with their merits and demerits.

Module 3: Instrumental Techniques: Biological:CentrifugationTechniques: Basic Principles of sedimentation, Types of centrifuges, Density gradient centrifugation, Prerogative centrifugation, Analysis of sub- cellular fraction, ultra- centrifuge, refrigerated centrifuges.**Immuno-chemicalTechnique:**Generalprinciples,Productionofantibodies,Precipitinreaction,Gelimmune-diffusion,Immuno-electrophoresis, complementfixation,RadioImmunoAssay(RIA),Enzyme-linkedImmunoSorbentAssay(ELISA),Fluorescenceimmuneassay.**ElectrophoreticTechnique:**General principles,Factorsaffectingelectrophoresis,Lowvoltagethinsheetelectrophoresis,Highvoltageelectrophoresis,Sodiumdodecylsulphate(SDS)polyacrylamidegelelectrophoresis,Isoelectricfocusing(IEF),Isoelectrophoresis,Preparativeelectrophoresis,HorizontalandVerticalElectrophoresis.

Suggested Readings:

- Albert's, B, Bray, D, Lewis, J, Roberts K & Watson, J.D; Molecular Biology of cell, 2nd ed. Garland Pub. New York (1989)
- Biology Methods manual; Metropolitan Police Forensic Science Laboratory, London; (1978)
- Catts, E.P. & Haskell NH : Entomology and death : A procedural guide : Joyce's Print Shop (1990)
- Clifford, B.J; The examination and typing of Bloodstains in the crime Laboratory, US Court Printing Press (1971)
- E.J. Gardner, M.I. Simmons and D.P. Snustad; Principles of Genetics; John Wiley, New York; (1991)
- Edwin, H. Mc Caney-Human Genetics, The Molecular Revolution, Jones & Bartlett Pub. London; (1993)
- Forensic DNA Typing : Biology, Technology, and Genetics behind STR Markers by John M. Butler
- Genetic Markers in Human Blood,(1969): Giblett, Eloise R. Blackwell Scientific Publications

- Herbert R. Mauersberger; Mathews Textile Fibers – their physical, Microscopic and chemical properties; John Wiley, New York; (1954)
- Kimball, John W; Biology; Arvind Publishing Co. New Delhi (1974)
- Oates, D W, Brown, C W & Weigel, D L; Blood and tissue identification of selected bird and mammals; JPR study Projects Lincoln NE Nebraska Gome and Perks Commission (1974)

	Environmental Science		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Fundamental of Environmental Science	PHDENV101	2.0
B.2.	Environmental Pollution: Monitoring & Laws	PHDENV102	2.0
B.3.	Current Issues on Environmental Science	PHDENV103	2.0
C.1.	**Dissertation**		**3.0**

B 1.Fundamental of Environmental Science(PHDENV101)

Module 1: Meaning, scope & interdisciplinary nature of Environmental Science; environmental factors; structure and composition of atmosphere, hydrosphere, lithosphere & biosphere.Heat transfer processes; Mass & energy transfer across the interfaces of various geospheres, Hydrologic cycle, Biogeochemical cycles- Carbon, nitrogen, phosphorous & sulphere cycle.
Meaning & scope; Ecosystems- types, structural & functional aspects; Energy flow in ecosystems, food chain, food web, trophic levels, ecological pyramids; Ecotone; Ecological niche.

Module 2. Weather elements & their variations; Heat balance of the earth atmosphere system, Earthb as a heat engine, Major climatic zones of the world, climates of India, Climate & vegetation, climatic extremes- environmental implications, global climate change & its impact on environment.Man-environment relationship, General relationship between landscape, biomes and climate. Concept of sustainable development, Environmental ethics, Population growth- biological growth curves and carrying capacity, Human population growth & environmental constrains, Effects of environment on human culture; Human impact on ecosystems.

Module 3. Neutralism, Symbiosis, Commensalism, Mutualism, antagonism, antibiosis, parasitism, predatism: Competition- intra-specific & inter-specific.Organisms-evolution &distribution in space & time; Hotspots of Biodiversity; Climate & its impact on biodiversity; Indian forest & vegetation types and diversity of flora fauna, Endangered & Endemic species; Threatened species; Categories of IUCN, Red data books.Biodiversity Conservation, Convergence & divergence in species; Strategies for conservation, Global agreements & national concerns, RAMSAP sites, CBD, Quarantine Regulations, National forest policy, Biodiversity Act, Wild- life Protection Act of India. Conservation of National Parks &Sanctuaries.

Suggested Readings

- Dobson, A.P., (1996). Conservation and Biodiversity. Scientific American Library, New York, NY.
- Gaston, K J. and J.I. Spicer (1998). Biodiversity: An Introduction. Blackwell Science, London, UK.
- Toman (Michael) (Ed.),(2002). Climate change, Economics and Policy, Cambridge University Press.
- Loreau, M., and P. Inchausti, (2002). Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
- Barry, R. G.,(2003). Atmosphere, weather and climate. Routledge Press, UK
- Environmental Science Working with the Earth; Miller, G.T. Jr, Environmental Science Working with the Earth, Thomson Brooks/Cole Publ. (International Students Edition)
- Environmental Science, Miller, G.T.Jr&Spoolman, S.E.Cenage Learning
- Odum, E.P. & Gary, B.W. (2004).Fundamentals of Ecology Cengage Learning, USA
- Dodson, S.I. (1999)Readings in Ecology,Oxford University Press.
- Environmental Science-The Natural Environment and Human Impact: (1998) A.R.W.Jackson&J.M.Jackson, Longman 6. Energy and Environment; J.A Fay and T.S.Golond, Oxford University Press

B 2. Environmental Pollution: Monitoring & Laws(PHDENV102)

Module 1. Definition and sources of pollution; Different types of pollution and their global, regional and local aspects.Composition & chemistry of Earth Atmosphere. Types & sources of air pollutants; Reaction of pollutants in air forming smog, PAN, Acid rain; Transport of pollutants; Effects of air pollutants on flora and fauna. Effects of Indoor Air Pollutants.

Sources of water and their contamination; Types of pollutants, various industrial effluents such as pulp and paper mills, oil refinery, petrochemicals, iron and steel industries, domestic wastes, agricultural wastes, pesticides; Treatment of water and waste water. Eutrophication- causes and effects and control measures.

Module 2. Concept of Sound, noise and hearing problems; Measurement of noise; Sources of Noise- Transport noise, Industrial noise, Domestic noise; Effects of Noise Pollution; Noise mapping. Noise control and abatement measures. Noise exposure levels and standards.Physico-chemical properties, sampling and analysis of soil quality; Different kinds of synthetic fertilizers and their interactions with different components of the soil. Degradation of different pesticides in soil. Control of Soil Pollution. Phyto-remediation. Solid waste Pollution: sources, nature, classification and environmental effects.

Module 3. Monitoring analytical techniques for air, water and soil quality.Introduction, Environmental Legislation in India; Statutory protection of the Human Environment- Water (Prevention & control of pollution) Act, 1974. Air (Prevention & control of pollution) Act, 1981. Environment (Protection) Act, 1986. Factories Act, 1948. Biological Diversity Act, 2002. Wild Life (Protection) Act, 1972. Hazardous waste legislation for pollution abatement.Genesis of global Environmental Movement, Major Environmental Movement in India- The Chipko Movemnet, Silent Valley Movement, Appiko Movement, Narmada Bachao Andolan, Tehri Dam Conflict. Environmental Conferences.

Suggested Readings

- Tietenberg, T.(2003).**Environmental and Natural Resource Economics.** Pearson Education, New York.
- Wayne, R. Ott (1995) **Environmental Statistics and Data Analysis**, CRC Press.
- Manly, Chapman and Hall(2001).**Statistics for Environmental Science and Management**. CRC Press.
- W. Chase and F. Bown(2008).**General Statistics**.New York, USA:J.Wiley
- Introduction to Statistics – C. Leach (J.Wiley, New York, USA)
- S.C.Gupta and V.K.Kapoor**Fundamentals of Mathematical Statistics**. S.Chand& Co.
- J.Medhi, **Statistical Methods : An introductory test**: New Age International Ltd. Publishers
- Rao, C.S.(2011).**Environment Pollution Control Engineering**. New Delhi:New Age International Publishers.
- Divan, S. &Rosencranz, A (2008).**Environmental Law and policy in India**, New Delhi:Oxford University Press.
- Leelakrishnan,P.&Wadhwa,B (2008).**Environmental Law in India** New Delhi:
- . Rao, C.S.(2011**). Environmental Pollution control engineering**, New Age International Publishers, New Delhi.
- Palmer, E. (2010).**Water Pollution, Apple Academics**, Canada.
- Able,,P.D.(2010).**Water Pollution Biology**, Taylor and Francis, London.

B 3. Current Issues on Environmental Science(PHDENV103)

Module 1. Introduction, Green house gases & Global Climate Changes, Impact of Global Warming- Sea Level Change, Crop Yeild, Water Balance, Human Health. Green house effect. Kyoto Protocol.

Cop 21.Ozone in Atmosphere, Ozone Depletion Process, Ozone Hole, The Montreal Protocol, Consequences of Ozone Depletion-Human health, Terrestrial Plants, Aquatic Ecosystems, Climate. Nature & development of Acid Rain, Impacts of Acid Rain- Aquatic environment, Terrestrial environment, Human health, Mitigation of Acid Rain Problems, carbon credits.

Module 2. Atmospheric Turbidity & Nuclear WinterAerosol Types, Production & Distribution, Atmospheric Turbidity- Natural & Man- Made Sources. NuclearWinter.Radiation Hazards & Environmental Degradation, Atomic Radiation, Measurement of Radioactivity, Effects of Radiations, Radioactivity and Effects on Man, Impact of Radioactive Radiation, Radioactive waste, Radiation Protection. Concept ofEnvironmental Degradation, Land Degradation & soil Erosion, Impact of soil Erosion, Wastelands, Desertification, Deforestation.

Module 3. Environmental ToxicologyConcepts, Bio-chemical aspects of Arsenic, Cadmium, Lead, Mercury, Chromium, Pesticides, Insecticides & MIC; Ecosystem Flow of Metals: Bioaccumulation and Bio-magnifications.

Suggested Readings

- W.E.Piegrosch and J.A.Bailer **Statistics for Environmental Biology and Toxicology**, (Chapman and Hall London, UK).
- C.H. Stevension and Arwin **Wildlife B**iology
- **India's Wildlife and Wildlife resources** – B. Sterling Publishing Pvt. Ltd.
- **Methods of Environmental Impact Assessment**; Morris & Ayers
- I.C.Shaw&J.Chadwick **Principles of Environmental toxicology**, Taylors & Francis Ltd.
- J.G.Rau&D.C.Woooten, **Environmental Impact Analysis Handbook**: McGraw-Hill Book

	Mathematics		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDAS101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Mathematics I	PHDMATH101	2.0
B.2.	Mathematics II	PHDMATH102	2.0
B.3.	Mathematics III	PHDMATH103	2.0
C.1.	**Dissertation**		**3.0**

B1.Mathematics I (PHDMATH101)

Module1: Real Analysis

Sequence and series. Limits. Differentiability. Riemann Integral

Module2:Complex Analysis Algebra of complex numbers. Power series. Analytic functions. Taylor and Laurent series. Conformal mappings. Integration in complex plane. Fundamental theorem of algebra. Maximum modulus theorem.

Module3:Functional Analysis Vector spaces. Subspaces. Base. Linear Transformations Normed linear spaces Banach spaces Bounded linear operators Convergence of Sequences of Functions. Dual of a normed linear space. Inner product space Hilbert space. operators.

References:

- Walter Rudin(1976**). Principles of Mathematical Analysis**.McGraw-Hill.
- Ahlfors. L.V.(1979).**Complex Analysis**. McGraw-Hill Book Company.
- A.H Siddiqi (1989).**Functional Analysis with application.**McGraw-Hill

B 2.Mathematics II(PHDMATH102)

Module1:Differential Equations:

First order ordinary differential equations. Singular solutions. Initial value problem of first order ODE. General theory of homogeneous and non-homogeneous linear ODE. Fundamental matrices. Elementary PDE. Equations solvable by direct integration. non-linear equations of first order. Charpits method.

Module2: Difference Equations

Difference equations. Definition. Order. linear difference equations. Existence and uniqueness theorem. Solution of the equation. General solution of the homogeneous and non-homogeneous difference equations.

Module3: Algebra and Discrete Mathematics:

Goups. Subgroups. Normal subgroups. Homomorphism. Vector spaces. Subspaces. Base. Linear Transformations. Algebra of matrices. Eigen values and eigen vectors. Graph theory: Eulerian and Hamiltonian graph. planar graph. Directed graph. Spanning tree.

References:

- George F Simmons.**Introduction to Topology and Modern Analysis**. McGraw-Hill
- I.N.Herstein: **Topics in Algebra**. Wiley- Eastern.
- Douglas B West.**Introduction to Graph Theory**. Prentice hall of India.

B 3. Mathematics III(PHDMATH103)

Module1:Banach Space:

Gateaux and Frechet derivatives in Banach spaces and their properties. Taylor's theorem and inverse function theorem.

Module2:Monotone Operators:

Concept of monotone operators. maximal monotone operators and their properties.

Module 3: Fixed Point:

Concept of fixed point and Banach's contraction principle. fixed point theorems of Browuer and Schauder Fixed point theorems for multi functions. Common fixed point theorems.

References:

- M. C. Joshi and R. K. Bose(1985).**Some Topics in Non-linear functional Analysis**. Wiley Eastern Ltd.
- Schwartz. I.(1969).**Non-Linear Functional Analysis**. Leordan and Breach Sci. Publ.

	Library Science		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Practices in Libraries and Information Centers	PHDLIS101	2.0
B.2.	ICT Applications in Libraries and Information Centers	PHDLIS102	2.0
B.3.	Digital Libraries	PHDLIS103	2.0
C.1.	**Dissertation**		3.0

B. 1. Management Practices in Libraries and Information Centers (PHDLIS101)

Module1: Organization structures; Library system: Public, Academic and Special. Staffing, Library authority, Delegation of Authority. LIS Committees. Human Resource Development and Job analysis. Library standards and library statistics. Library rules in the digital context.

Module2: Applications of system study techniques to library organizations and library situations. Evaluation of library procedures and services. Collection development, policies, processes, techniques and evaluation. Collection development in digital environment.

Module 3: Role of information in planning, decision making, management. Marketing of Information: Information as a resource and commodity. Marketing for Information Professionals. Marketing Research, Information Marketing Plan, and new technologies for information marketing.

B.2. ICT Applications in Libraries and Information Centers (PHDLIS102)

Module 1: Library automation: concepts, definition, need, purpose, Problems and issues in Library automation.. System Study: planning and Implementation for automation. Hardware and software requirements and its selection and evaluation tools and techniques. . Library automation: Software packages: commercial and Open Source softwares, SOUL, LIBSYS. Koha, New Genlib, e-Granthalaya, etc. .

Module 2: Automation of various housekeeping operations: acquisition, cataloguing,circulation, serial control and stock verification. Communication Technology-media,modeand components. Web 2.0 and Library 2.0

Module 3: Computer architecture and networks: Types and Topology. Internet and Intranet. Internet connections:Dial-up,cable, leased-line, ISDN. Internet protocols: IP/TCP, SMTP, FTP, POP. Web browsers andweb servers, Internet security. Internet Resources.

B.3.Digital Libraries (PHDLIS103)

Module 1: Digital Libraries: Need, objectives, hardware and software requirements. Digitization Processes. Institutional Repositories, creation and maintenance. Content Management Systems Preservation of digital resources, OSI, Greenstone, D Space, E-Print, Anti-Plagiarism soft wares. Turnitin, Authenticate, Urkund

Module 2: Digital Libraries: Initiatives in India and abroad, NDL, OCLC, Accessing information resources, through digital media, Use Medley, SCI, Scopus, Google scholar, Academia,:

Module 3: Networks and Information systems. Information services and resources through networks and information systems: INFLIBNET, DELNET, INIS, MEDLARS, AGRIS, CeRA, CSIR CONSORTIA, ETC. Federated Search Systems

Reference Books for Library and Information Science Course Work:

Akeroyd, John.. The Management of Change in Electronic Libraries. 66th IFLA Council and General Conference. Jerusalem. (2000)

Balasubramanian, P. Digital Libraries,(2021)

Bavakutty, M. and Abdul Azeez T. A. ICT Application in Academic Library Management,ESS, .(2018)

Chowdhury, G G and Chowdhury, Sudatta, “Introduction to Digital Libraries”, Facet Publishing, UK.Prin(2003)

Donald J. Management Information Systems for the Information Age. 5th ed. Boston: McGraw-Hill/Irwin. (2005)

Evans, G. E.. Management Techniques for Librarians. 2nd ed.: Academic Press. (1983)

Evans, G. Edward and Ward, Patricia L.. Beyond the Basics: A Management Guide for Library and Information Professionals. New York: Neal-Schuman Publishers. (2003)

Lesk, M. E. Practical Digital Libraries. San Francisco: Morgan Kaufman,(1997).

Papy, Fabrice. Digital Libraries, Elsevier (2016)

Stern,David. Digital Libraries: Philosophies, Technical Design Considerations, and Example Scenarios,Routledge (2014)

	Fine Arts		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Aesthetic Studies	PHDFA101	2.0
B.2.	Art Criticism Theories	PHDFA102	2.0
B.3.	Foundations of Fine Arts	PHDFA103	2.0
C.1.	**Dissertation**		3.0

COURSE CODE:

B.1. Aesthetic Studies (PHDFA101)

Module 1.

a) General overview of Greek art and the then dominant notion of humanism.
b) Plato's Views on Art.
c) The Concept of Mimesis.

Module 2.

a) Aristotle's Views about art
b) The Concept of Catharsis.
c) Leo Tolstoy's critique about Art.

Module 3.

a) Spiritual Pursuit in Art.
b) Hegel's Aesthetics.
c) Wassily Kandinsky's critique about Art.

Practical Component:

Exploring Abstraction/Surrealism/Action Painting in art using Mixed Media including at least three works on canvas size 3Feetx3Feet (Minimum). Completed works to be submitted at the end of coursework.

References :

- Hegel, G.W.F. (*1975).* Lectures on Fine Art, trans. T.M. Knox, 2 vols. Oxford. Clarendon Press.
- Kandinsky, Wassily. (2004). Concerning the Spiritual in Art.Egypt: Alexandria. Library of Alexandria.

B.2. Art Criticism Theories (PHDFA102)

Module 1.

a) Introduction to Art Criticism
b) Origin and development of art criticism in India and the West.

Module 2.

a) Important Theories of Art Criticism
b) Contemporary Art Critics of India

Module 3.

a) Steps of Art Criticism
b) Selecting a work of art and writing a note about it based on the steps of art criticism.
c)

Practical Component:

Exploring Minimalism/Realism/Expressionism/Cubism in art using Mixed Media including at least three works on canvas (Minimum) size 3Feetx3Feet. Completed works to be submitted at the end of coursework.

References:

- Barrett, Terry. (1994). Criticizing Art: Understanding the Contemporary.US: California. Mayfield Publishing Company.

- Krauss, Rosalind E.(1985). The Originality of the Avant-Garde and Other Modernist Myths. UK: Cambridge. MIT Press.
- Bryson, Norman. (1991). Visual Theory: Painting and Interpretation. US: New York. HarperCollins Publishers.

B.3. Foundations of Fine Arts (PHDFA103)

Module 1.

a) Worldview of Art
b) Shadang - Six Principles of Indian Painting

Module 2.

a) About Bharat Muni
b) Rasa Theory

Module 3.

a) Introducing Six Principles of Chinese Painting
b) Innovations in the field of fine arts including installations , public art and Performance art.

Practical Component:

Exploring Collage /Monoprint /Chine collé techniques in art using Mixed Media including at least three works on paper ofA3 size. Completed works to be submitted duly mounted/ framed at the end of coursework.

References :

- Cleaver, D. G. (1972). Art; an introduction. US: New York. Harcourt Brace Jovanovich.
- Barthes, Roland. (1977). 'Rhetoric of the Image, Image-Music-Text.Ed. by Stephen Heath, London: Fontana. Fontana Press.

	Life Science and Biotechnology		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Bioremediation and Bioleaching	PHDLS101	2.0
B.2.	Structural Biology and Bioprocess Modulation	PHDLS102	2.0
C.1.	**Dissertation**		3.0

B1: **Bioremediation and Bioleaching(PHDLS101)**

CourseOverview:*Thiscourseseekstoincreasethestudentsknowledgeandunderstanding ofbioremediation andbioleaching andtheapplications. Thiscoursewillalsoshowstudentshowknowledgeofmicrobialcommunitiesand their processes can be used tosolve environmental and industrial pollution problems tocontrol their detrimental effects.*

Module1.Classificationand characterizationof waste,principlesof wastetreatment,biodegradationof liquid/Solidwaste,principlesofbiodegradation,biodegradationofselectedpollutants:discardedengine oilanddyes.

Module2. Bioremediation:principlesandmechanism,Strategiesandtechniquesofinsituandex situbioremediation,bioremediationofpreciousandheavymetals

Module3. Bioleachingandbio-oxidation,bioleachingmethods,factorsaffectingbioleaching, bioleachingofmetalsfromsecondarysources-E-waste,metalrecoveryanduses.

ReferenceBooks

1. Hester, R. E., & Harrison, R. M. (Eds.). (2009). *Electronic waste management* (Vol. 27). Royal Society of Chemistry.
2. Bastioli, C. (Ed.). (2005). *Handbook of biodegradable polymers*. Taylor and Francis.
3. Stapleton Jr, R. D., & Singh, V. P. (Eds.). (2002). *Biotransformations: bioremediation technology for health and environmental protection* (Vol. 36). Elsevier.
4. Alvarez, P. J., & Illman, W. A. (2005). *Bioremediation and natural attenuation: process fundamentals and mathematical models* (Vol. 27). John Wiley & Sons.
5. Crawford, R. L., & Crawford, D. L. (Eds.). (2005). *Bioremediation: principles and applications* (Vol. 6). Cambridge University Press.

B2: **Structural Biology and Bioprocess Modulation**(**PHDLS102)**

Course Objective: *The course is designed to help the students to understand the basic analytical techniques used in biological sciences. It would help to learn about the interaction and structural modulation of biological molecules in the field of structural biology and bioprocess engineering respectively.*

Module1: Analytical Techniques

(i) Spectroscopic Techniques – UV, Fluorescence, FTIR, NMR; Basic principles, Instrumentations and applications in the field of Biology
(ii) Electrophoresis-Agarose, SDS PAGE and Native PAGE
(iii) In-vivo techniques used in biological sciences-Cell line and microbiological techniques

Module2: Structural Biology

Review on:

(i) Drug-DNA interaction
(ii) Protein-DNA interaction
(iii) Drug-RNA interaction

Module3 Bioprocess Engineering

Review on:

(i) Physical and Chemical Pretreatment Processes for Biomass

(ii) Overview of key pretreatment processes for biological conversion of lignocellulosic biomass to Bio-ethanol

References:

1. Biophysical Tools for Biologists, Volume 89: In Vivo Techniques (Methods in Cell Biology) 1st Edition by John J. Correia (Editor), H. William Detrich III; **Academic Press**
2. Pretreatment of Biomass 1st Edition Processes and Technologies by Ashok Pandey; **Elsevier**
3. Introductory Experiments on Biomolecules and their Interactions 1st Edition By Robert Delong Qiongqiong Zhou; **Academic Press**

	Commerce		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Financial Reporting Framework	PHDCOM301	2.0
B.2.	Cost and Management Accounting	PHDCOM302	2.0
B.3.	Dynamics of Financial Planning	PHDFM303	2.0
C.1.	**Dissertation**		3.0

B.1.Financial Reporting Framework (PHDCOM301)

Course Overview: *To understand Accounting Standards and recent trends in Accountancy for developing a broader view for research in Commerce*.

Module 1: Elementary Study of Accounting Standards: Introduction, objectives, formulation, advantages, applicability and implications of Accounting Standards

Module 2: Overview of Selected Accounting Standards-

i. Ind AS 1- Presentation of Financial Statements
ii. Ind AS 2-Inventories
iii. Ind AS 8- Accounting Policies, Changes in Accounting Estimates and Errors
iv. Ind AS 10- Events After the Reporting Period
v. Ind AS 16- Property Plant and Equipment

vi. Ind AS 37- Provisions, Contingent Liabilities and Contingent Assets

Module 3: Recent Developments in Accounting : Elementary study of - Human Resources Accounting, Inflation Accounting, Value Added Statement, corporate social reporting, interim reporting.

Reference Books:

- Advanced Accountancy – Vol. I , R. L. Gupta & M. Radhaswamy, Sultan Chand & Sons
- Advanced Accounts, M.C. Shukla, T.S. Grewal & S.C. Gupta, S. Chand & Co Ltd.
- Accounting Theory, R. K. Lele and Jawaharlal, Himalaya Publishers
- Accounting Text & Cases, Robert Anthony, D.F.Hawkins & K.A.Merchant- Tata McGraw Hill
- Corporate Accounting, Dr. S. N. Maheshwari, Vikas Publishing House Pvt. Ltd. New Delhi
- Advanced Accounting, Dr. Ashok Sehgal & Dr. Deepak Sehgal: Taxmann, New Delhi.
- Indian Accounting Standards Ind AS 3rd Edition 2020, Taxmann Publications
- Student's Guide to Accounting Standards, Taxman Publications

B.2.Cost and Management Accounting (PHDCOM302)

Course Overview: *To development an understanding over Cost and Management accounting techniques and their practical applicability in research.*

Module 1: Cost Accounting: Costing, Cost Accounting, Cost Accountancy- Objectives, Scope, Advantages and Limitations of Cost Accounting, Cost Ascertainment, Cost Control and Cost Reduction.

Module 2: Marginal Costing & Break-Even-Analysis : Marginal Costing – Concepts of Marginal Cost and Marginal Costing, Advantages and Limitations of Marginal Costing, Classification of costs, Fixed, Variable, Semi-variable- Break-up of Semi-Variable Expenses, Role of Contribution, Basic Equation of Marginal Costing, Marginal Costing Vs. Absorption costing, Break–Even Analysis-Meaning of Break-even point, Break-even Chart, Profit-Volume Ratio, Margin of Safety, Key-Factor, Cost-Volume Profit analysis, Point of Indifference, Computation and application of Break-Even Analysis. Major areas of application.

Module 3: Budget and Budgetary Control:
Concept of Budget, Budgeting & Budgetary Control, Budget Manual, Objectives, Advantages, Limitations of Budgetary Control. Classification of Budgets - Long term, Short term budget, Flexible budget, Fixed budget, Master Budget, Functional Budgets: Sales Budget, Production Budget, Purchase Budget, Capital Expenditure Budget, Cash Budget, Zero-Base Budgeting (ZBB), Nature, procedure, Advantages and limitations of ZBB

Reference Books:

- Fundamentals of Cost Accounting - S N Maheshwari – Sultan Chand & Sons, New Delhi.
- Cost Accounting - Jawaharlal – Tata McGraw Hill Publishing company Limited New Delhi.
- Advanced Cost and Management Accounting - V. K. Saxena and C. D. Vashist - Sultan Chand & Sons, New Delhi

- Cost & Management Accounting - Ravi M Kishore - Taxmann Allied Services Pvt Ltd
- Arora M.N. (2009), Cost and Management Accounting (Theory and Problems); Himalaya Publishing House, Latest edition

B.3.Dynamics of Financial Planning (PHDFM303)

Course Overview*:* *To develop insight in the new age financial planning process both at organizational and personal finance.*

Course Contents

Module 1: Planning Process:

Introduction to the Financial Planning Process, Life Cycle Planning, Personal Financial Statements and Budgeting, Emergency Fund Planning, Credit and Debt Management Buying vs. Leasing, Financial Planning for Various Business Entities.

Module 2: Legal Environment of Financial Planning:

Business Law, Function, Purpose and Regulation of Financial Institutions, Financial Services Industry Regulation Requirements,Investments : Introduction to Fixed Income Securities, Formula Investing and Investment Strategies, Asset allocation and portfolio diversification, Efficient Market Theory (EMT), Tax consequences of Sale of Assets, Tax compliance, Alternative Minimum Tax (AMT),

Module 3: Personal Financial Planning:

Retirement Planning and Employee Benefits : Retirement needs analysis, Social Security , Medicare, Types of retirement plans, Regulatory considerations, Plan selection for businesses, Investment considerations for retirement plans, Distribution rules, alternatives and taxation, Employee benefit plans, Employee stock options, Estate Planning : Methods of property transfer at death, Estate planning documents, Gifting strategies, Gift taxation and compliance, Satisfying liquidity needs, Powers of appointment, Behavioural Finance, Inflationary considerations on investment strategy.

Reference Books

The course will be covered by referring to web based materials, journals, magazines, research papers and varied sources.

	Food and Nutrition		
S.No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1	Research Methodology	PHDA101	3.0
A.2	Review of Literature	PHDA102	2.0
A.3	Computer Applications	PHDA103	2.0
A.4	Research Publication Ethics (RPE)	PHDA104	2.0

S.No.	**Elective Courses**	**Course Code**	**Credit Hours**
B.1.	Advances in Human Nutrition	PHDFSN101	2.0
B.2	Nutraceuticals and Functional Foods	PHDFSN102	2.0
B.3	Food Product Development	PHDFSN103	2.0
C.1	**Dissertation**		3.0

B.1. Advances in Human Nutrition (PHDFSN101)

Module 1.

Designer food and genetically modified foods. Novel proteins : leaf protein, single cell protein and fortified foods.

Module 2.
Irradiation of foods and application of irradiated foods .
Module 3. Space foods, Organic foods and Extruded Foods.

References :

1. Srilakshmi B. 2008, Nutrition Science. New Age International Pvt. Ltd, New Delhi.
2. 2 Mahan L K and Escott Stump S., 2000, Krause's Food Nutrition and Diet Therapy 10th Ed WB Saunders Ltd.
3. Shills, M.E., Olson, J., Shike, M. and Roos, C.,1998, Modern Nutrition in Health and Disease. 9th Edition .Williams and Williams A. Beverly Co. London.

B.2. Nutraceuticals and Functional Foods (PHDFSN102)

Module 1.

Nutraceuticals: definition, history, market trends, sources and classification..
Module 2.

Dietary Fibre, oligosaccharides, resistance starch and omega 3 fatty as nutraceuticals.

Module 3.

Recent advances in prebiotics – galacto-oligosaccharides (GOS) and functional disaccharides (lactulose, lactitol and lactose).

References :

1. Mary K. Schmidl, Theodore P. Labuza, 2000, Essentials of Functional Foods.
2. Se-Kwon Kim, 2013,Marine Nutraceuticals, CRC Press.
3. Dilip Ghosh et al., 2012, Innovation in Healthy and Functional Foods, CRC Press.
4. YashwantVishnupant Pathak, 2011, Hand book of Nutraceuticals, Volume II, CRC press.
5. Robert E.C. Wildman, 2006, Handbook of Nutraceuticals & Functional Foods , Second edition, CRC press.

B.3. Food Product Development (PHDFSN103)

Module 1.

Market survey consumer survey to identify new products. Innovative products and Creative products.

Module 2.

Product development, Concept and market research of the concern product. Development process – Idea generation, screening the ideas.

Module 3.

Developing the product and its sensory analysis.

References :

1. Fuller G W.,1994, New Food Product Development : From Concept to Market place CRC Press, New York .
2. Man C M D and Jomes A.,1994, Shelf life Evaluation of Foods. Blackie Academic and Professional, London.
3. Olickle, J K., 1990,New Product Development and value added. Food Development Division, Agriculture, Canada.

Graf E and Saguy I S.,1991, Food Product Development : From concept to the Market Place, Van Nostrand Reinhold New York.

	Design		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Design Thinking and Design Psychology	PHDDES101	2.0
B.2.	Design Management	PHDDES102	2.0
B.3.	Design Research and Innovation	PHDDES103	2.0
C.1.	**Dissertation**		3.0

B.1. Design Thinking and Design Psychology (PHDDES101)

Intention -Understanding Empathy; User stories; interpretive research; Problem Definition -Visual representation of problem statements; contextualization and validation of a problem.

Scenario Building -Mapping solutions; partial solutions; incremental solutions. Ideation Brainstorming; Differential Discussion; group methods to generate ideas; solitary methods to generate ideas; Lateral Thinking.

Module II: Introduction to Human Factors

Role of psychology, physiology in interaction design. Human factors in work station and work environment design.

Module III: Cognitive psychology of design

Sensation and perception. Human information processing and execution. Elements of learning, Learning theories of Behaviorism, Cognitivism and Constructivism.
Piaget‟s Development theory.

Suggested Book References-

1. Brenda Laurel, Design Research: Methods and Perspectives, The MIT Press, US, 2003
2. Ratner, Julie, ed. Human factors and web development. CRC Press, 2002.
3. Sanders, M.S; McCormick, Ernest J; Human factors in engineering and design, McGraw Hill (1993)
4. Zunse, Leonard; Visual perception of form; Academic Press (1990)
5. Leonard, David C; Learning Theories, A to Z, Greenwood Publishing Group, 2002

B.2. Design Management (PHDDES102)

Module I: Introduction: Design, Entrepreneurship & Organizational Change

Basics of Intellectual Property, Patent laws, Structure of a Patent Application. Understanding Intellectual Property Rights and its types. Copyright—Is it right to copy, Design Rights.

Module II: The Art of Management

Theory of the Organization

Module III: Trademarks and India Design Act.

Global and local frameworks of securing Intellectual Property Rights; Indigenous intellectual property. IP for Business—A profit making asset class: Indian laws and International laws and their enforcement mechanism.

Suggested Book References-

1. Best, K. (2006). Design management: managing design strategy,process and implementation. AVA publishing Cooper, R., Junginger,S., & Lockwood, T. (Eds.). (2013).
2. The handbook of design management. A&C Black Martin, R. L. (2009). The design of business: Why design thinking is the nextcompetitive advantage. Harvard Business Press.

B.3. Design Research and Innovation (PHDDES103)

Module I : Research in Design

Qualitative and qualitative research methodology, Questionnaire design, validation, repeatability testing, psychophysical scales.

Module II: Innovation in Design

User Innovation, Introduction to innovation in design. Social and Ecological factors of design - Importance of Humanfactors indesign; Creative techniques and tools for Concept generation.
USER INTERACTION - Overview of materials and processes; Evaluation tools and techniques for User- interaction.

Module III: Futuristic Design

Theories and methods that engage with and critique techno-centric, human-centric, and post human Articulate and critique the social and cultural, ethical and legal, health political, and economic implications of emerging technologies.

Suggested Book References-

1. Design Futures-BRADLEY QUINN.
2. Futuristic: Visions of Future Living-Caroline Klein

3. Design Research: Methods and Perspectives-Brenda Laurel
4. Methodology and Research Design:Stacy Ann Brett

	Law		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1.	Property Laws Relating to Transfer	PHDLAW101	2.0
B.2.	Criminal Law and its Objectives	PHDLAW102	2.0
B.3.	Constitution of India and Constitutionalism	PHDLAW103	2.0
C.1.	**Dissertation**		3.0

B.1. Property Laws relating to transfer (PHDLAW101)

Course Overview: The course is designedin order to explain the meaning of property and its types. In this course, the student will understand the mode of transfer and formalities of transfer. The course is designed relating to tangible properties and its alienation rules. The property Law is of technical

nature as to general principles of transfer. The course will enable the scholar how a bonafide purchaser or transferee will protect his rights in case of ostensible owner.The course will also help a legal researcher what types of rights are conferred through various modes of transfer by drawing a clear line between partial and absolute transfer.

Course Contents:

Module 1

Nature of Property Law in India,its applicability, essential of valid transfer.

The transferable properties, Capabilities of transfer, Restrictions on transfer and alienation,

Effect of transfer.

Module 2

Absolute transfer, Transfer to Unborn person and rule against double possibility, Rule against Perpetuity, Types of interest in transferred property, Conditional transfer, Transfer by unauthorised person and doctrine of election, Ostensible owner.

Module 3

Feeding the estoppel by grant, Transfer by co-owner, Improvements in property by bonafide person , Fraudulent Transfer ,Doctrine of Part Performance.

References:

1 Dinshaw, F.M. (2013). *The Transfer of Property Act (11th Ed.).* Lexis Nexis
2 Singh, A. (2019).*The Transfer of Property Act (6th Ed.).* Universal Lexis Nexis
3 Saxena , P.P. (2017), *Property Law (3rd ED.).* Lexis Nexis
4 Sinha,R.K. (2021).*The Transfer ofProperty Act (21st Ed.).*CLA Allahabad
5 Tripathi,G.P. (2016).*The Transfer of Property Act (19th Ed.).*CLA Allahabad Cases Reporter
6 All India Reporter
7 Supreme Court Cases
8 Manupatra Database

B.2. Criminal Law and its Objectives (PHDLAW102)

Course Overview: The course is designed with a view to enable the student to understand the basic principles of Criminal Law and its objectives in India . After studying the course, the student will enhance his/ her knowledge in the field criminal Law and its issues in present scenario.The course will also help the student understand how criminal will be applied to prevent crime and protect the

victim.Since the theme of criminal Law is to convict a culprit on proving the guilt beyond doubt, this course will achieve this ends of justice.

Course Contents:

Module 1

Principles of Criminal Law, Goodfaith and Mens rea, Actus Non FacitReume nisi mensit rea,Public Servant,Common Intention,General Exception,Act of legally bound person,Accident,Right of Private Defence.

Module 2

Abetment,Criminal Conspiracy, Unlawful Assembly, Riot,Affray, Public Nuisance,Obscenity. Sedition,Offences against state.

Module 3

Culpable Homicide and Murder, Death Caused by Negligence,Dowry Death, Simple Hurt and Grievous Hurt,Acid Attack,Sexual Harassment, stalking, Sexual Assault,Voyeurism.

References:

1. Ratan Lal Dhiraj Lal (2013) Indian Penal Code (35th ED.) Lexis Nexis Publication Mumbai
2. Gour,K.D. (2018) Indian Penal Code (7th.ED.) Universal Publication Lexis Nexis
3. Misra ,S.N. (2020) Indian Penal Code (22nd edition) Central Law Publication Allahabad
4. Bare Act Upto date 2022

Case Reporter

1. All India Reporter
2. Supreme Court Cases
3. Manupatra Database

B.3. Constitution of India and Constitutionalism (PHDLAW103)

Course Overview: The course of Constitution and Constitutionalism has been designed with a view to make the student know and understand the spirit of constitution. Similarly it is designed to impart the knowledge as to true meaning of democracy. The course will give the full contents of the nature of constitution. By going through this course, the student shall also understand how government machinery functions. The course has been designed to cover how parliament, judiciary and legislation preserve the constitutional values.

Course Contents:

Module 1

Preamble, importance, objects of preamble, basic structure, federal nature of constitution of India, State,organs of state, objectives to define state. Fundamental rights, Right to equality, Freedom of speech and expression, restrictions and abuse of Freedom of speech and expression.

Module 2

Union executive, President, Vice President, Prime Minister, their powers, duties, appointment, removal. Council of Ministers, collective responsibility of council of Ministers towards Loksabha. Parliament, constitution, removal from membership, Privileges of Parliament.

Module 3

Judiciary, independency of judiciary, Role of Judiciary in democracy, Judiciary and Federal structure.

References:

1 Basu,D,D,(2021). *Introduction to the Constitution of India (25th ed.)*. Chennai: Lexis Nexis Publication.

2 Jain ,M.P.(2018).*Constitutional Law of India(8th Ed.)*. Chennai: Lexis Nexis Publication.

3 Kauper,P. (1972). *Constitutional Law cases and Materials (4th. Ed.).*Bosten: Little Brown and Co.

4 Seervai, H.M. (2015).*Constitutional Law of India (3rd volume).* New Delhi: Universal Law Publication.

Cases Reporters

1 All India Reporters

2 Supreme Court Cases

3 Manupatra Database

Fashion Design

S.No.	Common Courses	Course Code	Credit Hours
A.1	Research Methodology	PHDA101	3.0
A.2	Review of Literature	PHDA102	2.0
A.3	Computer Applications	PHDA103	2.0
A.4	Research Publication Ethics (RPE)	PHDA104	2.0

S.No.	Elective Courses	Course Code	Credit Hours
B.1.	Visual Merchandising and Promotion	PHDFD101	2.0
B.2	Consumer Behaviour in Fashion	PHDFD102	2.0
B.3	Surface Embellishment	PHDFD103	2.0
C.1	**Dissertation**		3.0

B.1. Visual Merchandising and Promotion (PHDFD101)

Module 1. Introduction to retail format: Shopping Experience attached to retail format – Indian and International, Consumer Behavior and Vendor Management ; Store and Brand: Store façade design,Branding, Branding identity, How big brands work, Marquee display, landing display,Constraints of area design, importance of branding and unique identity.

Module 2. Visual Merchandising: Visual merchandisingconcept, role of visual merchandiser, window shopping,different types of display based ontheme, seasons, festivals, image of brand & Customer, corporate hierarchy and role of visual merchandiser.

Module 3. Visual merchandising Kits: Props, Mannequins, Signage's, merchandise and Planogram, Bay Charts and Fixtures; Space planning: Planning and 3D Display in Virtual Reality Software; store design.

References :

4. FringsG. S., 1999, Fashion: from concept to consumer, Sixth Edition. Prentice Hall, Inc., New Jersey, U.S.A.
5. MadhavanS., 2014, Cross Cultural Management. Oxford University Press, U.K.
6. Koontz H.,Weihrich H., Cannice M. V., 2020, Essentials of Management - An International, Innovation and Leadership Perspective, 11th Edition.Tata Mc Graw Hill Education private Limited, New Delhi.
7. StoneE., Samples J. A., 1985, Fashion Merchandising. McGraw-Hills, Inc.,U.S.A.

B.2. Consumer Behaviour in Fashion (PHDFD102)

Module 1. Introduction to Consumer Behavior and Concepts: Consumer behavior-interdisciplinary influences on the study of consumer behavior –two perspectives on consumer research – nature and meaning fashion. Structure of apparel industry. Fashion terminology, cycles of adoption – fashion leadership theories, collective selection.

Module 2. Demographic Influencers on Consumers: Culture and consumer behavior – myths and raise– sacred and profane consumption – the creation of culture – the diffusion of innovations – age, race, ethnicity, income, social class influences in consumer behavior. Individual Consumer Dynamics: Motivation in consumer dynamics – motivation-theories of motivation for wearing clothes - motivation for wearing clothes – motivation process – consumer involvement – values related to clothing choice – self concepts – components of self-concept – self consciousness

Module 3.Psychological Influencer in Consumer Behavior Personality: Personality – Freudian theory and trait theory – personality – attitude. ABC model attitude –multi attribute model, Fischbein model – lifestyle – lifestyle dimensions – consumer lifestyle trends – perception – perceptual process – perceptual elements in a garment – person perception and physical; Fashion shows organizing, fashion shows cheek. Points of fashion shows, Fashion association in India – fashion auxiliary services.

References :

1. Frings G. S., 1999, Fashion: from concept to consumer, Sixth Edition. Prentice Hall, Inc., New Jersey, U.S.A.
2. Norton M.I., 2015, Consumer Psychology. Cambridge University Press, Cambridge, U.K.
3. Schiffman, L. G., 1994,Consumer behavior, Prentice Hall, Inc., New Jersey, U.S.A.
4. Stone E., Samples J. A., 1985, Fashion Merchandising. McGraw-Hills, Inc.,U.S.A.

5. Kotler P., Keller K.L., 2006, Marketing Management, 12th Edition, Pearson Education International, London, U.K.

B.3.Surface Embellishment (PHDFD103)

Module 1. Introduction to embroidery: Definition, History of Embroidery, general rules for hand embroidery, Design transfer techniques, Tools for hand embroidery, Selection of needle, threads and fabrics for embroidery ; Indian traditional embroideries: Phulkari, Kasuti, Kashmiri embroidery, kutch embroidery, chikankari, kantha, tribal embroideries stitches, designs, colors and materials used.

Module 2. Hand embroidery stitches : Running, couching, button hole, satin, long and short, wheat, chain, stem, herringbone, cross stitch, knotted stitches, fish bone ;
Ornamentation Techniques: Eyelet work, cutwork, Richelieu work, lace work, drawn thread and fabric work, patch work, mirror work, applique, shaded embroidery, shadow work, badala work, bead and sequins work, bobbin thread embroidery.

Module 3. Machine Embroidery: History of embroidery machine, Advantages of embroidery machines, various types of needles, frames, bobbins, Selection of frames to design, Selection of needle thread and bobbin thread and suitable stitches for embroidery using computer, schiffli, sequinembroidery.

References :

1. NaikS. D., 1996, Traditional Embroideries of India. A.P.H Publishing, Corporation, New Delhi.

2. Paine S., 1997, Embroidered Textiles: Traditional Patterns from Five Continents with a Worldwide Guide to Identification. Thames & Hudson Inc., New York, U.S.A.

3. Lawther G., 1993, Inspirational Ideas for Embroidery on Clothes and Accessories. Search Press Ltd., Wellwood, Great Britain.

4. Mistry N.C., 2004, Embroidery Designs, Navneet Publications, Ahmedabad.

Agriculture		
Common Courses	**Course Code**	**Credit Hours**
Research Methodology	PHDA101	3.0
Review of Literature	PHDA102	2.0
Computer Applications	PHDA103	2.0
Research and Publication Ethics (RPE)	PHDA104	2.0
Elective Courses [Vegetable Science] **SEM - 1**		
Recent Trends in Vegetable Production	PHDVSC-101	2.0
Advances in Breeding of Vegetable Crops	PHDVSC-102	2.0
Arid and Dry Land Fruit Production	PHDVSC-103	2.0
Dissertation	PHD-D--101	3.0
Seminar I	PHD-S-101	1
Elective Courses [Vegetable Science] **SEM - 2**		
A biotic Stress Management in Vegetable Crops	PHDVSC-201	2.0
Seed Certification, Process in gand Storage of Vegetable Crops	PHDVSC-202	2.0
Advances in Production of Plantation and Spice Crops	PHDPSM-203	2.0
Modern concept in soil fertility	PHDSOIL-204	2.0
Advanced Statistical Methods	PHDSTAT-205	2.0

Recent trends in weed Management	PHDAGRON-206	2.0
Seminar II	PHD-S-201	
Thesis / Research	PHD-T-201	
Elective Courses [Genetics and Plant Breeding] SEM - I		
Advances in Plant Breeding Systems	PHDGPB-601	2.0
Genomics in Plant Breeding	PHDGPB-605	2.0
Plant Genetics Resources, Conservation, and Utilization	PHDGPB-604	2.0
Advanced Data Analytics	PHDSTAT-601	2.0
Dissertation	PHD-D-101	3.0
Seminar I	PHDGPB-S-691	1
Elective Courses [Genetics and Plant Breeding] SEM – II		
Crop Evolution	PHDGPB607	2.0
IPR And Regulatory Mechanism (E-Course)	PHDGPB609	2.0
Plant Molecular Biology	PHDMBB601	2.0
Plant Genome Engineering	PHDMBB602	2.0
Molecular Basis of Host Pathogen Interaction	PHDPLPATH604	2.0
Hybrid Seed Production Technology	PHDSST601	2.0
Seminar- II	PHDGPB-S-692	

Thesis/ Research	PHDGPB-S-699	
[Genetics and Plant Breeding] **SEM – III**		
Thesis/ Research	*PHDGPB699	
Comprehensive Examination	#PHD-CE-301	
Elective Courses **[Entomology]** **SEM – I**		
Insect Phylogeny and Systematics	PHDENT601	2.0
Insect Physiology and Nutrition	PHDENT602	2.0
Insect Ecology and Diversity	PHDENT603	2.0
Advances in Plant Virology	PHDPLPATH602	2.0
Doctoral Seminar – I	PHDENT-S-691	
Dissertation (Doctoral Research)	PHD-D-101	
Elective Courses **[Entomology]** **SEM – II**		
Bio-inputs for Pest Management	PHDENT605	2.0
Insect Toxicology and Residues	PHDENT606	2.0
Molecular Basis of Host-pathogen Interaction	PHDPLPATH604	2.0
Data Analysis Using Statistical Packages	PHDSTAT522	2.0
Introduction to Communication Technologies, Computer Networking and Internet	PHDMCA511	2.0
Doctoral Seminar –II	PHDENT-S-692	
Doctoral Research	PHDENT-D-699	

Elective Courses [Plant Pathology] **SEM – I**		
Advances in Mycology	PHDPLPATH601	2.0
Advances in Plant Virology	PHDPLPATH602	2.0
Principles and Procedures of Certification	PHDPLPATH605	2.0
Applied Regression Analysis	PHDSTAT521	2.0
Doctoral Seminar I	PHDPLPATH-S-691	
Dissertation (Doctoral Research)	PHD-D-101	
Elective Courses [Plant Pathology] **SEM – II**		
Advances in Plant Pathogenic Prokaryotes	PHDPLPATH603	2.0
Molecular Basis of Host-Pathogen Interaction	PHDPLPATH604	2.0
Plant Biosecurity and Biosafety	PHDPLPATH606	2.0
Bio-inputs for Pest Management	PHDENT605	2.0
Insect Toxicology and Residues	PHDENT606	2.0
Data Analysis Using Statistical Packages	PHDSTAT522	2.0
Doctoral Seminar II	PHDPLPATH-S-692	
Doctoral Research	PHDPLPATH-D-699	

Agriculture (Entomology)

PHDENT601: Insect Phylogeny and Systematics (2+1)

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course

To familiarize the students with different schools of classification, phylogenetics, classical and molecular methods, evolution of different groups of insects. Detailed study about the International Code of Zoological Nomenclature; ethics and procedure for taxonomic publications.

Theory

Unit I

Detailed study of three schools of classification- numerical, evolutionary and cladistic. Methodologies employed. Development of phenograms, cladograms, molecular approaches for the classification of organisms.

Unit II

Methods in identification of homology. Species concepts, speciation processes and evidences. Zoogeography.Study of different views on the evolution of insects- alternative phylogenies of insects: Kukalova Peck and Kristensen.

UnitIII

Fossil insects and evolution of insect diversity over geological times.Detailed study of International Code of Zoological Nomenclature, including appendices to ICZN; scientific ethics. Nomenclature and documentation protocols and procedures; report preparation on new species; deposition of holotypes.

Unit IV

Paratypes, and insect specimens as a whole in national and international repositories – requirements and procedures.Concept of Phylocode and alternative naming systems for animals. A detailed study of selected representatives of taxonomic publications – small publications of species descriptions, works on revision of taxa, monographs, check lists, faunal volumes, etc.

Unit V

Websites related to insect taxonomy and databases. Molecular taxonomy, barcoding species and the progress made in molecular sytematics.

Practical

• Collection, curation and study of one taxon of insects- literature search, compilation of a checklist, study of characters, development of character table, and construction of taxonomic keys for the selected group;

• Development of descriptions, photographing, writing diagrams, and preparation of specimens for “type like” preservation, Submission of the collections made of the group;

• Multivariate analysis techniques for clustering specimens into different taxa, and development of phenograms;

• Rooting and character polarization for developing cladograms and use of computer programmes to develop cladograms.

Suggested Readings

CSIRO 1990. The Insects of Australia: A Text Book for Students and Researchers. 2nd Ed. Vols. I and II, CSIRO. Cornell Univ. Press, Ithaca.

Dakeshott J and Whitten MA. 1994. Molecular Approaches to Fundamental and Applied Entomology. Springer-Verlag, Berlin.

Freeman S and Herron JC. 1998. Evolutionary Analysis. Prentice Hall, New Delhi.

Hennig W. 1960. Phylogenetic Systematics. Urbana Univ. Illinois Press, USA.

Hoy MA. 2003. Insect Molecular Genetics: An Introduction to Principles and Applications. 2nd Ed. Academic Press, New York.

Mayr E and Ashlock PD. 1991. Principles of Systematic Zoology. 2nd Ed. McGraw Hill, New York.

Mayr E.1969. Principles of Systematic Zoology. McGraw-Hill, New York.

Quicke DLJ. 1993. Principles and Techniques of Contemporary Taxonomy. Blackie Academic and Professional, London.

Ross HH. 1974. Biological Systematics. Addison Wesley Publ. Co., London.

Wiley EO. 1981. Phylogenetics: The Theory and Practices of Phylogenetic Systematics for Biologists. Columbia Univ. Press, USA.

PHDENT602: Insect Physiology and Nutrition (2+1)

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course

To impart knowledge to the students on detailed physiology of various secretory and excretory systems, moulting process, chitin synthesis, physiology of digestion, transmission of nerve impulses, nutrition of insects, pheromones, etc.

Theory

Unit I

Physiology and biochemistry of insect cuticle and moulting process. Biosynthesis of chitin, chitin-protein interactions in various cuticles, hardening of cuticlde.

Unit II

Digestive enzymes, digestive physiology in phytophagous, wood boring and wool feeding insects, efficiency of digestion and absorption, role of endosymbionts in insect nutrition, nutritional effects on growth and development;

Unit III

Physiology of excretion and osmoregulation, water conservation mechanisms.Detailed physiology of nervous system, transmission of nerve impulses, neurotransmitters and modulators.

Unit IV

Production of receptor potentials in different types of sensilla, pheromones and other semiochemicals in insect life, toxins and defense mechanisms.Endocrine system and insect hormones, physiology of insect growth and development- metamorphosis, polymorphism and diapause.

UnitV

Insect behaviour in IPM- Concept of super-normal stimuli and behavioural manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.

Practical

• Preparation of synthetic diets for different groups of insects;

• Rearing of insects on synthetic, semi-synthetic and natural diets;

• Determination of co-efficient of utilization;

• Qualitative and quantitative profile of bio-molecules: practicing analytical techniques for analysis of free amino acids of haemolymph;

• Zymogram analyses of amylase;

• Determination of chitin in insect cuticle;

• Examination and count of insect haemocytes.

Suggested Readings

Ananthkrishnan TN. (Ed.). 1994. Functional Dynamics of Phytophagous Insects. Oxford andIBH, New Delhi.

Bernays EA and Chapman RF. 1994. Host-Plant Selection by Phytophagous Insects. Chapmanand Hall, London.

Kerkut GA and Gilbert LI. 1985. Insect Physiology, Biochemistry and Pharmacology. Vols. IXIII. Pergamon Press, Oxford, New York.

Muraleedharan K. 1997. Recent Advances in Insect Endocrinology. Association for Advancementof Entomology, Trivandrum, Kerala.

Rockstein, M. 1978. Biochemistry of Insects, Academic Press.

Simpson, SJ. 2007. Advances in Insect Physiology, Vol. 33, Academic Press (Elsevier), London,UK.

PHDENT603: Insect Ecology and Diversity (2+1)

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course:

To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics. Study insect-plant interactions; get acquainted with biodiversity and conservation.

Theory

Unit I

Characterization of distribution of insects- Indices of Dispersion, Taylor's Power law. Island Biogeography. Population dynamics- Life tables, Leslie Matrix, Stable age distribution, Population projections. Predator-Prey Models- Lotka-Volterra and Nicholson-Bailey Model. Crop Modeling- an introduction.

Unit II

Insect Plant Interactions. Fig-figwasp mutualism and a quantitative view of types of associations. Role of insects in the environment. Adaptations to terrestrial habitats. Evolution of insect diversity and role of phytophagy as an adaptive zone for increased diversity of insects. Evolution of resource harvesting organs, resilience of insect taxa and the sustenance of insect diversity- role of plants. Herbivory, pollination, predation, parasitism.

Unit III

Modes of insect-plant interaction, tri-trophic interactions. Evolution of herbivory, monophagy vs polyphagy. Role of plant secondary metabolites. Meaning of stress- plant stress and herbivory. Consequences of herbivory to plant fitness and response to stress. Constitutive and induced plant defenses. Host seeking behavior of parasitoids.Biodiversity and Conservation- RET species, Ecological Indicators.

Unit IV

Principles of Population genetics, Hardy Weinberg Law, Computation of Allelic and Phenotypic frequencies, Fitness under selection, Rates of Evolution under selection. Foraging Ecology- Optimal foraging theory, Marginal Value Theorem, and Patch departure rules, central place foraging, Mean-variance relationship and foraging by pollinators, Nutritional Ecology.

Unit V

Reproductive ecology- Sexual selection, Mating systems, Reproductive strategies – timing, egg number, reproductive effort, sibling rivalry and parent-offspring conflict. Agro-ecological vs Natural Ecosystems – Characterisation, Pest Control as applied ecology- case studies.

Practical

• Methods of data collection under field conditions;

• Assessment of distribution parameters, Taylor's power law, Iwao's patchiness index, Index of Dispersion, etc.;

• Calculation of sample sizes by different methods;

• Fitting Poisson and Negative Binomial distributions and working out the data transformation methods;

• Hardy-Weinberg Law, Computation of Allelic and Phenotypic Frequencies – Calculation of changes under selection, Demonstration of genetic drift;

• Assessment of Patch Departure rules. Assessment of Resource size by female insects using a suitable insect model, fruit flies/ Goniozus/ Female Bruchids, etc.;

• A test of reproductive effort and fitness;

• Construction of Life tables and application of Leslie Matrix – population projections, Stable age distribution;

• Exercises in development of Algorithms for crop modeling;

Suggested Readings

Barbosa P and Letourneau DK. (Eds.). 1988. Novel Aspects of Insect-Plant Interactions. Wiley, London.

Elizabeth BA and Chapman RF. 1994. Host-Plant Selection by Phytophagous Insects. Chapman and Hall, New York.

Freeman S and Herron JC.1998. Evolutionary Analysis. Prentice Hall, New Delhi.

Gotelli NJ and Ellison AM. 2004. A Primer of Ecological Statistics. Sinauer Associates, Sunderland, MA.

Gotelli NJ. 2001. A Primer of Ecology. 3rd Ed., Sinauer Associates, Sunderland, MA, USA.

Krebs C. 1998. Ecological Methodology. 2nd Ed. Benjamin-Cummings Publ. Co., New York.

Krebs CJ. 2001 Ecology: The Experimental Analysis of Distribution and Abundance. 5th Ed. Benjamin-Cummings Publ. Co., New York.

Magurran AE. 1988. Ecological Diversity and its Measurement. Princeton University Press, Princeton.

Real LA and Brown JH. (Eds.). 1991. Foundations of Ecology: Classic Papers with Commentaries. University of Chicago Press, USA.

Southwood TRE and Henderson PA. 2000. Ecological Methods. 3rd Ed. Wiley Blackwell, London.

Strong DR, Lawton JH and Southwood R. 1984. Insects on Plants: Community Patterns and Mechanism. Harward University Press, Harward.

Wratten SD and Fry GLA. 1980. Field and Laboratory Exercises in Ecology. Arnold Publ., London.

PHDPATH602 Advances in Plant Virology 2+1

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course:

To educate about the advanced techniques and new developments in plant virology.

Theory

Unit I

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological effects in infected plant cells. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination, pseudorecombination, component re-assortment, etc.

Unit II

Major vector groups of plant viruses and their taxonomy, virus-vector relationship, molecular mechanism of virus transmission by vectors. Terminologies used in immunology and serology. Classification, structure and functions of various domains of Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detection of viruses.

Unit III

Immuno/ serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses.Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/ q PCR) and non PCR based: LAMP, Fluorescent in situ hybridization (FISH), dot blot hybridization.

Unit IV

Plant virus genome organization (General properties of plant viral genome- information content, coding and noncoding regions), replication, transcription and translational strategies of pararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses, satellite viruses and satellite RNA.Gene expression, regulation and viral promoters.Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants.

Unit V

Techniques and application of tissue culture for production of virus free planting materials. Phylogenetic grouping system based on partial/ complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

Practical

• Purification of viruses, SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation;

• Acquaintance with different serological techniques (i) DAC- ELISA (ii) DAS-ELISA Plant Protection–Plant Pathology 237 (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA. Nucleic acid isolation, DOT-blot, southern hybridization, probe preparation,and autoradiography;

• PCR application and viral genome cloning of PCR products, plasmid purification, enzyme digestion, sequencing, annotation of genes, analysis of viral sequences (use of gene bank, blast of viral sequences and phylogeny);

• Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology, BLAST, Clustal X/W, Tm pred and Phylogeny programs).

Suggested Readings

Davies 1997. Molecular Plant Virology: Replication and Gene Expression. CRC Press, Florida.

Fauquet et al. 2005. Virus Taxonomy. VIII Report of ICTV. Academic Press, New York.

Gibbs A and Harrison B. 1976. Plant Virology – The Principles. Edward Arnold, London.

Jones P, Jones PG and Sutton JM. 1997. Plant Molecular Biology: Essential Techniques. John Wiley & Sons, New York.

Khan J A and Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Howarth Press, New York.

Maramorosch K, Murphy FA and Shatkin AJ. 1996. Advances in Virus Research. Vol. 46. Academic Press, New York.

Pirone TP and Shaw JG. 1990. Viral Genes and Plant Pathogenesis. Springer Verlag, New York.

Roger Hull. 2002. Mathew's Plant Virology (4th Ed.). Academic Press, New York.

Thresh JM. 2006. Advances in Virus Research. Academic Press, New York

Syllabus

PHDENT605: Bio-inputs for Pest Management (2+1)

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course

To appraise the students with advanced techniques in handling of different bioagents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.

Theory

Unit I

Scope of classical biological control and augmentative bio-control; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts.

Unit II

dynamics of bio-agents vis-à-vis target pest populations.Bio-inputs: mass production of bio-pesticides, mass culturing techniques of bioagents, insectary facilities and equipments,

Unit III

Basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices.Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies.

Unit IV

Survivorship analysis and ecological manipulations, large-scale production of bio-control agents, bankable project preparation.Scope of genetically engineered microbes and parasitoids in biological control,

Unit V

Genetics of ideal traits in bio-control agents for introgressing and for progeny selections, breeding techniques of bio-control agents.

Practical

• Mass rearing and release of some commonly occurring indigenous natural enemies;

• Assessment of role of natural enemies in reducing pest populations; • Testing side effects of pesticides on natural enemies;

• Effect of semio-chemicals on natural enemies, breeding of various bio-control agents, performance of efficiency analyses on target pests;

• Project document preparation for establishing a viable mass-production unit/ insectary;

• Observation of feeding behavior acts of predatory bugs/ beetles

Suggested Readings

Burges HD and Hussey NW. (Eds.). 1971. Microbial Control of Insects and Mites. Academic Press, London.

Coppel HC and James WM. 1977. Biological Insect Pest Suppression. Springer Verlag, Berlin.

De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman and Hall, London.

Dhaliwal, GS and Koul O. 2007. Biopesticides and Pest Management. Kalyani Publishers, New Delhi.

Gerson H and Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman and Hall, New York.

Huffakar CB and Messenger PS. 1976. Theory and Practices of Biological Control.Academic Press, London.

PHDENT606 Insect Toxicology and Residues 2+1

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course:

To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.

Theory

Unit I

Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides. Modes of action of newer insecticide molecules; developments in bio-rational approaches; SPLAT; RNAi technology for pest management.

Unit II

Biochemical and physiological target sites of insecticides in insects; developments in biorationals, biopesticides and newer molecules; their modes of action and structural – activity relationships; advances in metabolism of insecticides.

Unit III

Joint action of insecticides; activation, synergism and potentiation.

Unit IV

Problems associated with pesticide use in agriculture: pesticide resistance; resistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.

Unit V

Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; bound and conjugated residues, effect on soil fertility; insecticide laws and standards, and good agricultural practices.

Practical

• Residue sampling, extraction, clean-up and estimation of insecticide residues by various methods;

• Calculations and interpretation of data;

• Biochemical and biological techniques for detection of insecticide resistance in insects;

• Preparation of EC formulation using neem oil.

Suggested Reading

Busvine JR. 1971. A Critical Review on the Techniques for Testing Insecticides. CABI, London.

Dhaliwal GS and Koul O. 2007. Biopesticides and Pest Management. Kalyani Publishers, New Delhi.

Hayes WJ and Laws ER. 1991. Handbook of Pesticide Toxicology. Academic Press, New York.

Ishaaya I and Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi.

Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.

O' Brien RD. 1974. Insecticides Action and Metabolism. Academic Press, New York.

Perry AS, Yamamoto I, Ishaaya I and Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.

Prakash A and Rao J. 1997. Botanical Pesticides in Agriculture. Lewis Publ., New York.

PHDPLPATH 604 Molecular Basis of Host-pathogen Interaction 2+1

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Aim of the course:

To understand the concepts of molecular biology and biotechnology in relation to host plant- pathogen interactions.

Theory

Unit I

History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II

Different forms of plant-microbe interactions and nature of signals/ effectors underpinning these interactions. Plant innate immunity: PAMP/ DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III

Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. Molecular basis of genefor-gene hypothesis; R-gene expression and

transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

Unit IV

Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance.Pathogen population genetics and durability, viruses vs cellular pathogens.

Unit V

Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical

• Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation;

• Gene mapping and marker assisted selection;

• Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

Suggesting Reading

Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.

Gurr SJ, McPohersen MJ and Bowlos DJ. (Eds.). 1992. Molecular Plant Pathology – A Practical Approach. Vols. I & II, Oxford Univ. Press, Oxford.

Mathew JD. 2003. Molecular Plant Pathology. Bios Scientific Publ., UK.

Ronald PC. 2007. Plant-Pathogen Interactions: Methods in Molecular Biology. Humana Press, New Jersey.

Stacey G and Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

PHDSTAT522 Data Analysis Using Statistical Packages 2+1

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students a hands on experience in the analysis of their research data. This course is useful to all disciplines.

Theory

Unit I

Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

Unit II

Test for normality; Testing of hypothesis using chi-square, t and F statistics and Z-test.

Unit III

Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

Unit IV

Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.

UnitV

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.

Practical

• Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data;

• Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for large samples - Chi-squares test, F test, one-way analysis of variance;

• Designs for Factorial Experiments, fixed effect models, random effect models, mixed effect models, estimation of variance components;

• Linear regression, Multiple regression, Regression plots;

• Discriminant analysis - fitting of discriminant functions, identification of important variables;

• Factor analysis. Principal component analysis - obtaining principal component.

Suggested Readings

• Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley.

• Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press.

• Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmount, California.

• Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.

• Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.

• Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.

• Erickson B.H. and Nosanchuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.

• Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.

• Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.

• Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.

• Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.

• Weisberg S. 1985. Applied Linear Regression. John Wiley.

• Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.

• Wetherill GB.1986. Regression Analysis with Applications. Chapman & Hall.

• Cleveland WS. 1994. The Elements of Graphing Data, 2nd Ed., Chapman & Hall

• http://freestatistics.altervista.org/en/learning.php. http://freestatistics.altervista.org/en/stat.php. http://www.cas.lancs.ac.uk/glossary_v1.1/main.html. http://www.stat.sc.edu/~grego/courses/stat706/.

• www.drs.icar.gov.in.

PHDMCA511: Introduction to Communication Technologies, Computer Networking and Internet 1+1

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

Aim of the course:

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand Computer networking and web applications development.

Theory

Unit I

Networking fundamentals, types of networking, network topology; Introduction to File Transfer Protocol (FTP), Telnet.

Unit II

Simple Mail Transfer Protocol (SMTP), Internet Protocol v4 & v6. Network infrastructure and Security-switches, routers, firewall, intranet, internet, Virtual Private Network.

Unit III

World Wide Web (www), working with Internet; Web pages, web sites, web servers; Web Applications. Hyper Text Markup Language (HTML).

Unit IV

DHTML, web based application development. Static websites, dynamic websites.

Unit V

Client Side processing – scripting languages, Jquery. Server Side processing ASP.NET/JSP.

Practical

• Network and mail configuration;
• Using Network Services;
• Browsing of Internet;
• Creation of web pages;
• Creation of websites using HTML and scripting languages.

Suggested Readings

• Cox V, Wermers L and Reding E.E. 2006. HTML Illustrated Complete. 3rd Ed. Course Technology.
• Niederst J. 2001. Web Design in a Nutshell. O'Reilly Media.
• Tanenbaum A.S. 2003. Computer Networks. Prentice Hall of India.

Syllabus (Plant Pathology)

PHDPLPATH601	**Advances in Mycology**

01. Legends: L - *Lecture****; P –*** *Practical*

*1****2. ********Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

2Aim of the course

3To acquaint with the advances in mycology

4Theory

5Unit I

6General introduction, historical development and advances in mycology. Recent taxonomic criteria, morphological criteria for classification. Serological, chemical (chemotaxonomy), molecular and numerical (computer based assessment) taxonomy.

7Unit II

8Interaction between groups: Phylogeny, Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti.

9Unit III

10Population biology, pathogenic variability/ vegetative compatibility. Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation.

11Unit IV

12Ultra structures and chemical constituents of fungal cells, functions of cell organelles. Mitosis, meiosis, gene action and regulation. Effects of fungal interaction with hostplants and other microorganisms; parasitism, symbiosis and commensalism.

13Unit V

14Genetic Improvement of Fungal strains. Fungal biotechnology. Fungi mediatedsynthesis of nano particles – characterization process and application. Mycotoxinsproblems and its management.

15Practical

16• Isolation, purification and identification of cultures, spores and mating typendetermination;

17• Study of conidiogenesis-Phialides, porospores, arthospores;

18• Study of fruiting bodies in Ascomycotina;

19• Identification of fungi up to species level;

20• Study of hyphal anastomosis;

21• Morphology of representative plant pathogenic genera form different groups of fungi;

22• Molecular characterization of fungi.

23Suggested Reading

- *Alexopoulos CJ, Mims CW and Blackwell M. 1996. Introductory Mycology. John Wiley & Sons,New York.*
- *Restructured and Revised Syllabi of Post-graduate Programmes Vol. 1236*
- *Dube HC. 2005. An Introduction to Fungi. 3rd Ed. Vikas Publ. House, New Delhi.*
- *Kirk PM, Cannon PF, David JC and Stalpers JA. (Eds.). 2001. Ainsworth and Bisby's Dictionaryof Fungi. 9th Ed., CABI, Wallington.*
- *Maheshwari R. 2016. Fungi: Experimental Methods in Biology 2nd edn. CRC Press, US.*
- *Ulloa M and Hanlin RT. 2000. Illustrated Dictionary of Mycology. APS, St. Paul, Minnesota.*
- *Webster J and Weber R. 2007. Introduction to Fungi. Cambridge University Press, Cambridge.*

PHDPLPATH602	Advances in Plant Virology

241. Legends: L - *Lecture****; P –*** *Practical*

*25****2. ********Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course:

To educate about the advanced techniques and new developments in plant virology.

Theory

Unit I

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological

effects in infected plant cells. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination, pseudo recombination, component re-assortment, etc.

Unit II

Major vector groups of plant viruses and their taxonomy, virus-vector relationship,molecular mechanism of virus transmission by vectors. Terminologies used inimmunology and serology. Classification, structure and functions of various domainsof Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detectionof viruses. Immuno/ serological assays (Slide agglutination tests, Test tubeprecipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot ImmunoBinding Assay, and nucleic acid based assays for detection of plant viruses.

Unit III

Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR,Nested PCR, Real time/ q PCR) and non PCR based: LAMP, Fluorescent in situhybridization (FISH), dot blot hybridization.

Unit IV

Plant virus genome organization(General properties of plant viral genome- information content, coding and noncoding regions), replication, transcription and translational strategies ofpararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses,satellite viruses and satellite RNA. Gene expression, regulation and viral promoters.Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants.

Unit V

Techniques andapplication of tissue culture for production of virus free planting materials.Phylogenetic grouping system based on partial/ complete sequences of virus genomesand using of next generation sequencing technology in plant virus discovery.

Practical

• Purification of viruses, SDS-PAGE for molecular weight determination, productionof polyclonal antiserum, purification of IgG and conjugate preparation;

• Acquaintance with different serological techniques (i) DAC- ELISA (ii) DAS-ELISA(iii) DIBA (iv) Western blots (v) (ab) 2-ELISA. Nucleic acid isolation, DOT-blot,southern hybridization, probe preparation,and autoradiography;

• PCR application and viral genome cloning of PCR products, plasmid purification, enzyme digestion, sequencing, annotation of genes, analysis of viral sequences(use of gene bank, blast of viral sequences and phylogeny);

• Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology,BLAST, Clustal X/W, Tm pred and Phylogeny programs).

Suggested Reading

Davies 1997. Molecular Plant Virology: Replication and Gene Expression. CRC Press, Florida.

Fauquet et al. 2005. Virus Taxonomy. VIII Report of ICTV. Academic Press, New York.

Gibbs A and Harrison B. 1976. Plant Virology – The Principles. Edward Arnold, London.

Jones P, Jones PG and Sutton JM. 1997. Plant Molecular Biology: Essential Techniques. JohnWiley & Sons, New York.

Khan J A and Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Howarth Press, NewYork.

Maramorosch K, Murphy FA and Shatkin AJ. 1996. Advances in Virus Research. Vol. 46.Academic Press, New York.

Pirone TP and Shaw JG. 1990. Viral Genes and Plant Pathogenesis. Springer Verlag, NewYork.

Roger Hull. 2002. Mathew's Plant Virology (4th Ed.). Academic Press, New York.

Thresh JM. 2006. Advances in Virus Research. Academic Press, New York.

PHDPLPATH605	Principles and Procedure of Certification

*261. **Legends: L -** Lecture**; P –** Practical*

*27**2. ****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course:

To acquaint with the certification procedures of seed and planting material.

Theory

Unit I

Introduction to certification. International scenario of certification and role of ISTA,EPPO, OECD, etc. in certification and quality control.

Unit II

Case studies of certificationsystems of USA and Europe. National Regulatory mechanism and certificationsystem including seed certification, minimum seed certification standards.

Unit III

Nationalstatus of seed health in seed certification. Methods for testing genetic identity,physical purity, germination percentage, seed health, etc.

Unit IV

Fixing tolerance limits for diseases and insect pests in certification and quality control programmes. Methods used in certification of seeds, vegetative propagules and in-vitro cultures.

Unit V

Accreditation of seed testing laboratories. Role of seed/ planting material healthcertification in national and international trade.

Suggesting Reading

- Association of Official Seed Certifying Agencies. Hutchins D and Reeves JE. (Eds.). 1997.
- Seed Health Testing: Progress Towards the 21st Century. CABI, UK. ISHI-veg Manual of Seed
- Health Testing Methods.
- ISHI-F Manual of Seed Health Testing Methods.
- ISTA Seed Health Testing Methods.
- Tunwar NS and Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed
- Certification Board, Department of Agriculture and Cooperation, Ministry of Agriculture,
- Government of India, New Delhi. US National Seed Health System.
- e-Resources
- http://www.aosca.org/index.htm.
- http://www.worldseed.org/enus/international_seed/ishi_vegetable.html
- http://www.worldseed.org/en-us/international _seed/ ishi_f.html
- http://www.seedtest.org/en/content—1—1132—241.html
- http://www.seedhealth.org

PHDSTAT521	Applied Regression Analysis

*281. **Legends: L -** Lecture**; P –** Practical*

*292. *****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course:

This course is meant for students of all disciplines including agricultural andanimal sciences. The students would be exposed to the concepts of correlation andregression. Emphasis will be laid on diagnostic measures such as autocorrelation,multi collinearity and heteroscedasticity. This course would prepare students tohandle their data for analysis and interpretation.

Theory

Unit I

Introduction to correlation analysis and its measures, Correlation from groupeddata, correlation, Rank correlation, Testing of population correlation coefficients;Multiple and partial correlation coefficients and their testing.

Unit II

Problem of correlated errors; Auto correlation; Heteroscedastic models, Durbin WatsonStatistics; Removal of auto correlation by transformation; Analysis of collinear data;Detection and correction of multi collinearity,

Unit-III

Regression analysis; Method of leastsquares for curve fitting; Testing of regression coefficients; Multiple and partialregressions.

Unit IV

Diagnostic of multiple regression equation; Concept of weighted least squares;regression equation on grouped data; Various methods of selecting the bestregression equation.

Unit V

Concept of nonlinear regression and fitting of quadratic, exponential and powercurves; Economic and optimal dose, Orthogonal polynomial.

Practical

• Correlation coefficient, various types of correlation coefficients, partial and multiple,testing of hypotheses;

• Multiple linear regression analysis, partial regression coefficients, testing ofhypotheses, residuals and their applications in outlier detection;

• Handling of correlated errors, multi collinearity;• Fitting of quadratic, exponential and power curves, fitting oforthogonal polynomials.

Suggested Reading

• Kleinbaum DG, Kupper LL, Nizam A. 2007. Applied Regression Analysis and OtherMultivariable Methods (Duxbury Applied) 4th Ed.

• Draper NR and Smith H. 1998. Applied Regression Analysis. 3rd Ed. John Wiley.

• Ezekiel M. 1963. Methods of Correlation and Regression Analysis. John Wiley.

• Koutsoyiannis A. 1978. Theory of Econometrics. MacMillan.

• Kutner MH, Nachtsheim CJ and Neter J. 2004. Applied Linear Regression Models. 4th Ed.With Student CD. McGraw Hill

Syllabus

PHDPLPATH603	**Advances in Plant Pathogenic Prokaryotes**

*30**. Legends: L -** Lecture**; P –** Practical*

**12. ***Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class

2Aim of the course

3To learn about the latest developments in all the plant pathogenic prokaryotes asa whole.

4Theory

5Unit I

6Prokaryotic cell: Molecular basis for origin and evolution of prokaryotic life, RNAworld, prokaryotic cytoskeletal proteins. Flagella structure, assembly and regulation.Structure and composition (bacteria) cell wall/ envelop, Types of secretion systems(TI to TIV) and their molecular interaction, fimbriae and pili (Type IV pili), Bacterialchromosomes and plasmids, other cell organelles. Growth, nutrition and metabolismin prokaryotes (Embden-Meyerhof-Parmas (EMP) pathway, PhosphoketolasePathway and Entner Doudoroff Pathway).

7Unit II

8Current trends in taxonomy and identification of phytopathogenic prokarya:International code of nomenclature, Polyphasic approach, New/ special detectionmethods for identification of bacterial plant pathogens. Taxonomic ranks hierarchy;Identification, Advances in classification and nomenclature.

9Unit III

10Bacterial genetics: General mechanism of variability (mutation), specializedmechanisms of variability. Transposable genetic elements in bacteria-integron andprophages, Mechanism of gene transfer. Pathogenicity islands, horizontal genetransfer, Bacterial Pan-Genome.

11Unit IV

12Bacteriophages: Composition, structure and infection. Classification and use ofphages in plant pathology/ bacteriology. Host pathogen interactions: Molecularmechanism of pathogenesis: Pathogenicity factors of soft rot, necrosis, wilt, canker,etc. Immunization, induced resistance/ Systemic Acquired Resistance, Quorumsensing. Bacterial pathogenicity and virulence: Molecular mechanism of virulenceand pathogenesis, bacterial secretion systems, pathogenicity of bacterial enzymesthat degrade the cell walls, Role of hrp/hrc genes and TALE effectors. Synthesisand regulation of EPSs.

13Unit V

14Beneficial Prokaryotes-Endophytes, PGPR, Phylloplane bacteria and their role indisease management. Endosymbionts for host defence. Advances in management ofdiseases caused by prokaryotes: genetic engineering, RNA silencing; CRISPR cas9.

15

16Practical

17• Pathogenic studies and race identification, plasmid profiling of bacteria, fatty acidprofiling of bacteria, RFLP profiling of bacteria and variability status, Endospore,Flagella staining, Test for secondary metabolite production, cyanides, EPS,siderophore, specific detection of phytopathogenic bacteria using species/ pathovarspecific primers;

18• Basic techniques in diagnostic kit development, Molecular tools to identifyphytoendosymbionts;

19• Important and emerging diseases and their management strategies.

20**Suggested Reading**

21Dale JW and Simon P. 2004. Molecular Genetics of Bacteria. John Wiley & Sons, New York.

22Garrity GM, Krieg NR and Brenner DJ. 2006. Bergey's Manual of Systematic Bacteriology: TheProteobacteria. Vol. II. Springer Verlag, New York.

23Gnanamanickam SS. 2006. Plant-Associated Bacteria. Springer Verlag, New York.

24Mount MS and Lacy GH. 1982. Plant Pathogenic Prokaryotes. Vols. I, II. Academic Press, NewYork.

25Sigee DC. 1993. Bacterial Plant Pathology: Cell and Molecular Aspects. Cambridge Univ. Press,Cambridge.

Starr MP. 1992. The Prokaryotes. Vols. I–IV. Springer Verlag, New York

PHDPLPATH604	Molecular Basis of Host-Pathogen Interaction

01. Legends: L - *Lecture**; P –** Practical*

*1**2. ****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course:

To understand the concepts of molecular biology and biotechnology in relation to host plant- pathogen interactions.

Theory

Unit I

History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II

Different forms of plant-microbe interactions and nature of signals/ effectors underpinning these interactions. Plant innate immunity: PAMP/ DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III

Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. Molecular basis of genefor-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

Unit IV

Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance. Pathogen population genetics and durability, viruses vs cellular pathogens.

Unit V

Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical

• Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation;

• Gene mapping and marker assisted selection;

• Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

Suggesting Reading

Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.

Gurr SJ, McPohersen MJ and Bowlos DJ. (Eds.). 1992. Molecular Plant Pathology – A Practical Approach. Vols. I & II, Oxford Univ. Press, Oxford.

Mathew JD. 2003. Molecular Plant Pathology. Bios Scientific Publ., UK.

Ronald PC. 2007. Plant-Pathogen Interactions: Methods in Molecular Biology. Humana Press, New Jersey.

Stacey G and Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

PHDPLPATH606	Plant Biosecurity and Biosafety

*2**1. Legends: L -** Lecture**; P –** Practical*

*3**2. ****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course

To facilitate deeper understanding on plant biosecurity and biosafety issues in agriculture.

Theory

Unit I: History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine,Invasive Alien Species, Biowarfare, Emerging/ resurgence of pests and diseases.Introduction and History of biosecurity and its importance.

Unit II: National Regulatory Mechanism and International Agreements/ Conventions, viz.,Agreement on Application of Sanitary and Phytosanitary (SPS) Measures. World TradeOrganization (WTO), Convention on Biological Diversity (CBD), InternationalStandards for Phytosanitary Measures.

Unit-III: Pest risk analysis, risk assessment models, pestinformation system, early warning and forecasting system, use of Global PositioningSystem (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management, strategies for combating risks and costs associatedwith agroterrorism event, mitigation planning, integrated approach for biosecurity.

Unit IV: Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety andits implications, Issues related to release of genetically modified crops.

Unit V: Emerging/resurgence of pests and diseases in the changing scenario of climatic conditions.

Suggested Reading

Biosecurity: A Comprehensive Action Plan.
Biosecurity Australia.
Biosecurity for Agriculture and Food Production.
FAO Biosecurity Toolkit 2008.
Grotto Andrew J and Jonathan B Tucker. 2006. Biosecurity Guidance.
Khetarpal RK and Kavita Gupta 2006. Plant Biosecurity in India – Status and Strategy. AsianBiotechnology and Development Review 9(2): 3963.
Randhawa GJ, Khetarpal RK, Tyagi RK and Dhillon BS (Eds.). 2001. Transgenic Crops andBiosafety Concerns. NBPGR, New Delhi.

e-Resources

http://www.inspection.gc.ca/english/anima/heasan/fad/biosecure.sht ml
www.fao.org/docrep/010/a1140e/a1140e00.htm Laboratory
http://www.who.int/csr/resources/publications/biosafety/WHO_CD S_EPR_2006.pdf
http://www.americanprogress.org/kf/biosecurity_ a_comprehensive_ action_plan.pdf
www.biosecurity.govt.nz DEFRA. www.defra.gov.uk/animalh/diseases/control/biosecurity/index.htm
www.daff.gov.au/ba;www.affa.gov.au/biosecurityaustralia Biosecurity New Zealand.
http://www.fao.org/biosecurity/ CFIA.

List of Journals

• Annals of Applied Biology – Cambridge University Press, London
• Annals of Plant Protection Sciences- Society of Plant Protection, IARI, New Delhi
• Annual Review of Phytopathology – Annual Reviews, Palo Alto, California
• Annual Review of Plant Pathology – Scientific Publishers, Jodhpur
• Canadian Journal of Plant Pathology – Canadian Phytopathological Society, Ottawa
• Indian Journal of Biotechnology – National Institute of Science Communicationand Information Resources, CSIR, New Delhi
• Indian Journal of Mycopathological Research – Indian Society of Mycology, Kolkata.
• Indian Journal of Plant Protection – Plant Protection Association of India, NBPGR,Hyderabad.
• Indian Journal of Virology – Indian Virological Society, New Delhi
• Indian Phytopathology-Indian Phytopathological Society, IARI New Delhi.
• Journal of Mycology and Plant Pathology – Society of Mycology and Plant Pathology,Udaipur.
• Journal of Plant Disease Science- Association of Plant Pathologists (Central India)PDKV, Akola.
• Journal of Phytopathology – Blackwell Verlag, Berlin
• Mycologia – New York Botanical Garden, Pennsylvania
• Plant Disease Research – Indian Society of Plant Pathologists, Ludhiana
• Plant Pathology – British Society for Plant Pathology, Blackwell Publ.
• Review of Plant Pathology – CAB International, Wallingford
• Virology- New York Academic Press e-Resources
• www.shopapspress.org
• www.apsjournals.apsnet.org
• www.apsnet.org/journals
• www.cabi_publishing.org
• www.springer.com/life+Sci/agriculture
• www.backwellpublishing.com
• www.csiro.au
•www.annual-reviews.org

PHDENT605	Bio-inputs for Pest Management

41. Legends: L - *Lecture****; P –*** *Practical*

*5****2. ****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Aim of the course

To appraise the students with advanced techniques in handling of different bioagents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.

Theory

Unit I

Scope of classical biological control and augmentative bio-control; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts.

Unit II

dynamics of bio-agents vis-à-vis target pest populations. Bio-inputs: mass production of bio-pesticides, mass culturing techniques of bioagents, insectary facilities and equipments,

Unit III

Basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices. Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies.

Unit IV

Survivorship analysis and ecological manipulations, large-scale production of bio-control agents, bankable project preparation. Scope of genetically engineered microbes and parasitoids in biological control,

Unit V

Genetics of ideal traits in bio-control agents for introgressing and for progeny selections, breeding techniques of bio-control agents.

Practical

• Mass rearing and release of some commonly occurring indigenous natural enemies;

• Assessment of role of natural enemies in reducing pest populations; • Testing side effects of pesticides on natural enemies;

• Effect of semio-chemicals on natural enemies, breeding of various bio-control agents, performance of efficiency analyses on target pests;

• Project document preparation for establishing a viable mass-production unit/ insectary;

• Observation of feeding behavior acts of predatory bugs/ beetles

Suggested Readings

Burges HD and Hussey NW. (Eds.). 1971. Microbial Control of Insects and Mites. Academic Press, London.

Coppel HC and James WM. 1977. Biological Insect Pest Suppression. Springer Verlag, Berlin.

De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman and Hall, London.

Dhaliwal, GS and Koul O. 2007. Biopesticides and Pest Management. Kalyani Publishers, New Delhi.

Gerson H and Smiley RL. 1990. Acarine Biocontrol Agents – An Illustrated Key and Manual. Chapman and Hall, New York.

Huffakar CB and Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London

PHDENT606	**Insect Toxicology and Residues**

PHDSTAT522	**Data Analysis Using Statistical Packages**

*61. **Legends: L -** Lecture**; P –** Practical*

*7**2. ****Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.*

Objective

This course is meant for exposing the students in the usage of various statistical packages for analysis of data. It would provide the students a hands on experience in the analysis of their research data. This course is useful to all disciplines.

Theory

Unit I

Introduction to various statistical packages: Excel, R, SAS, SPSS. Data Preparation; Descriptive statistics; Graphical representation of data, Exploratory data analysis.

Unit II

Test for normality; Testing of hypothesis using chi-square, t and F statistics and Z-test.

Unit III

Data preparation for ANOVA and ANCOVA, Factorial Experiments, contrast analysis, multiple comparisons, Analyzing crossed and nested classified designs.

Unit IV

Analysis of mixed models; Estimation of variance components; Correlation and regression analysis, Probit, Logit and Tobit Models.

Unit V

Discriminant function; Factor analysis; Principal component analysis; Analysis of time series data, Fitting of non-linear models; Neural networks.

Practical

• Use of software packages for summarization and tabulation of data, obtaining descriptive statistics, graphical representation of data;

• Testing the hypothesis for one sample t-test, two sample t-test, paired t-test, test for large samples - Chi-squares test, F test, one-way analysis of variance;

• Designs for Factorial Experiments, fixed effect models, random effect models, mixed effect models, estimation of variance components;

• Linear regression, Multiple regression, Regression plots;

• Discriminant analysis - fitting of discriminant functions, identification of important variables;

• Factor analysis. Principal component analysis - obtaining principal component.

Suggested Readings

• Anderson C.W. and Loynes R.M. 1987. The Teaching of Practical Statistics. John Wiley.

• Atkinson A.C. 1985. Plots Transformations and Regression. Oxford University Press.

• Chambers J.M., Cleveland W.S., Kleiner B and Tukey P.A. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmount, California.

• Chatfield C. 1983. Statistics for Technology. 3rd Ed. Chapman & Hall. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.

• Cleveland W.S. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.

• Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.

• Erickson B.H. and Nosanchuk T.A. 1992. Understanding Data. 2nd Ed. Open University Press, Milton Keynes.

• Snell E.J. and Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman and Hall.

• Sprent P. 1993. Applied Non-parametric Statistical Methods. 2nd Ed. Chapman & Hall.

• Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.

• Velleman PF and Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.

• Weisberg S. 1985. Applied Linear Regression. John Wiley.

• Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.

• Wetherill GB.1986. Regression Analysis with Applications. Chapman & Hall.

• Cleveland WS. 1994. The Elements of Graphing Data, 2nd Ed., Chapman & Hall

• http://freestatistics.altervista.org/en/learning.php. http://freestatistics.altervista.org/en/stat.php. http://www.cas.lancs.ac.uk/glossary_v1.1/main.html. http://www.stat.sc.edu/~grego/courses/stat706/.
• www.drs.icar.gov.in.

Syllabus: (Vegetable Science)

PHDVSC 101: RECENT TRENDS IN VEGETABLE PRODUCTION (3+0)

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To keep abreast with latest developments and trends in production technology of vegetable crops.

Theory

Unit I
Solanaceous crops: Tomato, brinjal, chilli, sweet pepper and potato
UNIT II
Cole crops: Cabbage, cauliflower and knol-khol, sprouting broccoli.
UNIT III
Okra, onion, peas and beans, amaranth and drumstick.
UNIT IV
Root crops and cucurbits: Carrot, beet root, turnip and radish and cucurbits
UNIT V
Tuber crops: Sweet potato, Cassava, elephant foot yam, Dioscorea and taro

Suggested Readings

- Bose TK and Som NG. 1986. Vegetable crops of India. Naya Prakash.
- Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I&III.Naya Udyog.
- Brewster JL. 1994. Onions and other vegetable alliums. CABI.
- Chadha KL and Kalloo G (Eds.). 1993-94. Advances in horticulture Vols. V-X. Malhotra Publ.House.
- Chadha KL (Ed.). 2002. Handbook of horticulture, ICAR.
- Chauhan DVS (Ed.). 1986. Vegetable production in India. Ram prasad and Sons.
- Fageria MS, Choudhary BR and Dhaka RS. 2000. Vegetable crops: production technology. Vol.II. Kalyani.
- FFTC. Improved vegetable production in Asia. Book Series No. 36.
- Ghosh SP, Ramanujam T, Jos JS, Moorthy SN and Nair RG. 1988. Tuber crops. Oxford andIBH.
- Gopalakrishanan TR. 2007. Vegetable crops. New India Publ. Agency.

- Hazra P and Som MG. 2015. Seed production and hybrid technology of vegetable crops. Kalyanipublishers, Ludhiana.
- Hazra P. 2016. Vegetable science. 2ndedn, Kalyani publishers, Ludhiana.
- Hazra P. 2019. Vegetable production and technology. New India publishing agency, NewDelhi.
- Kallo G and Singh K. (Ed.). 2001. Emerging scenario in vegetable research and development.Research periodicals and Book Publ. House.
- Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabeerathuma S and Pallai SV. 1996. Tropicaltuber crops, problems, prospects and future strategies. Oxford and IBH.
- Rana MK. 2008. Olericulture in India. Kalyani Publishers, New Delhi.
- Rana MK. 2008. Scientific cultivation of vegetables. Kalyani Publishers, New Delhi.
- Rubatzky VE and Yamaguchi M. (Eds.). 1997. World vegetables: principles, production andnutritive values. Chapman and Hall.
- Saini GS. 2001. A Textbook of oleri and flori culture. Aman Publishing House.
- Salunkhe DK and Kadam SS. (Ed.). 1998. Handbook of vegetable science and technology:production, composition, storage and processing. Marcel Dekker.
- Shanmugavelu KG. 1989. Production technology of vegetable crops. Oxford and IBH.
- Sin MT and Onwueme IC. 1978. The tropical tuber crops. John Wiley and Sons.
- Singh DK. 2007. Modern vegetable varieties and production technology. International bookdistributing Co.
- Singh NP, Bhardwaj AK, Kumar A and Singh KM. 2004. Modern technology on Vegetableproduction. International book distr. Co.
- Singh PK, Dasgupta SK and Tripathi SK. 2006. Hybrid vegetable development. Internationalbook distr. Co.
- Singh SP. (Ed.). 1989. Production technology of vegetable crops. Agril. Comm. Res. Centre.
- Thamburaj S and Singh N. (Eds.). 2004. Vegetables, tuber crops and spices. ICAR.
- Thompson HC and Kelly WC. (Eds.). 1978. Vegetable crops. Tata McGraw-Hill.

PHDVSC102: ADVANCES IN BREEDING OF VEGETABLE CROPS (3+0)

Legends:L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on the recent research trends and advances in breeding of vegetable crops.

Theory

UNIT I

Solanaceous crops—Tomato, Brinjal, Hot Peeper, Sweet Pepper, Okra and Potato

UNIT II

Cucurbits and Cole crops

UNIT III

Legumes and leafy vegetables—Peas and Beans, Amaranth, Palak, Chenopods and Lettuce

UNIT IV

Root crops and onion—Carrot, Beetroot, Radish, Turnip, Onion

UNIT V

Tuber crops—Sweet potato, Tapioca, Elephant foot yam, Colocasia, Dioscorea

Suggested Readings

- Allard RW. 1999. Principle of plant breeding. John Willey and Sons, USA.
- Basset MJ. (Ed.). 1986. Breeding vegetable crops. AVI Publ.
- Dhillon BS, Tyagi RK, Saxena S and Randhawa GJ. 2005. Plant genetic resources: horticulturalcrops. Narosa Publ. House.
- Fageria MS, Arya PS and Choudhary AK. 2000. Vegetable crops: Breeding and seed production.Vol. I. Kalyani.
- Gardner EJ. 1975. Principles of genetics. John Wiley and Sons.
- Hayes HK, Immer FR and Smith DC. 1955. Methods of plant breeding. McGraw-Hill.
- Hayward MD, Bosemark NO and Romagosa I. (Eds.). 1993. Plant Breeding-principles andprospects. Chapman and Hall.
- Hazra P and Som MG. 2015. Vegetable science (Second revised edition), Kalyani publishers,Ludhiana, 598 p
- Hazra P and Som MG. 2016. Vegetable seed production and hybrid technology (Second revisededition), Kalyani Publishers, Ludhiana, 459 p
- Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, Fl, USA.
- Kalloo G. 1998. Vegetable breeding. Vols. I-III (Combined Ed.). Panima Edu. Book Agency.
- Kumar JC and Dhaliwal MS. 1990. Techniques of developing hybrids in vegetable crops. AgroBotanical Publ.
- Paroda RS and Kalloo G. (Eds.). 1995. Vegetable research with special reference to hybridtechnology in Asia-Pacific Region. FAO.
- Peter KV and Pradeepkumar T. 2008. Genetics and breeding of vegetables. Revised, ICAR.
- Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables. Studium press LLC, P.O. Box722200, Houston, Texas 77072, USA, 678p.
- Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume II.Studium Press LLC,P.O. Box 722200, Houston, Texas 77072, USA, 509p.
- Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume III.Studium Press LLC,P.O. Box 722200, Houston, Texas 77072, USA, 634p.
- Rai N and Rai M. 2006. Heterosis breeding in vegetable crops. New India Publ. Agency.
- Ram HH. 1998. Vegetable breeding: principles and practices. Kalyani Publishers, New Delhi.
- Simmonds NW. 1978. Principles of crop improvement. Longman. Singh BD. 1983. PlantBreeding.Kalyani Publishers, New Delhi.
- Singh BD. 1983. Plant breeding. Kalyani Publishers, New Delhi.
- Singh PK, Dasgupta SK and Tripathi SK. 2004. Hybrid vegetable development. InternationalBook Distributing Co.
- Swarup V. 1976. Breeding procedure for cross-pollinated vegetable crops. ICAR.

PHDFSC103: Arid and Dryl and Fruit Production(2+0)

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To keep abreast with latest developments and trends in production technology of

arid and dryl and fruit crops.

Theory

Unit I:

General Concepts and Current Scenario: Characteristics features and major constraints of the arid and dryland region, distinguishing features of the fruit species trees for adaptation in adapting to the region.

Unit II

Nutritional and pharmaceutical importance, national problems

Unit III

Propagation, Planting Systems and Crop Regulation: Recent advances in propagation – root stocks, planting systems, High density planting,crop modelling, Precision farming, decision support systems.

Unit IV:

Aspects of crop regulation- physical and chemical regulation, effects on physiology and development, influence of stress factors.

Unit V:

Stress Mitigation and Integrated Approaches: Strategies to overcomestress effects,integrated and modern approaches in water and nutrientmanagement, total quality management (TQM) – Current topics.

Crops

Aonla, Annonas, ber, bael, jamun, date palm, cactus pear, khejri, kair, pilu, lasoda,

manila, tamarind, monkey jack, mahua, khirni, amra, seabuckthorn, chilgoza, cafel,

rhododendron, box myrtle, chironji, phalsa,

Suggested Reading

Hiwale S. 2015. *Sustainable Horticulture in Semiarid Drylands.* Springer.
Krishna H and Sharma RR. 2017. *Fruit Production – Minor Fruits.*Daya Publishing House,Delhi.
More T A, Singh RS, Bhargava R and Sharma BD. 2012. *Arid Horticulture for Nutrition andLivelihood.* Agrotech Publishing Academy, Udaipur (Rajasthan).
Pareek OP, Sharma S and Arora RK. 2007. *Underutilised Edible Fruits and Nuts*, IPGRI,Rome.
Peter K.V. 2010. *Underutilized and Underexploited Horticultural Crops*. NIPA, New Delhi.
Saroj PL, Dhandar DG and Vashishta BB. 2004. *Advances in Arid Horticulture*, Vol.-1 *PresentStatus*. IBDC, Lucknow.
Saroj P L and Awasthi OP. 2005. *Advances in Arid Horticulture*, Vol: II: *Production Technologyof Arid and Semiarid Fruits*. IBDC, Lucknow.
Sontakke MB. 2014. *Production and Management of Fruit crops in Arid/ Drylands.* AgrotechPublishing Academy, Udaipur (Rajasthan).

PHDVSC201: ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS (2+1)

Legends:L- Lecture;**P**–Practical;

*TeacherAssessmentshallbebasedonfollowingcomponents:Quiz/Assignment/Project/Participatio nin Class etc.

Objective

Toupdateknowledgeontherecentresearchtrendsinthefieldofabioticstressmanagementinvegetables.

Theory:

Unit I

Environmentalstress—itstypes,soilparametersincludingpH,classificationofvegetablecropsbasedon susceptibility and tolerance to various types of stress.

Unit II

Mechanismandmeasurements—tolerancetodrought,waterlogging,soilsalinity,frostandheatstressin vegetable crops.

Unit III

Soil-plant-waterrelations—
underdifferentstressconditionsinvegetablecropsproductionandtheirmanagement practices.

Unit IV

Techniques of vegetable growing under water deficit,water logging,salinity and sodicity.

Unit V

Useofchemicals—techniquesofvegetablegrowingunderhighandlowtemperatureconditions,useof chemicals and antitranspirants in alleviation of different stresses

Practical

- Identificationofsusceptibilityandtolerancesymptomstovarioustypesofstressinvegetablecrops;
- Measurementoftolerancetovariousstressesinvegetablecrops;
- Shorttermexperimentsongrowingvegetableunderwaterdeficit,waterlogging,salinityandsodicity,h ighand low temperature conditions;
- Useofchemicalsforalleviationofdifferentstresses.

Suggested Readings

- DhillonBS,TyagiRK,SaxenaSandRandhawaGJ.2005.Plantgeneticresources:horticulturalcr ops. NarosaPubl. House.

- DwivediPand DwivediRS. 2005.Physiologyof abiotic stressin plants.Agrobios.
- JanickJJ.1986.Horticultural science.4thEd.WH FreemanandCo.
- KalooGandSinghK.2001.Emergingscenarioinvegetableresearchanddevelopment.Research periodicals andbook publ. house.
- KalooG.1994.Vegetable breeding.Vols. I-III.VedamseBooks.
- LernerHR.(Eds.).1999. Plantresponsestoenvironmentalstresses.MarcelDecker.
- MalooSR.2003.Abioticstressesandcropproductivity.AgrotechPubl.Academy.
- NarendraT.etal.2012.Improvingcrops resistanceto abioticstress.Wileyand Sons.US.
- PeterKVandPradeepKumarT.2008.Geneticsandbreedingofvegetables.(RevisedEd.).ICAR.
- PeterKVandHazraP.(Eds).2015.HandbookofvegetablesvolumeII.StudiumPressLLC,P.O. Box722200, Houston, Texas 77072, USA, 509p.
- PeterKVandHazraP.(Eds).2015.HandbookofvegetablesvolumeIII.StudiumPressLLC,P.O. Box722200, Houston, Texas 77072, USA, 634p.
- RamHH.2001.Vegetablebreeding.Kalyani.
- RaoNK.(Eds.).2016.Abioticstressphysiologyofhorticulturalcrops.Springerpublication.

PHDVSC202: SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE SEEDS(2+1)

Legends:L- Lecture;**P**–Practical;
*TeacherAssessmentshallbebasedonfollowingcomponents:Quiz/Assignment/Project/Participationin Class etc.

Objective

Toimpart the knowledge on seed certification,process in gandstorage of vegetable seeds

Theoy

UnitI

Seedcertification,history,conceptsandobjectives,seedcertificationagency,phasesofseedcertification,Indian Minimumseed Certification standards, Planning and management of seed certification programmes.

UnitII

Principlesandproceduresoffieldinspection,seedsampling,testingandgrantingcertification,OECDcertification Schemes.

UnitIII

Principlesofseedprocessing,Methodsofseeddryingandcleaning,seedprocessingplant-Layoutanddesign, seed treatment, seed qualityenhancement,packagingand marketing

UnitIV

Principles of Seed Storage, orthodox/ recalcitrant seeds, types of storage (open, bulk, controlled,germplasm, cryopreservation), factors affecting seed longevity in storage (Pre and post harvestfactors).

UNITV

Seedaginganddeterioration,maintenanceofseedviabilityandvigorduringstorage,storagemethods,storagestructures, transportation and marketingof seeds.

Practical

• Generalproceduresofseedcertification;

• Fieldinspectionandstandards;

• Isolationandrouging;

• Inspectionandsamplingatharvesting,threshingandprocessing;

• Testingphysicalpurity,germinationandmoisture,grow-outtest;

• Visittoregulatoryseedtestingandplantquarantinelaboratories;

• Seedprocessingplantsandcommercialseedstores.

Suggested Readings

- AgarwaalPKandAnuradhaV.2018.Fundamentalsofseedscienceandtechnology.Brilliantpublications, New Delhi.
- BasraAS.2000.Hybrid seed productioninvegetables.CRCpress, Florida,USA.
- BenchALRandSanchezRA.2004.Handbookofseedphysiology.Foodproductspress,NY/London.
- ChakrabortySK,PrakashS,SharmaSPandDadlaniM.2002.Testingofdistinctiveness,uniformityand stabilityfor plant varietyprotection.IARI, NewDelhi
- CoplandLOandMcDonaldMB.2004.Seedscienceandtechnology,Kluweracademicpress.
- FageriaMS,AryaPSandChoudhryAK.2000.Vegetablecrops:breedingandseedproductionVol 1. Kalyani publishers, New Delhi.
- GeorgeRAT.1999.Vegetableseedproduction(2ndEdition).CABInternational.
- HazraPandSomMG.2016.Vegetableseedproductionandhybridtechnology(Secondrevisededition), Kalyani publishers,Ludhiana, 459p
- KallooG,JainSK,VariAKandSrivastavaU.2006.Seed:Aglobalperspective.Associatedpublishingcompany, New Delhi.
- SinghalNC.2003.Hybridseedproduction.Kalyanipublishers,NewDelhi

PHDPSM203: Advances in Production of Plantation and Spice Crops (3+0)

Legends:L-Lecture; P–Practical;

*TeacherAssessmentshallbebasedonfollowingcomponents:Quiz/Assignment/Project/Participation in Class etc.

Objective

Thecourseisdesignedtoprovide advancedcropproductiontechniquesofvariousplantationandspicecropsgrown inIndia.

Theory

Unit I: Area, production, productivity: Indian and world scenario: Role of plantation and spicecropsinnationaleconomy,area-productionstatisticsatnationalandinternationallevel,productivity challenges, industrial requirement of plantation and spice crops, demand-supplyscenarioofplantation and spicecrop.

Unit II: Export potential: Export scenario, market opportunities and challenges in plantation andspice crops, global imports and exports, export of organic produce and products. Promotionalprogrammes: Role of commodity boards and directorates. in the development programmes ofplantation and spice crops, contract farming, Farmer Producer Organizations (FPO) and FarmerProducerCompanies (FPC).

Unit III: Varietal wealth and planting material production: Cultivars and improved varieties inplantationandspicecrops,massmultiplicationtechniques,hi-technurserytechniques.Agrotechniques: Precision farming techniques, HDP systems, fertigation, chemical regulation ofcropproductivity,protectedcultivationofhighvaluecrops,mechanizationinplantationandspicecrops, hydroponics,aeroponics,applicationof nanotechnology,robotics.

UnitIV: Impactofclimatechange:Impactofbioticandabioticfactorsongrowthandproductivity,climate resilienttechnologiesinplantationandspicecrops,soil health management,organicproductionsystems.Maturity indicesandharvest:Influence of pre andpost-harvest factors on quality of plantation and spice crops, pre and post-harvest managementtechniquesforimproving quality,goodmanufacturingpracticesinplantation andspicesector.

UnitV: Quality standards:Domesticandinternationalstandards,HACCP,BISstandards,domesticand export grades, modern packaging techniques, export protocols.

Crops

Coconut, Arecanut, Oil palm, Cashew, Coffee, Tea, Cocoa, Rubber, Palmyrah, Black pepper,Cardamom, Ginger, Turmeric, Nutmeg, Cinnamon, Clove, Vanilla, Garcinia, Coriander, Cumin,Fennel,Fenugreek,Ajwain, Dill, Safron

Suggested Reading

AfoakwaEO. 2016.*Cocoa Productionand ProcessingTechnology*. CRCPress

AgarwalS,DivkarasastryEVandSharmaRK.2001.*SeedSpices,Production,QualityandExport*.Pointer Publ.

Anonymous.1985.*RubberanditsCultivation*.TheRubber Boardof India.

BarcheS.2016.*ProductionTechnologyoSpices,Aromatic,MedicinalandPlantationCrops*.New India PublishingAgency, New Delhi.

ChadhaKL.2001.*Hand BookofHorticulture*.ICAR.

ChopraVLand Peter KV. 2005.*Handbookof Industrial Crops*.Panima.

ChoudappaP,AnithaK,RajeshMKandRameshSV.2017.*BiotechnologyofPlantationCrops*.DayaPublishingHouse,New Delhi.

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HarlerCR.1963. *TheCultureand MarketingofTea*. OxfordUniv. Press.

JoshiP.2018.*TextBookonFruitandPlantationCrops*.NarendraPublishingHouse,NewDelhi.

KurianAandPeterKV. 2007.*CommercialCropsTechnology*.NewIndiaPubl.Agency.

MarshAC,MossMKandMurphyEW.1977.*CompositionofFoodSpicesandHerbs,Raw,Processedand Prepared*.Agric. Res. Serv.HandBook 8-2. Washinton DC.
irMK,BhaskararaoEVV,NambiarKKNandNambiarMC.1979.*Cashew*.CPCRI,Kasaragod.

Nybe EV, Mini Raj N and Peter KV. 2007. *Spices*. New India Publ.

Agency.PandaH. 2013.*TheCompleteBookon Cashew*.Asia

PacificBusinessPressInc.

PandaH.2016.*TheCompleteBookonCultivationandManufactureof Tea*(2ndRevisedEdition).AsiaPacificBusiness PressInc.

PeterKV.2001.*HandBookofHerbsandSpices*.Vols.I-III.WoodheadPubl.Co.,UKandCRC,USA.

PeterKV.2002.*PlantationCrops*. NationalBookTrust.

PillayPNR.1980.*HandbookofNaturalRubberProductioninIndia*.RubberResearchInstitute,Kottayam.pp.668.

Ponnuswami*etal*.2018.*Spices*.NarendraPublishingHouse,NewDelhi

PradeepkumarT, SumaB, Jyothibhaskar andSatheesanKN.
2007.*ManagementofHorticulturalCrops*.PartsI,II.NewIndia Publ. Agency.

Purseglove JW, Brown EG, Green CL and Robbins SRJ. 1984. *Spices*. Vols. I, II.

Longman.PursegloveJW. 1968.*TropicalCrops–Dicotyledons*.Longman.

Ramachandra*etal*.2018.*BreedingofSpicesandPlantationcrops*.NarendraPublishingHouse,NewDelhi.

Ranganathan V. 1979. *Hand Book of Tea Cultivation*. UPASI, Tea Res. Stn.

Cinchona.RavindranPN. 2003. *Cinnamon and cassia*. CRCpress.

RavindranPN.2004.*Ginger,thegenusZingiber*. CRCpress

RavindranPN.2007.*Turmeric,thegenuscurcuma*.CRCpress, MedicinalandAromaticPlants–IndustrialProfiles.Routledge,UK.

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RavindranPNand MadhusoodananKJ. 2002. *Cardamom, theGenusElettaria*. CRCpress.

SeraT, SoccolCR, PandeyA and RoussosS CoffeeBiotechnologyand Quality.Springer,Dordrecht.

SethurajMR and MathewNT. 1992. *NaturalRubber: Biology,Cultivation andTechnology* (DevelopmentsinCropScience).ElsevierScience.

Shanmugavelu KG, Kumar N and Peter KV. 2002. *Production Technology of Spices andPlantationCrops*. Agrobios.

SharangiABandAcharyaSK.2008. *QualitymanagementofHorticulturalcrops*.AgrotechPublishingHouse, Udaipur;ISBN: 81-8321-090-2

Sharangi AB and Datta S. 2015. *Value Addition of Horticultural crops: Recent trends and Futuredirections*.SPRINGER;ISBN: 978-81-322-2261-3.

Sharangi AB, Datta S and Deb, P. 2018. *Spices: Agrotechniques for quality produce*, April,AcademicPress (Tylor and FrancisGroups), NewJersey, USA.

Sharangi AB. 2018. *Indian Spices: The legacy, production and processing of India's treasuredexport*. Springer International publishing. AG, Part of Springer Nature, 2018, Cham,Switzerland.

Srivastava HC, Vatsaya and Menon KKG. 1986. *Plantation Crops–Opportunities andConstraints*.Oxford and IBH.

Swain SC. 2018. *Precision Farming in Horticulture: Approaches and strategies*. NarendraPublishingHouse, NewDelhi.

ThampanPK.1981.*HandBookofCoconutPalm*.OxfordandIBH.Varm

udyV. 2001.*Marketing of Spices*. DayaPubl. House.

Winton AL and Winton KB. 1931. *The Structure and Composition of Food*. John Wiley andSons.

YagnaNarayanAyerAK.1960.*CultivationofClovesinIndia*.ICAR.

PHDSOIL204: Modern Concept in Soil Fertility (2+0)

Legends:L-Lecture; P–Practical;

*TeacherAssessmentshallbebasedonfollowingcomponents:Quiz/Assignment/Project/Participation in Class etc.

Objective

Toprovide knowledgeofmodern conceptsof soilfertilityand nutrientuse in cropproduction.

Theory

Unit I

Nutrient availability-concept and relationships, modern concepts of nutrients availability; soilcolloids and nutrient availability; soil amendments and availability maintenance of nutrients, soilsolutionandplantgrowth;nutrientresponsefunctionsandavailabilityindices.Nutrientmovement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply anduptakebyplants; models fortransformation and movement of major micronutrients in soils.

Unit II

Chemicalequilibria(includingsolid-solutionequilbria)involvingnutrientionsinsoils,particularly in submerged soils; Kinetic studies of nutrients in soils. Modern concepts of fertilizerevaluation,nutrient use efficiencyand nutrientbudgeting.

Unit III

Modernconcepts in fertilizer application; soil fertility evaluation techniques; role of soil tests infertilizeruserecommendations; site-specificnutrient managementforprecisionagriculture.

Unit IV

Monitoring physical, chemical and biological changes in soils; permanent manurial trials andlong term fertilizer experiments; soil productivity under long-term intensive cropping; direct,residualand cumulativeeffect of fertilizer use.

Unit V

Carbon– a nutrient central to soil fertility; carbon cycle in nature, stocks, pools and fluxes;greenhouse effect and climate change; carbon sequestration vis-à-vis sustenance of soil qualityandcrop productivity.

Suggested Readings

BarberSA. 1995.*Soil NutrientBioavailability*.John Wiley&Sons.

• BarkerVAllenandPilbeamDavidJ.2007.*HandbookofPlantNutrition*.CRC/Taylor&Francis.

• BradyNCand WeilRR.2002.*TheNatureand PropertiesofSoils*. 13thEd.Pearson Educ.

• CookeGW. 1979. *TheControl of Soil Fertility*.CrossbyLockwood &Sons.

• Epstein E. 1987. *Mineral Nutrition of Plants - Principles and Perspectives*. International PotashInstitute,Switzerland.

• Kabata-PendiasAlina 2001. *TraceElementsinSoilsandPlants*.CRC/Taylor&Francis.

• KannaiyanS,KumarKandGovindarajanK.2004.*BiofertilizersTechnolo*gy.ScientificPubl.

• MortvedtJJ,Shuman LM,CoxFR andWelch RM.(Eds.). 1991.*Micronutrients inAgriculture.* 2ndEd. Soil ScienceSocietyof America, Madison.

• PrasadRandPowerJF.1997.*SoilFertilityManagementforSustainableAgriculture*.CRCPress.

• StevensonFJandColeMA.1999.*CyclesofSoil:Carbon,Nitrogen,Phosphorus,Sulphur,Micronutri ents.* JohnWiley&Sons.

• StevensonFJ.(Ed.).1982.*NitrogeninAgriculturalSoils*.SoilScienceSocietyofAmerica,Madison.

• TisdaleSL,NelsonWL,BeatonJDandHavlinJL.1990.*SoilFertilityandFertilizers.*5th Ed.Macmilla nPubl.

• WildA.(Ed.).1988. *Russell'sSoilConditionsandPlantGrowth*.11thEd.Longman.

PHDSTAT205 : Advanced Statistical Methods (2+1)

IV. Aim of thecourse

This is an advanced course in Statistical Methods that aims at describing some advanced leveltopics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

V.

TheoryUn

it I

Truncated and compound distributions. Fitting of orthogonal polynomials. Pearsonian curves.Categoricaldataanalysis-

loglinearmodels,Associationbetweenattributes.Variancestabilizingtransformations.

Unit II

Sampling distribution of correlation coefficient, regression coefficient, correlation ratio, intraclasscorrelation coefficient.

Unit III

Non-central t, x^2 and F distributions. Distribution of quadratic forms. Cochran's theorem.Testsfornormality.Largesampletests.Testsofsignificancebasedont,x^2andFdistributions.Orderstatistics,distributionofr^{th}orderstatistics,jointStatisticalSciences:

AgriculturalStatisticsdistributionofseveralorderstatisticsandtheirfunctions,marginaldistributionsoforder statistics, distribution ofrange, median, etc.

Unit IV

Fittingofageneralizedlinearmodel,mixedmodelandvariancecomponentsestimation,MINQUE,MIVQUE, REML.

VI. Practical

•Fittingof truncated distribution,

•FittingofPearsoniancurves,

•Analysisofassociationbetweenattributes,categoricaldata.

•Fittingofnon-central t, $x^2$and Fdistributions.

•ComputationofTestsofsignificancebasedont,x^2 andFdistributions.

•Orderstatistics.

VII. Suggested Reading

•ChatterjeeS,HadiAandPriceB.2013.*RegressionAnalysisbyExamples*.5thEd.JohnWiley.

•DraperN.R.andSmithH.1998. *AppliedRegressionAnalysis*.3rdEd.JohnWiley.

•Rao C.R.2009. *LinearStatistical Inferenceandits Applications*.2nd Ed.JohnWiley.

•SearleS.R,CasellaGandMcCullochC.E.1992.*VarianceComponents*.JohnWiley.

•SearleS.R.1971. *LinearModels*. JohnWiley.

PHDAGRON206: RECENT TRENDS IN WEED MANAGEMENT (2+0)

Legends:L-Lecture; P–Practical;

*TeacherAssessmentshallbebasedonfollowingcomponents:Quiz/Assignment/Project/Participation in Class etc.

Objective

Toteachaboutthechangingweedflora,newherbicides,theirresistance,toxicity,antidotesandresiduemanagement under different cropping systems

Theory UNIT 1

Crop-weed competition in different cropping situations; changes in weed flora, various causesandeffects;differentmethodsofweedmanagement.Migration,introduction,adaptationofweeds, Invasive weeds – biology and management. Different mechanisms of invasion – present statusand factors in fluencing weed invasion.

Unit II

Physiological and biological aspects of herbicides, their absorption, translocation, metabolismand mode of action; selectivity of herbicides and factors affecting them. Climatic factors andphytotoxicity of herbicides; fate of herbicides in soil and factors affecting them, Degradation of herbicides in soil and plants- factors affecting it, primary and secondary metabolites, residue managemen to fherbicides, adjuvants.

Unit III

Advances in herbicide products and application techniques and methods; herbicide resistance;antidotes and crop protection compatibility of herbicides of different groups; compatibility of herbicides with other pesticides; herbiciderotation and herbicide mixtures.

UNIT IV

Development of transgenicher bicideresistant crops;herbicide development, registration procedures.

UNITV

Relationship of herbicides with tillage, fertilizer, and irrigation, cropping system; bioherbicides,allelochemical and alleloherbicides, herbicide bioassays. Recent advances in nonchemical weedmanagementincludingdeleterious rhizobacteria,robotics, biodegradablefilm, etc.

Suggested Readings

• Böger,Peter,Wakabayashi,Ko,Hirai,Kenji(Eds.).2002.HerbicideClassesinDevelopment. ModeofAction,Targets,GeneticEngineering,Chemistry.Springer.

• DasTK.2008.WeedScience: Basics andApplications,JainBrothers(NewDelhi)

• Fennimore,StevenAandBell,Carl.2014.PrinciplesofWeedControl,4thEd,California WeedSci.Soc.

• GuptaOP.2007.WeedManagement:Principles andPractices,2ndEd.

• JugulanM,(ed).2017.Biology,Physiologyand MolecularBiologyofWeeds.CRCPress

- MonacoTJ,WellerSCandAshtonFM.2014.WeedSciencePrinciplesandPractices,Wiley
- PowlesSBandShanerDL.2001.HerbicideResistanceandWorld Grains,CRCPress.
- WaliaUS.2006.WeedManagement,Kalyani.
- ZimdahlRL.(ed).2018.IntegratedWeedManagementforSustainableAgriculture,B.D.Sci.Publ.

Agriculture: (Genetics and Plant Breeding) G & PB – 2023

PHDGPB601	Advances In Plant Breeding Systems

Legends:L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart theoretical knowledge about advances in plant breeding.

Theory

Unit I

Advances in reproductive biology of crops; Genes governing the whorls formation and various models proposed; Pollen pistil interaction: biochemical and molecular basis, environmental factors governing anthesis and bottlenecks for gene transfer. Plant Breeding methodologies: Classic versus modern; Over view of Pre and Post Mendelian breeding methods in self and cross pollinated crops; Molecular and transgenic breeding approaches; doubled haploid breeding, shuttle breeding, forward and reverse breeding, speed breeding, participatory plant breeding, breeding for organic situations.

UNIT II

Principles and procedures in the formation of a complex population; Genetic basis of population improvement in crop plants; Recurrent selection methods in self and cross pollinated crops and their modifications; Convergent selection, divergent selection; Recurrent selection, usefulness in hybrid breeding programs; Reciprocal recurrent selection; Selection in clonally propagated crops – Assumptions and realities.

UNIT III

Choice of molecular markers for plant breeding efficiency, fingerprinting and genetic diversity assessment, application of MAS for selection of qualitative and quantitative traits; Gene pyramiding, accelerated backcrossing, marker-based utilization of exotic germplasm, introgression libraries. Genetic resources: primary, secondary, tertiary and alien trans gene pool; Molecular and biochemical basis of self-incompatibility and male sterility, nucleocytoplasmic interactions with special reference to male sterility – genetic, biochemical and molecular bases.

UNIT IV

Genetic engineering technologies to create male sterility, prospects and problems, use of self-incompatibility and sterility in plant breeding – case studies; Fertility restoration in male sterile lines and restorer diversification programs; Conversion of agronomically ideal genotypes into male sterile: Concepts and breeding strategies; Case studies - Generating new cyto-nuclear interaction system for diversification of male sterile; Stability of male sterile lines – Environmental influence on sterility, Environmentally Induced Genic Male Sterility (EGMS) – Types of EGMS; Influence on their expression, genetic studies; Photo and thermo sensitive genetic male sterility and its use in heterosis breeding; Temperature sensitive genetic male sterility and its use heterosis breeding; Apomixis and its use in heterosis breeding; Incongruity: Factors influencing incongruity Methods to overcome incongruity mechanisms.

UNIT V

Breeding for climate change -Improving root systems, abiotic stress tolerance, water use efficiency, flooding and sub-mergence tolerance; Biotic stress tolerance; Nutrient use efficiency, nitrogen fixation and assimilation, greenhouse gases and carbon sequestration; Breeding for bio-fortification.

Suggested Readings

- Agarwal RL. 1996. Fundamentals of Plant Breeding and Hybrid Seed Production. Oxford & IBH.
- Allard RW. 1966. Principles of Plant Breeding. John Wiley & Sons.
- Briggs FN and Knowles PF. 1967. Introduction to Plant Breeding. Reinhold.
- Fehr WR. 1987. Principles of Cultivar Development: Theory and Technique. Vol I. Macmillan.
- Hayes HK, Immer FR and Smith DC. 1955. Methods of Plant Breeding. McGraw-Hill.
- Kang MS and Priyadarshan PM (Edit.). 2007. Breeding Major Food Staples. Blackwell Publishing.
- Kole C. 2013. Genomics and Breeding for Climate-Resilient Crops. Springer. Volume 2- Target Traits.
- Richards AJ. 1986. Plant Breeding Systems. George Allen & Unwin.
- Sharma JR. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
- Simmonds NW. 1979. Principles of Crop Improvement. Longman.
- Singh BD. 1997. Plant Breeding: Principles and Methods. 5th Ed., Kalyani Publishers, New Delhi.
- Singh P. 1996. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
- Welsh JR. 1981. Fundamentals of Plant Genetic and Breeding. John Wiley

PHDGPB605	Genomics in Plant Breeding

Legends:L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart practical skills in advanced molecular techniques in genome mapping structural/ functional genomics.

Theory

UNIT I

Introduction to the plant genomes: nuclear, chloroplast and mitochondrial genomes; Concept of genome size and complexity: C-value paradox, repetitive and unique DNA. Genome sequencing: Principles and techniques of conventional approaches and next generation sequencing including sequencing-by-synthesis/ ligation and single molecule real time (SMRT) technologies; Applications of sequence information: structural, functional and comparative genomics; Plant genome projects: Strategies for genome sequencing including shot gun and clone-by-clone method.

UNIT II

Molecular maps: Use of molecular markers/ SNPs for development of genetic and physical maps; Linkage and LD-based gene mapping approaches including gene/ QTL mapping, genome wide association studies (GWAS) and association analysis; Integration of genetic and physical map for map-based cloning of economically important genes. Concept of allele mining; Diversity array technology: concepts and applications.

UNIT III

Functional genomics: concept of reverse and forward genetics; Use of activation tagging, transposon tagging, insertional mutagenesis, TILLING and ecoTILLING for crop improvement; Genome-wide and gene-specific transcriptomics approaches: serial analysis of gene expression, massively parallel signature sequencing, next generation sequencing, microarray, northern hybridization, RT-PCR, qRT-PCR and molecular beacon.

UNIT IV

Development and management of database; Applications of bioinformatics tools/ software in genomics for crop improvement. Basic concepts of high-throughput proteomics, metabolomics and phenomics.

UNIT V

Recent transgene free genome editing tools such as CRISPR-Cas9 system, TALENS and ZFNs for crop improvement. Cisgenesis and Intragenesis tools as twin sisters for Crop Improvement; Genomics-based plant breeding: Genome-Wide Genetic Diversity Studies, Identification of molecular markers linked to single Genes and QTL, Marker Assisted Selection (Marker Assisted Backcross Selection, Association mapping, Breeding by Design, Genome selection).

Suggested Readings

- Alonso JM, Stepanova AN. 2015. Plant Functional Genomics: Methods and Protocols. Springer.
- Chopra VL, Sharma RP, Bhat SR and Prasanna BM. 2007. Search for New Genes. Academic Foundation, New Delhi.
- Hackett PB, Fuchs JA and Messing JW. 1988. An Introduction to Recombinant DNA Technology—Basic Experiments in Gene and Manipulation. 2nd Ed. Benjamin Publication Co.
- Primose SB and Twyman RM. 2006. Principles of Gene Manipulation and Genomics. 7th Ed. Wiley-Blackwell Publishing.
- Sambrook J and Russel D. 2001. Molecular Cloning - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Laboratory Press.
- Singh BD. 2005. Biotechnology: Expanding Horizons. Kalyani Publishers, New Delhi.
- Somers DJ, Langridge P, Gustafson JP. 2009. Plant Genomics: Methods and Protocols. Springer.

e-Resources

http://gramene.org
https://www.arabidopsis.org
https://wheat.pw.usda.gov
http://ncbi.nlm.nih.gov
http://www.maizegenetics.net

PHDGPB604	Plant Genetic Resources, Conservation and Utilization

Legends:L - Lecture; **P** – Practical.

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on the methods of germplasm conservation and its utilization.

Theory

UNIT I

Concept of natural reserves and natural gene banks; In situ conservation of wild species in nature reserves: in situ conservation components, factors influencing conservation value, national plan for in situ conservation; in situ conservation of agro-biodiversity on-farm; scientific basis of in situ conservation on-farm, building on-farm conservation initiatives, implementation of on-farm conservation, management of in situ conserved genetic diversity on-farm, enhancing benefits for farmers from local crop diversity.

UNIT II

Ex situ conservation: components, plant genetic resources conservation in gene banks, national gene banks, gene repositories, preservation of genetic materials under natural conditions, perma-frost conservation, guidelines for seed multiplication and exchange to network of active/ working collections, orthodox, recalcitrant seeds- differences in handling, clonal repositories, genetic stability under long term storage condition.

UNIT III

In-vitro storage, maintenance of in-vitro culture under different conditions, in-vitro bank maintenance for temperate and tropical fruit crop species, spices, tubers, bulbous crops, medicinal and endangered plant species, conservation of embryos and ovules, cell/ suspension cultures, protoplast and callus cultures, pollen culture, micro propagation techniques, problems, prospects of in-vitro gene bank.

UNIT IV

Cryopreservation- procedure for handling seeds of orthodox and recalcitrant-cryoprotectants, desiccation, rapid freezing, slow freezing, vitrification techniques, encapsulation/ dehydration techniques, national facilities, achievements, application of cryopreservation in agricultural, horticultural and forestry crops. Problems and prospects; challenges ahead.

UNIT V

Concept and procedure for PGR management, germplasm characterization, evaluation and utilization; Concept of core and mini core; collections and registration of plant germplasm

Suggested Readings

- Ellis RH, Roberts EH and White Head J. 1980. A New More Economic and Accurate Approach to Monitor the Viability of Accessions During Storage in Seed Banks. FAO/ IBPGR Pl. Genet. Resources News 41-3-18.
- Frankel OH and Hawkes JG. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press, Cambridge.

- Paroda RS and Arora RK.1991. Plant Genetic Resource Conservation and management, NBPGR, New-Delhi. Simmonds NW. 1979. Principles of Crop Improvement, Longman.
- Westwood MN. 1986. Operation Manual for National Clonal Germplasm Repository. Processed Report. USDA-ARS and Oregon State Univ. Oregon, USA.
- Withers LA. 1980. Tissue Culture Storage for Genetic Conservation. IBPGR Tech. Rep. IBPGR, Rome, Italy.

PHDSTAT601	Advanced Data Analytics

Legends:L - Lecture; **P** – Practical.

Objectives:

This is an advanced course in Statistical Computing that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences and use of statistical packages.

Theory

Unit I: Measures of association. Structural models for discrete data in two or more dimensions. Estimation in complete tables. Goodness of fit, choice of a model. Generalized Linear Model for discrete data, Poisson and Logistic regression models. Log-linear models. Elements of inference for cross-classification tables. Models for nominal and ordinal response.

Unit II: Computational problems and techniques for robust linear regression, nonlinear and eneralized linear regression problem, tree-structured regression and classification, cluster analysis, smoothing and function estimation, robust multivariate analysis.

Unit III: Analysis of incomplete data: EM algorithm, single and multiple imputations. Markov Chain, Monte Carlo and annealing techniques, Neural Networks, Association Rules and learning algorithms.

Unit IV: Linear mixed effects models, generalized linear models for correlated data (including generalized estimating equations), computational issues and methods for fitting models, and dropout or other missing data.

Unit V: Multivariate tests of linear hypotheses, multiple comparisons, confidence regions, prediction intervals, statistical power, transformations and diagnostics, growth curve models, dose-response models. Restructured and Revised Syllabi of Post-graduate Programmes

Practical:
• Analysis of qualitative data;
• Generalized linear for correlated data;
• Generalized linear models for discrete data;
• Robust methods of estimation and testing of non-normal data;
• Robust multivariate analysis;
• Cluster analysis;
• Analysis of Incomplete data;
• Classification and prediction using artificial neural networks;
• Markov Chain;
• Analysis of data having random effects using Linear mixed effects models;
• Analysis of data with missing observations;
• Applications of multiple comparison procedures;
• Building Simultaneous confidence intervals;
• Fitting of growth curve models to growth data;
• Fitting of dose-response curves and estimation of parameters.

Suggested Reading

• Everitt B.S. and Dunn G. 1991. Advanced Multivariate Data Analysis. 2nd Ed. Arnold.
• Geisser S. 1993. Predictive Inference: An Introduction. Chapman & Hall.
• Gentle J.E., Härdle W and Mori Y. 2004. Handbook of Computational Statistics-Concepts and Methods. Springer.
• Han J and Kamber M. 2000. Data Mining: Concepts and Techniques. Morgan.
• Hastie T, Tibshirani R and Friedman R. 2017. The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer. 2nd Ed.
• Kennedy W.J. and Gentle J.E. 1980. Statistical Computing. Marcel Dekker.
• Miller R.G. Jr. 1986. Beyond ANOVA, Basics of Applied Statistics. John Wiley.
• Rajaraman V. 1993. Computer Oriented Numerical Methods. Prentice-Hall.
• Robert C.P. and Casella G. 2004. Monte Carlo Statistical Methods. 2nd Ed. Springer.
• Ross S. 2000. Introduction to Probability Models. Academic Press.
• Simonoff J.S. 1996. Smoothing Methods in Statistics. Springer.
• Thisted R.A. 1988. Elements of Statistical Computing. Chapman & Hall.
• Venables W.N. and Ripley B.D. 1999. Modern Applied Statistics With S-Plus. 3rd Ed. Springer.
• Free Statistical Softwares: http: //freestatistics.altervista.org/en/stat.php.
• Design Resources Server: www.drs.icar.gov.in.

Semester II

PHDGPB607	Crop Evolution

Legends:L - Lecture; **P** – Practical;
*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on crop evolutionary aspects and role of mutations, hybridizations and polyploidy in crop evolution and improvement.

Theory

UNIT I

Origin and evolution of species; Centres of diversity/ origin, diffused centres; Time and place of domestication; Patterns of evolution and domestication-examples and Case studies; Domestication and uniformity – Characteristics of early domestication and changes – Concept of gene pools and crop evolution; Selection and Genetic drift – Consequences

UNIT II

Speciation and domestication–The process of speciation, Reproductive isolation barriers; Genetic differentiation during speciation; Hybridization - speciation and extinction; Exploitation of natural variation: Early attempts to increase variation, Distant hybridization and introgression, Inter-specific, inter-generic hybridization, scope and limitations, techniques to overcome the limitations.

UNIT III

Gene transfer into cultivated species, tools and techniques; Validation of transferred genes and their expression; Controlled introgressions.Processes in crop evolution and stabilization of polyploids, cytogenetic and genetic stabilization; Genome organization – Transgenesis in crop evolution, Multifactorial genome, Intragenomic interaction, Intergenomic interaction, Genome introgression.

UNIT IV

Methods to study crop evolution - Contemporary Methods, Based on morphological features, Cytogenetic analysis, Allozyme variations and crop evolution, DNA markers, genome analysis and comparative genomics.Evolutionary significance of polyploidy, evolution of crop plants through ploidy manipulations.

UNIT V

Polyploids: methods, use of autopolyploids; haploidy and DH-method of production and use, allopolyploids; synthesis of new crops; Case studies – Cereals, Pulses, Oilseeds, vegetables, Fibre crops, Plantation crops, Forage crops, Tuber crops, Medicinal Plants.

Suggested Readings

- Hancock JF. 2004. Plant Evolution and the Origin of Crop Species. 2nd Ed. CABI.
- Ladizinsky G. 1999. Evolution and Domestication. Springer.
- Miller AJ. 2007. Crop Plants: Evolution. John Wiley & Sons.
- Smartt J and Simmonds NW. 1995. Evolution of Crop Plants. Blackwell
-

PHDGPB609	IPR and Regulatory Mechanism (e-course)

Legends:L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

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

UNIT I: 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.

Unit II: 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.

Unit III: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit IV: National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.

Unit V: 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 & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.

PHDMBB601	Plant Molecular Biology

Legends:L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

• To provide in depth knowledge of recent developments of plant molecular biology and applications

• To discuss case studies and success stories in agriculture and industry

Theory

Unit I : Model Systems in Plant Biology (Arabidopsis, Rice, etc.) Forward and Reverse Genetic Approaches. Organization expression and interaction of nuclear, Mitochondrial and Chloroplast Genomes. Cytoplasmic male sterility.

Unit II: Transcriptional and Post-transcriptional Regulation of Gene Expression, Isolation of promoters and other regulatory elements, RNA interference, Transcriptional Gene Silencing, Transcript and Protein Analysis.

Unit III: Plant Developmental Processes, ABC Model of Floral Development, Role of hormones (Ethylene, Cytokinin, Auxin and ABA, SA and JA) in plant development.

Unit IV: Regulation of Flowering, Plant photoreceptors and light signal transduction, vernalization, Circadian Rhythms.Abiotic Stress Responses: Salt, Cold, Heat and Drought.

UNIT V: Biotic Stress Responses. Molecular Biology of Plant-pathogen Interactions, Molecular Biology of Rhizobium and Agrobacterium- Plant interaction. Role of programmed Cell Death in Development and Defense.

Suggested Readings

• Buchanan, B.B., Gruissem, W. and Jones R. 2015. Biochemistry and Molecular Biology of Plants, 2nd edition, Wiley and Blackwell Publications.

• Slater, A., Scott, N.W., and Fowler, M.R. 2003. The Genetic Manipulation of Plants. Plant Biotechnology Oxford, England: Oxford University Press.

• Walker, J.M., Rapley, R. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications.

PHDMBB602	Plant Genome Engineering

Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective: To discuss the specialized topics and advances in field of genetic engineering and application of molecular tools in breeding of specific crops.

Theory

UNIT I: Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement. Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses;
UNIT II: Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc.); edible vaccines, etc.
UNIT III: Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement
UNIT IV: Gene stacking; Pathway engineering; Marker-free transgenic development strategies; Genome editing: principles and methods, Development of genome edited plants; High throughput phenotyping of transgenic plants.
UNIT V: Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

Suggested Readings

• Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.

• Stewart Jr, C.N. 2016. Plant Biotechnology and Genetics: Principles, Techniques, and Applications. John Wiley & Sons.

• Kirakosyan A and Kaufman PB. 2009. Recent Advances in Plant Biotechnology p. 409. Dordrecht: Springer.

PHDPLPATH 604	Molecular Basis of Host-Pathogen Interaction

1. Legends: L - Lecture; P – Practical
2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

To understand the concepts of molecular biology and biotechnology in relation to host plant-pathogen interactions.

Theory

Unit I: History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II: Different forms of plant-microbe interactions and nature of signals/ effectors underpinning these interactions. Plant innate immunity: PAMP/ DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III: Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. Molecular basis of genefor-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

Unit IV: Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance. Pathogen population genetics and durability, viruses vs cellular pathogens.

Unit V: Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical:

• Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation;
• Gene mapping and marker assisted selection;
• Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

Suggesting Reading

- Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.
- Gurr SJ, McPohersen MJ and Bowlos DJ. (Eds.). 1992. Molecular Plant Pathology – A Practical Approach. Vols. I & II, Oxford Univ. Press, Oxford.

- Mathew JD. 2003. Molecular Plant Pathology. Bios Scientific Publ., UK.
- Ronald PC. 2007. Plant-Pathogen Interactions: Methods in Molecular Biology. Humana Press, New Jersey.
- Stacey G and Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

PHDSST601	Hybrid Seed Production Technology

Legends: L - Lecture; P – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To provide students a comprehensive knowledge and practical exposure on hybrid seed production techniques in agricultural and horticultural crops

Theory

UNIT I

Introduction – history – scope – importance of hybrid development – national and international scenario of seed industry – popular public sector hybrids in various crops. Heterosis – definition – expression – types – utilization ofheterosis in hybrid development, hybrid vigour and seed vigour.

Unit II

Types of hybrids – intra-specific, inter-specific hybrids, single, double, three way cross, top cross hybrids – apomixes; generation system of seed multiplication in different types of hybrids. Development and maintenance of inbred lines – male sterile – maintainer lines – fertility restoration – transgenic hybrids – principles and method of development.

Unit III

Breeding tools – genetic mechanism – male sterility – types: CMS, GMS, CGMS, TGMS, PGMS – barnase and barstar system – pistillateness – self incompatibility. Manual creation of male sterility – emasculation and pollination – gametocides – mode of action, mechanism. Synchronization of flowering – problems – methods to achieve synchrony – planting ratio and supplementary pollination methods.

UNIT IV

Techniques of hybrid seed production in major agricultural crops – cereals (wheat, rice), millets (maize, sorghum, bajra), pulses (red gram), oilseeds (sunflower, castor, mustard), cotton and forage crops

UNIT V

Hybrid seed production techniques in horticultural crops – tomato, brinjal, chilli, bhendi, onion, bitter gourd, bottle gourd, ridge gourd, cucumber, melon, cabbage, cauliflower, potato, coconut and papaya

Practical:

• Characteristics features of parental lines and their hybrids;

• Floral biology of rice, maize, pearl millet, sunflower, castor and cotton;

• Study on floral biology of vegetable crops – solanaceous and other vegetables;

• Study on floral biology of cucurbitaceous crops;

• Production and maintenance of A, B and R lines;

• Practicing planting design and border rows – rice, maize, pearl millet, sunflower and red gram; brinjal and chillies;

• Practicing planting design and border rows in tomato, cotton and cucurbitaceous vegetables;

• Manipulation for synchronization – rice, sunflower, pearl millet and sorghum;

• Practicing supplementary pollination – rice and sunflower;

• Practicing field inspection in hybrid seed production plot – crops planted in ratio – sunflower, pearlmillet, sorghum, etc.;

• Practicing field inspection in hybrid seed production field – red gram, castor, cotton, cucurbits and tomato;

• Practicing roguing and identification of off-types – pollen shedders – shedding tassel – selfed fruits;

• Visit to hybrid seed production fields;

• Visit to potato seed production plots;

• Determination of cost benefit of hybrid seed production;

• Visit to seed Industry and assessing problems and perspectives in hybrid seed production.

Suggested Readings

- Agarwal RL. 2012. Seed Technology. 3rd Ed. Oxford & IBH Publishers, New Delhi.
- Basra A. 1999. Heterosis and Hybrid Seed Production in Agronomic Crops. CRC Press., Florida, United States.
- Chhabra AK. 2006. Practical Manual of Floral Biology of Crop Plants. Department of Plant Breeding, CCSHAU, Hisar.
- Dar SH. 2018. Methods of Hybrid Seed Production in Major Crops. Educreation Publishing, Chhattisgarh.
- Frankel R and Galun E. 1977. Pollination Mechanisms, Reproduction and Plant Breeding. Springer Verlag, New York.
- Hebblethwaite PD. 1980. Seed Production. Butterworth Heinemann Ltd., London, UK.
- Joshi AK and Singh BD. 2004. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Krishnan M. 2012. Plant breeding and Hybrid Seed Production. Domin and Publishers & Distributors, New Delhi, India.
- Kulkarni GN. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
- Maiti RK, Sarkar NC and Singh VP. 2006. Principles of Post Harvest Seed Physiology and Technology. Agrobios., Jodhpur, India.
- McDonald MF and Copeland LO. 2012. Seed Production: Principles and Practices. Springer Science and Business Media, Boston, United States.

- Mondal SS, Saha M and Sengupta K. 2009. Seed Production of Field Crops. New India Publishing Agency, New Delhi.
- Sen S and Ghosh N. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Singhal NC. 2003. Hybrid Seed Production. Kalyani Publishers., New Delhi, India.
- Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publications, New Delhi.
- Singhal NC. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Vanangamudi K, Prabhu M, Kalaivani S, Bhaskaran M and Manonmani V. 2010. Vegetable Hybrid seed Production and Management. Agrobios., Jodhpur, India.

Suggested e-books

https://www.springer.com/in/book/9780792373223

https://www.springer.com/in/book/9780412075513

https://www.nipabooks.com/info/9788190723763/seed-production-of-field-crops

https://www.kopykitab.com/Vegetable-Hybrid-Seed-Production-And-Management

https://www.researchgate.net/publication/229432295_Hybrid_Seed_Production_and Flowers

http://www.worldcat.org/title/seed-production-principles-andractices/oclc

https://libgen.is/search.php?req=Raymond+A++T+George&column=author

https://www.researchgate.net/profile/Gulzar_S_Sanghera/publication/236865752_Advances_in_Hybrid_Rice_Technology_through_Applications_of_Novel_Technologies/links/ 0deec519b46087d815000000.pdf

Suggested websites

www.agriquest.info

www.agriinfo.in

www.seedquest.com

https://agriinfo.in/botany/18/

http://www.fao.org/3/a-e8935e.pdf

http://www.agriquest.info/seed_production.php

	Political Science		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
Sr. No.	**Electives Courses**		
B.1.	Frontier Areas in Political Science	PHDPOSC101	2.0
B.2.	Political Theory	PHDPOSC102	2.0
B.3.	International Relations and Peace Studies	PHDPOSC103	2.0
C.1.	**Dissertation**		3.0

B1. Frontier Areas in Political Science (PHDPOSC101)

Module1 : Theories and Concepts: a) Social Justice/ identity/civil society b) Neo-Liberalism/Globalization/Nation.

Module -2: State Politics in India: a) State, Economy and Development b) Indian Democracy: Changes and Challenges.

Module -3: International Relations: a) National Security and Foreign Policy. b): Positivist and Post Positivist Approaches.

References

- Mathur, K. (2013).*Public Policy and Politics in India- How Institution Matters.*U.K.: Oxford University Press.
- Mehra, A.K.(2013).*The Indian Parliament and Democratic Transformation*.U.K: Routledge, Taylor & Francis Group.
- Routledge, R.J.(2000).*Democratic Politics and Economic Reforms in India*.Cambridge: Cambridge University Press.

- Sapru, R.K. (2017).*Public Policy: A Contemporary Perspective*.New Delhi:Atlantic Publishers and Distributors (P) Ltd.

B 2 Political Theory(PHDPOSC102)

Module1: Issues in Epistemology and Ontology, Historicism and Neo-Historicism

Module2: Base- super structure relation in Marxist Theory- view of and Gramsci. Structural and Humanist Interpretation of Marxism- Althusser and Frankfurt School debate

Module3: Socio- Theory of Imperialism- view of Lenin and Trotsky, Dependency Theory views of Andre Gunder Frank and Paul Baron.

References

- Hay, C. (2006).*Political Ontology in R. E. Goodin and C. Tilly (eds.).Oxford Handbook of Contextual Political Analysis*. Oxford: Oxford University Press.
- Marsh, D. and Savigny, H. (2004).*Political Science as a Broad Church: The Search for aPluralist Discipline,*U.S.: Sage Journals.
- Marsh, D. and Stoker, G. (2002).*Theories and Methods in Political Science*. U.K.Basingstoke Palgrave Macmillan.
- Norrie, A. (2005).*Theorising Spectrality: Ontology and Ethics in Derrida and Bhaskar*.London: Lawrence & Wishart Publication.

B 3.International Relations & Peace Studies (PHDPOSC103)

Module 1: Theories of International Relations:
Indian School of International Relation (Kautilya), English School of International Relations, Constructivism, Post-Modern Theory, Critical Theory, Ethics in International Relations.

Module 2: Concept in International Relations:
Global Governance, Global Citizenship, Clash of Civilizations, Multiculturalism, Globalisation and anti-Globalisation Movements.
Contemporary Challenges:
Climate Change & Environmental Concerns, International Terrorism, Migration and Refugees, Human Rights.

Module 3: Gandhian and Peace Studies:
Gandhian vision of World Peace, Justice, Conflict-Resolution, Globalisation, Civilization and Environmental Challenges.

References

- Acharya, A.& Buzan, B. (2019).*The Making of Global International Relations: Origin and Evolution of International Relations at its Centenary*, Cambridge: Cambridge University Press.
- Gandhi, M.K. (2001).*The Story of My Experiments with Truth*, Ahmedabad: Navajivan Publishing House.
- Gandhi, M.K. (2001).*Satyagraha in South Africa*, Ahmedabad: Navajivan Publishing House.
- Pevehouse, J.C.W. & Goldstein, J.S. (2016).*International Relations*, London: Pearson Publishing.
- Smit, C.R.& Snidal, D. (2018).*The Oxford Handbook of International Relations*, UK: Oxford University Press

	Forensic Science CRIMINOLOGY		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
Sr. No.	**Electives Courses**		
B.1.	Legal Aspects Of Private Detective And Undercover Operation	PHDCR101	2.0
B.2.	Financial Frauds And Crime Prevention	PHDCR102	2.0
B.3.	Victimisation, Impacts And Victim Assistance	PHDCR103	2.0
C.1.	**Dissertation**		3.0

B.1- LEGAL ASPECTS OF PRIVATE DETECTIVE AND UNDERCOVER OPERATION (PHDCR101)

Course Overview: Familiarize the students with detective works as per the standard practices, expose the students to detective and investigative skills and understand various interrogation techniques.

Module I: Basic concepts and Legal aspects

Detective- Concept and Nature, Introduction to private detective, History of private detective and investigation, code of ethics of private investigators, how does private detective agency work. Private Detective Agencies (Regulation) Bill 2007- Licensing, Qualification of detectives, registration, Punishment for private detectives, barred from investigation, Evidentiary Value in Court, Private detective agencies in other countries.

Module II: Types of Investigation

Pre and Post Marital Investigation – Land Dispute investigation - Student Investigation, Kidnapping and abduction investigation – missing person investigation – Traffic accident investigation, Pre- and post- employment verification, Adultery investigation, domestic violence investigation, tenant screening and blackmail investigation.

Module III: Surveillance and Instrument

Surveillance: Purpose, Pre-surveillance Conference, Covert and overt Surveillance, Undercover Operations, Automobile Surveillance, Foot Surveillance, Team Surveillance, Audio recording devices – Video recording devices – Photo camera

References:

1. Bill Copeland (2001) Private Investigation: How to be successful, Absolutely zero loss Inc.
2. Private Detective Agencies (Regulation) Bill 2007
3. Douglas Cruise (2002) The Business of Private Investigations, Texas: Thomas Investigative Publications.
4. W. John George Moses (2004) Materials for Diploma in Private Investigation, Institute of Intelligence and Investigation, Eagle's Eye Detective Agency, Chennai
5. Louis and Lawrence (1999) Investigations: 150 Things, Butter worth – Heinemann.
6. Michael Corun (2003) Training Manual on Private Investigation, Texas: Thomas Investigative Publications.
7. Rojer J. Willand (1997) PI: Self study guide on becoming a private detective, Paladin press.
8. Rosy J. Methahon (2000) Practical Handbook for private Investigations, CRC Press

B.2-FINANCIAL FRAUDS AND CRIME PREVENTION (PHDCR102)

Course Overview- Aim of the subject is to provide a student the basic understanding of Financial Frauds and Familiarise with different forms of Financial Frauds and related legislations

Module 01: Introduction

Financial Crimes- Introduction, Causes, Characteristics, types, White collar crime and Financial Crimes, Impact of Financial Crimes. Legislations dealing with Financial Crimes in India- An overview.

Module 02 : Bribery and Corruption

Definition – Bribery and corruption in Indian public and private sectors – Prevention of Corruption Act, 1988 – The Right to Information Act, 2005, Jan LokPal and Lokayuktha – United Nations Convention Against Corruption, 2009 – Anti-corruption movements in India-Role of national and international institutions in combating corruption.

Module 03 : Insurance Frauds

Introduction; types of Insurance – General insurance, Life Insurance; Principles of Insurance; Legislative & Regulatory Framework – Insurance Act 1938, IRDA Act & Various Regulations and Guidelines issued by the Regulator; Market Structure, Role & Responsibilities of various Parties including Intermediaries; Insurance Dispute Resolution Mechanisms and Frauds; Insurance Product; General Insurance Frauds – Concepts/Areas; Grievance Redressal Mechanism in General Insurance; Mechanism to identify, avoid, prevent Frauds.

References-

1. Reuvid Jonathan, 1995, The Regulation and Prevention on Economic Crimes, Internationally, Kogan Page Ltd.
2. Derrig, R. A. (2007). Tackling Insurance Fraud: Law and Practice. *Risk Management and Insurance Review*, *10*(1), 175.
3. Derrig, R. A. (2002). Automobile Insurance: Road Safety, New Drivers, Risks, Insurance Fraud and Regulation (Book Reviews). *Journal of Risk and Insurance*, *69*(1), 113-115.
4. Iturrioz, R. (2009). Agricultural insurance.
5. Prevention of Corruption Act, 1988
6. Right to Information Act, 2005
7. United Nation Convention against Corruption, 2009
8. WhistleBlowers Protection Act, 2011.
9. Srinivasan, M. (2008). Criminal Breach of Trust and Cheating as sources for Money Laundering, The Indian Journal of Criminology & Criminalistics, Vol. XXIX, No.2 (May –August, 2008). pp 104–112.
10. Indian Penal Code,1860.
11. Companies act,2013.
12. Indian contract act
13. Pedneault, S. (2010). *Fraud 101: Techniques and strategies for understanding fraud*. John Wiley & Sons.
14. Timmer, C. P. (2002). Agriculture and economic development. *Handbook of agricultural economics*, *2*, 1487-1546.
15. Insurance Regulatory and Development Authority Act,1999

B.3- VICTIMISATION, IMPACTS AND VICTIM ASSISTANCE (PHDCR103)

Course Overview- To get to know the history, concepts, theories of Victimology, various forms of victimization and impact and role of the Criminal Justice System, NGOs, and Community in victim assistance

Module I: Introduction to Victimology

Origin and development of Victimology – Definitions – Dimensions of victimization – Typology – Victims in the criminal justice system – Retributive justice – Restorative justice – Scope of Victimology and Victim Justice.Victim precipitation – Victim facilitation – Victim provocation – Indirect victimization – Forms of victimization – Victim vulnerability vs. Actual vulnerability – Fear of crime – Reporting behaviour – Dark figure – Crime victimization survey – Victim blaming – Victimological theories – Bystander effect – Victim recovery – Psycho-social coping methods.

Module II: Forms and Impacts of Victimization

Victims of conventional crime – Gender-based violence – Inter-personal violence – Hate crime – Domestic violence – Women victims of crime – Child victimization – Victims of group violence – Cultural victimization – Elderly victimization – Victims of natural disaster – Impact of crime victimization – Trauma – Post-Traumatic Stress Disorder (PTSD), Acute Stress Disorder (ASD) – Social exclusion – Stockholm syndrome – Battered women syndrome – Cycle of domestic violence – Rape trauma syndrome.

Module III: Victim Assistance Programme and Services

Needs of victims – Victim assistance – Role of Judiciary, Government (Observation homes, vigilance homes) – Citizens and voluntary organizations – Concepts and forms of victim services – Victim advocacy – Victim assistance during crime investigation and trial – Victim- centred policing – Prevention of victimization – Legal aid – Crisis intervention – Basic concepts of counselling and guidance – Methods of victim counselling and psychotherapy –Compassion fatigue – Victim service organizations in India – Police and victim.

1. Das, Bharat B. (1997). Victims in the criminal justice system. New Delhi: APH Publishing Corporation.
2. Chockalingam, M. (ed.). (1985). Readings in Victimology. Madras: Ravi Raj Publications.
3. Elias, R. (1993). Victims still: The political manipulation of crime victims. London: Sage Publications.
4. Fattah, E. A. (1991). Understanding criminal victimization. Scarborough: Prentice Hall.
5. Hentig von, Hans (1981). The criminal and his victims. New York: Schocken Books.
6. Karmen, A. (2012). Crime victims: An introduction to Victimology. Boston: Cengage Learning.

7. Kirchhoff, G. F. (2005). What is Victimology? Japan: Seibundo Publishing Co.
8. Lynch, R. P. (1976). Improving the treatment of victims: Some guides for action.
9. In McDonald, W. T. (Ed.), Criminal justice and the victim. Beverly Hills: Sage Publications.
10. Maguire, M., & Ponting J. (1988). Victims of crime: A new deal? Milton Keynes: Open University Press.
11. Mawby, R. I., & Gill, M. L. (1987). Crime victims: Needs, services and the voluntary sector. London: Tavistock.
12. Menon, N. R. Madhava (2004). Victim compensation law and criminal justice: A plea for a victim-orientation in criminal justice.
13. Vibhute, K. I. (Ed.) Criminal justice – A human rights perspective of the criminal justice process in India. Lucknow: Eastern Book Company.
14. National Law University (2012). Justice Verma Committee Report to Criminal Law. New Delhi.
15. Rajan, V. N. (1995). Victimology in India perspectives beyond frontiers. New Delhi: Ashish Publishing House

.	**Urban Planning**		
Sr. No.	**Common Courses**	**Course Code**	**Credit Hours**
A.1.	Research Methodology	PHDA101	3.0
A.2.	Review of Literature	PHDA102	2.0
A.3.	Computer Applications	PHDA103	2.0
A.4.	Research and Publication Ethics (RPE)	PHDA104	2.0
Sr. No.	**Electives Courses**		
B.1.	**Advanced Urban Development**	**PHDUP101**	2.0
B.2.	**The Social Context of Planning**	**PHDUP102**	2.0
B.3.	**Future Settlements and Urban Planning**	**PHDUP103**	2.0
C.1.	**Dissertation**		3.0

Course Curriculum for Ph.D Program,

Syllabi: Urban Planning

B1. Advanced Urban Development (PHDUP101)

Course Overview: *The course is designed to understand the demographic and geographical dimensions of urbanization in today's context.The study presents a contextual exploration of the vulnerability, exposure and hazards faced by the urban areas , and helps the students to provide inclusive solutions for the issues. Main focus of the study is to analyze the roles of different stakeholders in advanced level perspective for urban development.*

Module 1. Introduction to Urbanization, urban economics, Process of Urbanization , components of Urban Growth , Urbanization International and National scenarios, Impacts of Urbanization , Urbanization in India : levels and trends .

Module 2. Advanced Urban development process and components, Citizen partnership in development, Urban E-Governance, Planning for city-Regions.

Module 3. Tools and techniques of Advanced urban development , Inclusive and sustainable urban development strategies, case studies , Sustainable city planning - the way forward.

Reference Books :

1. Bhagat, R. B. (1992) ,**Components of Urban Growth in India with Reference to Haryana: Findings from Recent Censuses,** Nagarlok**,** Vol. 25
2. Arnab Jana (2021) , **Advances in Urban Planning in Developing Nations: Data Analytics and Technology** , Routledge India
3. Paul James (2014) , **Urban Sustainability in Theory and Practice: Circles of sustainability** , Routledge
4. Pathak, P., and Mehta, D. (1995). **Recent Trend in Urbanization and Rural-Urban Migration in India: Some Explanations and Projections,** Urban India

5. Harry W. Richardson (2005) **, Globalization and Urban Development (Advances in Spatial Science),** Springer-Verlag Berlin and Heidelberg GmbH & Co. K

B2. The Social Context of Planning (PHDUP102)

Course Overview:*The course aims to create sensitivity for sociological context in urban planning students. It will help to understand the changing perspectives of human life and surroundings to create more socially successful and sustainable urban planning solutions.*
The course is intended to enlighten the importance of sociology in urban studies with analytical and logical thinking approach.

Module 1. Theoretical Framework , Social Dynamics , Spatial Forms and People's Behavior, Patterns of Occurrence of Behaviors , Evolution and Urban planning theories and involvement of society.
Module 2. Social and critical features of Urban Sociology , Global cities and their social foundations, Urban social ecology and Neighborhood effects.
Module 3. Need for Social Impact Assessment in urban planning , Integration of the SIA into planning process , Benefits of SIA for planning and community .

Reference Books :

1. Shannon, Thomas R., (1991) , **Urban Problems in Sociological Perspective,** Waveland Press Inc
2. Kundu, A. (1983) ,**Theories of City Size Distribution and Indian Urban Structure - A Reappraisal. Economic and Political weekly ,** Economic and Political Weekly
3. Kundu, A. (1994) ,**"Pattern of Urbanisation with Special Reference to Small and Medi urn Towns in India" in Chadha, G. K. Sectoral Issues in the Indian Economy** , New Delhi: Har-Anand Publications
4. Raza, Moonis and Kundu, A. (1978) , **Some Aspects of Dysfunctional Characteristics of Urbanisation: Socio-Economic Development Problems in South and South East Asia,** Bombay: Popular Prakashan

5. United Nations. (2007) ,**World Urbanization Prospects - The 2007 Revision**: Executive Summary. New York: United Nations

B3. Future Settlements and Urban Planning (PHDUP103)

Course Overview:

The course is intended to impart knowledge about futuristic approach and indicates the areas of research for new urban developments. It investigates the future human settlements, connecting living spaces/cities with basic services and commodities.Also Assesses at both site and city levels, combined with public participation in planning and governance. And provides thinking approach that enables students to learn how to plan urban areas and services as per the current and future global need.

26Module 1.Cities of the 21st century – planning theories, Needs and Role of Green space and the built environment: Optimizing benefits in emerging Global cities , Understanding Basic needs of the city.

Module 2. Changes in cities : Urban disruptions, unintended inequalities, Urban innovations, Technology in Urban.

27Module 3.Transforming the city , Exploring socio- technical systems , Localizing the Sustainable Development Goals through the Lens of Urban Resilience .

Reference Books :

1. Benton-Short, L., Price, M. and Friedman, S. (2005) , "**Globalization from below: the ranking of global immigrant cities",** International Journal of Urban and Regional Research
2. Webber, Melvin M. (1963), "**Order in Diversity: Community Without Propinquity**." , RFF Press
3. Garreau, Joel. (1991) ,**Edge City: Life on the New Frontier**, New York: Doubleday.
4. Kevin Lynch (1960) , **The Image of the City** , MIT Press

5. Tajbaksh, Kian(2001) ,**The Promise of the City: Space, Identity, and Politics in Contemporary Urban Thought. Berkeley and Los Angeles**, University of California Press.

EDUCATION			
S.No.	CommonCourses	CourseCode	Credit
A.1	ResearchMethodology	PHDAS101	3.0
A.2	Review of Literature	PHDA102	2.0
A.3	Computer Application	PHDA103	2.0
A.4	Research and Publication Ethics (RPE)	PHDA104	2.0
	Elective Courses		
B.1	Guidance and Counselling	PHDEDU101	2.0
B.2	Measurement & Evaluation	PHDEDU102	2.0
B.3	EducationalTechnology	PHDEDU103	2.0
C.1	**Dissertation**		**3.0**

B.1 GUIDANCE AND COUNSELLING (PHDEDU101)

Module1: Concept of GuidanceandCounselling

Meaning,DefinitionandScopeofGuidanceandCounselling,ComparisonofGuidanceandCounselling.

Module 2: Theories of Counselling

Theories of Counselling: Rationale Theory of Counselling and Learning Theory,TheoriesofcarrierCounselling,TraitandFactorCarrierCounselling,CounsellorCentredCounsellingandPsyhoDynamicCareerCounselling.

Module 3:Trends and Issues of Counselling

Current Trends and issues in Counselling Evaluation, Ethical and Legal Aspects of Counselling.

References:

SharmaR.A.(2001)"FundamentalsofGuidance'sCounselling"R.LallBookDepot,Meerut,U.P.KocharS.K.(1990)"EducationalandvocationalGuidancein

SecondarySchool"SterlingPublication,NewDelhi

AgarwalJ.C.(1991)Educational&Vocationalguidance&Counselling2.Bengalee
M.D.(1985

B.2 MEASUREMENT AND EVALUATION (PHDEDU102)

Module1:Concept of Measurement and Evaluation

Meaning and Definitions of Assessment, Measurement, Evaluation andAppraisalandScalesofMeasurement.RelevanceandDifferencebetweenAssessmentandEva luation.

Module2:ConceptandTypesofTests

AchievementTest,DiagnosticTest:Concept,andConstructions
CriterionReferenceTestandNormReferenceTest:ConceptandDifferences

Module3:ModernTrendsofEvaluation

OnlineandOn-DemandExamination:ConceptandInnovativeFeatures,Self-Assessment & Peer Assessment: Concept and Innovative Features, 360DegreeEvaluation:ConceptandProcess.

References:

Ebel,RobertL.,(1966).Measuringeducationalachievement.PrenticeHallofIndia.GronlundENorman(196 6).MeasurementandEvaluationinTeaching.TheMacMillanCompany.
Harper,AEdwin,J.andHarperErikaS.,(1992).PreparingobjectiveExaminations.Ahandbookfor teachers,StudentsandExaminers.PrenticeHallofIndia.IGNOU(2000).EducationalEvalua tion.NewDelhi.

B.3 EDUCATIONAL TECHNOGY (PHDEDU103)

Module 1:Concept of Technology

Concept, Meaning, Definition, Characteristics and Advantages, Nature, Scope and Significance, Hardware and Software Approaches.

Module 2:SystemApproach&SystemAnalysis

Hardware approach, Software approach and System approach: Definition,Characteristics and Limitations, Designing and Analyzing System,ImplementationofSystemApproachinEducation.Concept ofCybernetics.

Module 3:INNOVATIONSINEDUCATIONTECHNOLOGY

ProgrammedLearningMaterial,LearningManagementSystem:MOODLE,OpenEducationResources,BlendedLearning,FlippedClassroom,
Educational Podcast, m-learning, Web-based Learning, online learning, AIandRoboticsinEducation,EducationalGameandConceptMap.

References:

Agrawal,J.C.(1996).Essentials of Educational Technology–Teaching Learning Innovations in Education. Vikas Publishing House.

Chouhan, S.S.(1973).InnovationsinTeachingandLearningPractices.VikasPublishingHouse.

Mangal, S.K.(1988).Fundamentals of Educational Technology.Prakash Brothers.