ANNEXURE-1

Session 2026-27

Ph.D. Coursework Syllabus

Paper No.	Name of the Paper	Assignment Marks/ Internal**	Semester Exam Marks/ Viva*	Total	Exam Duration
1	Research Methodology	40	60	100	3 Hrs.
2	ICT Lab work/presentation (practical)	40	60*	100	1 Hr.
3	Research and Publication Ethics	40	60	100	2 Hrs.
4	Elective Subject	40	60*	100	3 Hrs.

SCHEME OF EXAMINATION OF Ph.D. COURSE WORK

Paper Code	Paper Name	Contact Hours	Paper Credit
RES-I	Research Methodology	3 L + 1 T	4
RES-II	ICT Lab Work & Presentation	2 P	2
RES -IV	Research and Publication Ethics	2 L	2
As per the elective mentioned below	Elective Subject	3 L + 1 T	4

L = Lecture T = Tutorial P = Practical

Elective Subjects Name with Codes

Paper Code	Name of the Paper	Assignment Marks / Internal	Semester Exam Marks/Viva	Total	Contact Hours	Paper Credit	Exam Duration
School of Engineering & Technology							
PHCS101	**Introduction to Machine Learning**	40	60	100	3 L+1 T	4	3 Hrs.
PHCS102	**Artificial Intelligence**	40	60	100	3 L+1 T	4	3 Hrs.
PHEE101	**Advanced Technologies in Electrical Engineering**	40	60	100	3 L+1 T	4	3 Hrs.
PHEC101	**Antenna Theory & Design**	40	60	100	3 L+1 T	4	3 Hrs.
PHEC102	**Recent Advances in Electronics and Communication Engineering**	40	60	100	3 L+1 T	4	3 Hrs.
PHME101	**Recycling of Machines**	40	60	100	3 L+1 T	4	3 Hrs.
PHCE101	**Advanced Construction Technology**	40	60	100	3 L+1 T	4	3 Hrs.
PHCE102	**Smart and Sustainable Infrastructure**	40	60	100	3 L+1 T	4	3 Hrs.
School of Basic & Applied Science							
PHPY101	**Electronics**	40	60	100	3 L+1 T	4	3 Hrs.
PHPY102	**Solid State Physics**	40	60	100	3 L+1 T	4	3 Hrs.
PHCH101	**Environmental Chemistry and Pollution control**	40	60	100	3 L+1 T	4	3 Hrs.
PHCH102	**Nano Chemistry and Nanomaterials**	40	60	100	3 L+1 T	4	3 Hrs.
PHMA101	**Special Functions, Integral Transforms, and Fractional**	40	60	100	3 L+1 T	4	3 Hrs.
PHMA102	**Advanced Fluid Dynamics**	40	60	100	3 L+1 T	4	3 Hrs.
PHBO101	**Advances in Mycology**	40	60	100	3 L+1 T	4	3 Hrs.
PHBO102	**Instrumentation & Techniques in Plant Sciences**	40	60	100	3 L+1 T	4	3 Hrs.
PHZO101	**Advanced Zoology & Integrative Biology**	40	60	100	3 L+1 T	4	3 Hrs.

PHZO102	**Tools and Technologies for Zoological Research**	40	60	100	3 L+1 T	4	3 Hrs.
PHGI101	**Geo- Informatics in Regional and Urban Planning**	40	60	100	3 L+1 T	4	3 Hrs.
School of Management Studies							
PHMG101	**Contemporary Developments in Business Management**	40	60	100	3 L+1 T	4	3 Hrs.
PHMG102	**Contemporary Issues in Management**	40	60	100	3 L+1 T	4	3 Hrs.
School of Legal Studies							
PHLS-101	**Constitutional Law**	40	60	100	3 L+1 T	4	3 Hrs.
PHLS102	**Environmental law**	40	60	100	3 L+1 T	4	3 Hrs.
School of Agriculture Science & Technology							
PHAG101	**Seminar 1**	40	60	100		4	
PHAG102	**Seminar 2**	40	60	100		4	
PHAG103	**Advanced Principles and Practices of Agriculture**	40	60	100	3L+ 1T	4	3 Hrs.
School of Arts & Humanities							
PHGE101	**Applied Geography**	40	60	100	3 L+1 T	4	3 Hrs.
PHGE102	**Trends in Geography**	40	60	100	3 L+1 T	4	3 Hrs.
PHSO101	**Perspectives in Indian Sociology**	40	60	100	3 L+1 T	4	3 Hrs.
PHSO102	**Sociology of Crime and Deviance**	40	60	100	3 L+1 T	4	3 Hrs.
PHHI101	**आधुनिक चिंतन और साहित्य**	40	60	100	3 L+1 T	4	3 Hrs.
PHHI102	**भारतीय ज्ञान परंपरा एवं हिंदी साहित्य**	40	60	100	3 L+1 T	4	3 Hrs.
PHEN101	**Advanced Literary Theory and Cultural Studies**	40	60	100	3 L+1 T	4	3 Hrs.
PHEN102	**Contemporary Global Literature and Research Methodologies**	40	60	100	3 L+1 T	4	3 Hrs.
PHPS101	**Advanced Research in Public Policy and Governance**	40	60	100	3 L+1 T	4	3 Hrs.
PHPS102	**Contemporary Issues in Indian Politics and International Relations**	40	60	100	3 L+1 T	4	3 Hrs.
PHLM101	**Library management**	**40**	**60**	**100**	3 L+1 T	4	3 Hrs.
PHEO101	**Advanced Micro-Economic Analysis**	**40**	**60**	**100**	3 L+1 T	4	3 Hrs.
PHEO102	**Advanced Macro-Economic Analysis**	**40**	**60**	**100**	3 L+1 T	4	3 Hrs.
School of Pharmacy							
PHPH101	**Pharmaceutics**	40	60	100	3 L+1 T	4	3 Hrs.

PHPH102	**Pharmaceutical Quality Assurance**	40	60	100	3 L+1 T	4	3 Hrs.

Total Credit for Paper 1: L (3)-T (1)-P (2): Total Credit 6 L = Lecture, T = Tutorial, P = Practical

The detailed syllabus of course work is given below.

Paper-I: Code: RES-I
Research Methodology

Course objectives

1	To understand the role of research methodology in engineering
2	To understand the literature review process and formulation of a research problem.
3	To understand data collection methods and basic instrumentation
4	To learn various statistical tools for data analysis
5	To prepare research reports, theses, presentations, and understand IPR and patent procedures.

Course Outcomes (COs)

1	Explain the fundamental concepts of research, research methodologies, research ethics, hypothesis formulation, and the role of Information and Communication Technology (ICT) in scientific research.
2	Formulate a research problem through systematic literature review, identify research gaps, define objectives and hypotheses, and develop an appropriate research design and methodology
3	Select suitable data collection methods, sampling techniques, and research instruments, and demonstrate the ability to collect, organize, and manage research data effectively.
4	Apply appropriate statistical techniques and software tools to analyze research data, test hypotheses, interpret results, and develop valid conclusions.
5	Prepare professional research reports, research proposals, theses, and technical presentations using appropriate referencing and documentation practices while understanding Intellectual Property Rights (IPR), patents, and technology transfer.

After successful completion of the course, the research scholars will be able to:

UNIT-I	**Introduction to Research Method:** Definition of research, Nature and scope of research , Importance of research in current scenario, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas of engineering/Management/Legal Studies/ Basic and Applied Science, Introduction to problem Identification and solving, basic research terminology such as Exposition, concept, construct, types of variables , definition and types of hypothesis, proposition etc., Role of Information and Communication, Technology(ICT) in research.

UNIT-II	**Research Problem Formulation and methods:** Literature review, sources of literature, various referencing procedures, maintain literature data using Endnote2, Identifying the gap areas from the literature review and research database, Problem Formulation, Identifying variables to be studied, determine the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution, Important steps in research methods: Research design , types of Observation and communication , Laws and Theories, Development of Models. Developing a research plan: Exploration, Description, Diagnosis and Experimentation.
UNIT- III	**Data collection:** Static and dynamic characteristics of instruments (structured and unstructured questionnaire) used in experimental setup, calibration of various instruments, sampling methods, sample size determination, methods of data collection, Selection of Appropriate Method for Data Collection, Data collection using a digital computer system, case studies of data collection
UNIT- IV	**Planning & doing Data Analysis:** Editing , coding and data entry ,Data processing, data analysis strategies, and tools, data analysis with statistical packages, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization, and interpretation Applied statistics: Regression analysis, Parameter estimation, Univariate and Bivariate Multivariate statistics, Factor analysis , T test , Z test , chi square tests, Principal component analysis Software tools for modeling, Simulation, and analysis.
UNIT - V	**Research reports and Thesis writing:** Structure and components of scientific research reports, types of research report, developing a research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, word processing tools such as Latex Oral presentation: planning, software tools, creating and making effective presentations, use of visual aids, importance of effective communication. IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copyright, royalty, trade-related aspects of intellectual property rights.

Reference/Text Books

1. Donald R cooper Pamela Schindler, Business Research methods, 13 th Edition, McGraw hill, New Delhi
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, SAGE publications Ltd., 2011..
3. Zikmund, W.G. , Business Research methods , Cengage , latest edition
4. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.
5. C. R. Kothari, Research Methodology: Methods and Trends, New Age International, 2004

Paper-II: CODE: RES-II
ICT LAB WORK

Course objectives

1	Enable research scholars to produce professionally formatted thesis chapters, research papers, and academic documents using advanced wordprocessing and collaborative tools.
2	Equip scholars with skills to organize, clean, analyze, and visualize research data using spreadsheets, pivot tables, dashboards, and basic automation.
3	Train scholars to design and deliver effective academic presentations, webinars, and poster sessions using modern presentation and multimedia techniques.
4	To enable scholars to organize, manage, analyze, and present research information using appropriate digital tools and technologies.
5	To promote ethical research practices through understanding of plagiarism, citation standards, data privacy, academic integrity, and responsible use of AI technologies.

Course Outcomes (COs)

CO1	Demonstrate proficiency in advanced word processing tools for preparing academic, research, and professional documents with proper formatting and collaboration features.
CO2	Apply spreadsheet skills to organize, clean, analyze, and visualize research data using formulas, functions, charts, PivotTables, and dashboards.
CO3	Create effective academic presentations using multimedia, design principles, and slide management techniques for seminars, conferences, and thesis defense.
CO4	Understand the applications of emerging technologies such as Artificial Intelligence and digital research tools in interdisciplinary research environments.
CO5	Apply ethical and responsible practices related to plagiarism, cybersecurity, data privacy, citation metrics, and AI-assisted research activities.

UNIT-I	**Academic Word Processing and Research Documentation:** MS Word interface, menus, ribbon, toolbars, and shortcuts. Creating, saving, opening, editing, formatting, and printing documents. Styles, templates, headers, footers, page numbering, section breaks, and table of contents. Footnotes, endnotes, captions, indexing, and document protection. Track changes, comments, collaborative editing, and version control. Tables, images, charts, shapes, WordArt, and equation editing. Mail merge for letters, labels, and academic correspondence. Conversion of documents into PDF, RTF, HTML, and other formats. Cloud saving and sharing for research collaboration.
UNIT-II	**Spreadsheet Applications and Research Data Handling:** Workbook and worksheet management. Data entry, formatting, and worksheet organization.Cell referencing: relative, absolute, and mixed. Formulas and functions for academic and research data. Sorting, filtering, data validation, and conditional formatting. Charts, graphs,PivotTables, and dashboards. Multiple worksheets and linking data across sheets. Basic statistical analysis and data visualization. Macros for automating repetitive tasks. Research data management and spreadsheet ethics.
UNIT- III	**Presentation Tools and Digital Research Resources:** Creating academic presentations for seminars, conferences, thesis defense, and online lectures. Slide layouts, themes, slide master, and design templates. Text formatting, images, audio, video, SmartArt, charts, animations, and transitions. Slide show settings, notes, handouts, hyperlinks, and action buttons. Webinar-friendly presentation design and screen-sharing basics. E-books, e-journals, digital libraries, and open educational resources. Google Scholar, DOI search, institutional repositories, and subject databases. Effective search strategies using Boolean operators. Virtual labs, open courseware, and online academic learning platforms. ORCID and research visibility tools.
UNIT- IV	**Digital Research Tools:** Online survey tools (Google Forms, SurveyMonkey), Research data organization and cloud storage, LaTeX basics for thesis formatting, Research publication portals and journal systems, Digital presentation and webinar tools, Academic profile management (ORCID, Google Scholar, ResearchGate)
UNIT - V	**Unit-V: Emerging ICT Technologies and Digital Ethics:** Artificial Intelligence applications in research, Generative AI tools and responsible usage, Cybersecurity awareness for researchers, Data privacy and digital safety, Research analytics and citation metrics, Plagiarism detection software and interpretation, Ethical issues in AI and digital research.

Reference/Text Books

1 Lambert, J., Microsoft Office 365 Step by Step, Microsoft Press.
2 Walkenbach, J., Excel Bible, Wiley Publications.
3 Alley, M., The Craft of Scientific Writing, Springer.

4 Marder, M. and Budiu, R., Reference Management Tools and Academic Writing or an equivalent reference on Zotero/Mendeley use.
5 Russell, S. and Norvig, P., Artificial Intelligence: A Modern Approach, Pearson.

Paper-III: CODE: RES-IV
RESEARCH AND PUBLICATION ETHICS

Course Objectives

1	To understand the fundamental concepts of philosophy, ethics, AI ethics, and scientific conduct in research.
2	To apply the principles of research integrity and identify scientific misconduct, including plagiarism, fabrication, and falsification.
3	To understand publication ethics, authorship, conflicts of interest, and identify predatory journals and unethical publication practices.
4	To use open-access resources, journal selection tools, plagiarism detection software, and publisher copyright policies effectively.
5	To evaluate research quality using indexing databases and research metrics while adhering to ethical standards in scholarly publishing

Course Outcomes (COs)

CO1	Explain the fundamental concepts of philosophy, ethics, moral reasoning, AI ethics, and their significance in scientific research and professional practice.
CO2	Demonstrate an understanding of research integrity, scientific conduct, and ethical issues in research, including fabrication, falsification, plagiarism (FFP), and responsible research practices.
CO3	Evaluate publication ethics, authorship responsibilities, conflicts of interest, publication misconduct, and international ethical guidelines for scholarly communication.
CO4	Apply appropriate tools and resources to identify suitable journals, recognize predatory publishers, understand open-access publishing policies, and comply with copyright and self-archiving requirements.
CO5	Analyze publication misconduct using plagiarism detection software and bibliometric databases, and interpret research metrics such as Impact Factor, h-index, i10-index, CiteScore, SJR, SNIP, and related indicators for research evaluation.

UNIT-I	**PHILOSOPHY AND ETHICS:** Introduction to Philosophy: Definition, Nature and Scope, concept, Branches, Ethics: Definition, moral philosophy, nature of moral judgments and reactions, AI Ethics, concepts of moral philosophy and ethical judgments.
UNIT-II	**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 & data misrepresentation; Selective reporting and misrepresentation of data

UNIT- III	**PUBLICATION ETHICS:** Publication ethics: Definition, importance of ethics; Best practices/standards setting initiatives and guidelines: COPE, WAME, etc; Conflicts of interest; Publication misconduct: Definition, concept, problems that lead to unethical behaviour and vice versa, types of misconduct, Violation of publication ethics, authorship and contributor ship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.
UNIT- IV	**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 Suggester, etc.
UNIT - V	**PUBLICATION MISCONDUCT:** **A**. Group Discussions: Subject specific ethical issues, FFP, authorship; Conflicts of interest; Complaints and appeals: examples and fraud from India and abroad **B**. Software tools: Use of plagiarism software like Urkund, Turnitin and other open source software tools as well as recognizing predatory publishers and journals. **C**.DATABASES AND RESEARCH METRICS: Indexing databases (Web of Science, Scopus, PubMed); Citation databases; Research metrics - impact factor, h-index, i10-index, g index, altmetrics and citation counts; Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score

Reference/Text Books	
1	Penslar, R. L. (Ed.). (1995). Research ethics: Cases and materials. Indiana University Press.
2	Comstock, G. (2013). Research ethics: A philosophical guide to the responsible conduct of research. Cambridge University Press.
3	Yadav, S. K. (2023). Research and publication ethics. Springer.
4	Iphofen, R. (Ed.). (2020). Handbook of research ethics and scientific integrity (pp. 675-691). Cham: Springer.
5	Correa, C. M. (2020). Trade related aspects of intellectual property rights: a commentary on the TRIPS agreement. Oxford University Press.

Elective Subjects

School of Engineering & Technology

PHCS101- Introduction to Machine Learning

Course objectives

1	To understand the fundamental concepts, scope, and mathematical foundations of machine learning and genetic algorithms.
2	To develop knowledge of supervised learning methods and their applications in classification and prediction tasks.
3	To study unsupervised learning techniques for clustering, association rule mining, and pattern discovery in unlabeled data.
4	To introduce statistical learning theory, feature extraction, and feature selection methods for improving model performance.
5	To familiarize students with semi-supervised learning, reinforcement learning, artificial neural networks, deep learning, and genetic algorithm-based intelligent systems.

Course Outcomes (COs)

After successful completion of the course, research scholars will be able to:

CO1	Explain the fundamental concepts, types, applications, and mathematical foundations of machine learning and genetic algorithms
CO2	Apply supervised learning algorithms such as Linear Regression, Naïve Bayes, Decision Trees, K-Nearest Neighbors, Logistic Regression, Support Vector Machines, and Random Forests to solve real-world problems.
CO3	Analyze and implement unsupervised learning techniques including clustering, association rule mining, and probabilistic models for pattern discovery in unlabeled data.
CO4	Utilize statistical learning methods, feature extraction, and feature selection techniques to improve machine learning model performance.
CO5	Demonstrate understanding of reinforcement learning, artificial neural networks, deep learning concepts, and genetic algorithm-based machine learning applications for intelligent decision-making systems.

UNIT-I	Introduction: Objective, scope and outcome of the course. Supervised learning algorithm: Introduction, types of learning, application, Supervised learning: Linear Regression Model, Naive Bayes classifier Decision Tree, K nearest neighbor, Logistic Regression, Support Vector Machine, Random Forest algorithm.
UNIT-II	Unsupervised learning algorithm: Grouping unlabelled items using k-means clustering, Hierarchical Clustering, Probabilistic clustering, Association rule mining, Apriori Algorithm, f-p growth Algorithm, Gaussian mixture model.
UNIT- III	Introduction to Statistical Learning Theory, Feature extraction - Principal component analysis, Singular value decomposition. Feature selection – feature ranking and subset selection, filter, wrapper and embedded methods.
UNIT- IV	Semi supervised learning, Reinforcement learning: Markov decision process (MDP), Bellman equations, policy evaluation using Monte Carlo, Policy iteration and Value iteration.
UNIT -V	Model-based Reinforcement Learning, Artificial neural network, Perceptron, Multilayer network, Back propagation, Introduction to Deep learning.

Reference/Text Books

1 Mitchell, T. M. Machine Learning. McGraw-Hill Education, 1997. A classic text covering the fundamentals of machine learning algorithms and concepts.

2 Alpaydin, E. Introduction to Machine Learning (4th Edition). MIT Press, 2020. Comprehensive coverage of supervised, unsupervised, and reinforcement learning

3 Bishop, C. M. Pattern Recognition and Machine Learning. Springer, 2006. Standard reference for statistical learning theory, probabilistic models, and machine learning.

4 Goodfellow, I., Bengio, Y., and Courville, A. Deep Learning. MIT Press, 2016. Authoritative text on neural networks and deep learning fundamentals.

5 Hastie, T., Tibshirani, R., and Friedman, J. The Elements of Statistical Learning (2nd Edition). Springer, 2009.

PHCS102- Artificial Intelligence

Course objectives

1	To introduce the fundamental concepts, scope, and applications of Artificial Intelligence and expert systems.

2	To develop an understanding of knowledge representation, reasoning, and heuristic search methods used in AI problem-solving.
3	To study the structure and functioning of artificial neural networks for intelligent learning and decision-making.
4	To understand fuzzy logic and genetic algorithms as computational techniques for optimization and control.
5	To enable students to design basic AI-based solutions using search, learning, and inference techniques.

Course Outcomes (COs)

CO1	Explain the concepts, importance, and applications of Artificial Intelligence and Expert Systems
CO2	Apply knowledge representation techniques and reasoning methods for problem-solving.
CO3	Analyze and implement artificial neural network models for intelligent decision-making
CO4	Utilize fuzzy logic and genetic algorithms to solve optimization and control problems.
CO5	Design AI-based solutions using appropriate search, learning, and inference techniques.

UNIT-I	Introduction to AI knowledge based Expert systems Introduction, Importance and Definition of AI, ES ES building tools and shells.
UNIT-II	Concept of knowledge, Representation of knowledge using logics rules, frames Procedural versus Declarative knowledge, forward versus backward chaining Control Strategies: -Concept of heuristic search, search techniques depth first search, Breath first search, Generate & test hill climbing, best first search.
UNIT- III	Biological Neurons and synapse characteristics Artificial Neural Networks Types of activation functions. Perception representation, limitations of perceptrons Single layer and multilayer perceptrons and Perception learning algorithms.
UNIT- IV	Supervised learning, Back propagation algorithm, unsupervised learning Kohonen's top field network & Algorithm.
UNIT -V	Fuzzy logic concepts, Fuzzy relation and membership functions Defuzzification, Fuzzy controllers Genetic algorithm: concepts, coding, reproduction, crossover, mutation, scaling and fitness

Reference/Text Books

1 Elaine Rich and Kevin Knight, Artificial Intelligence 3/e, TMH

2 PADHY: ARTIFICIAL INTELLIGENCE & INTELLIGENT SYSTEMS, Oxford Publications.

3 James A Anderson, An introduction to Neural Networks. Dan. W Patterson, Artificial Intelligence and Expert Systems.

PHEE101- Advanced Technologies in Electrical Engineering

Course objectives

1	To develop an in-depth understanding of advanced concepts and modern technologies in electrical engineering including power systems, electrical machines, power electronics, and control systems..
2	To enhance analytical and problem-solving skills for modeling, simulation, and analysis of complex electrical engineering systems.
3	To familiarize students with modern tools, intelligent techniques, and emerging technologies used in advanced electrical engineering applications and research.
4	To enable students to apply interdisciplinary approaches, automation, optimization, and smart technologies for efficient and sustainable electrical systems.
5	To promote research aptitude, innovation, and professional competence for addressing

	contemporary challenges and future developments in electrical engineering.

Course Outcomes (COs)

CO1	Analyze advanced power system models, perform load flow and stability studies, and evaluate the integration of renewable energy sources, smart grids, and microgrids
CO2	Apply advanced power electronics concepts, electric drive control techniques, and power quality improvement methods for industrial automation and electric vehicle applications.
CO3	Design and analyze modern control systems using state-space methods, adaptive and robust control techniques, and AI-based control approaches such as fuzzy logic and neural networks.
CO4	Evaluate the performance of electrical machines, develop advanced machine models, and implement condition monitoring and fault diagnosis techniques for reliable operation.
CO5	Utilize emerging technologies, optimization methods, MATLAB/Simulink tools, and data-driven approaches to solve complex electrical engineering problems and support research and innovation in the field.

UNIT-I	Advanced Power Systems: Power system modeling and load flow analysis. Steady-state and transient stability studies. Smart grid architecture, microgrids, and distributed generation. Integration of renewable energy sources and associated technical challenges. Fundamentals of digital signal processing including FFT and digital filters. Signal analysis techniques for monitoring and protection of power systems.
UNIT-II	**Power Electronics and Drives:** Advanced power electronic converters including multilevel, resonant, and matrix converters. Principles and control of electric drives such as DC, induction, and BLDC motors. Applications of power electronics and drives in electric vehicles and industrial automation. Power quality issues, harmonics, and mitigation techniques. Internet of Things (IoT) applications in electrical engineering systems.
UNIT- III	State-space representation, analysis, and design of control systems. Nonlinear control system concepts and adaptive control techniques. Optimal and robust control methodologies for complex engineering systems. Artificial intelligence-based control approaches including fuzzy logic controllers and neural network-based control systems.
UNIT- IV	Advanced modeling and analysis of electrical machines. Performance characteristics of synchronous and induction machines under various operating conditions. Study of special electrical machines including BLDC motors, stepper motors, and switched reluctance motors (SRM). Techniques for condition monitoring, fault detection, and fault diagnosis of electrical machines.
UNIT -V	Emerging Technologies and Research Trends: Electric vehicles, energy storage systems, and charging infrastructure. Applications of Artificial Intelligence and Machine Learning in electrical engineering. MATLAB/Simulink-based modeling and simulation techniques. Optimization methods including linear, nonlinear, and evolutionary algorithms. Data-driven modeling approaches, case studies, and real-world applications in modern electrical engineering systems.

Reference/Text Books

1 Hadi Saadat, Power System Analysis, 3rd Edition, McGraw-Hill Education, 2010.

2 Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications, and Design, 3rd Edition, John Wiley & Sons, 2003.

3 Katsuhiko Ogata, Modern Control Engineering, 5th Edition, Prentice Hall, 2010.

4 Alan V. Oppenheim and Alan S. Willsky, Signals and Systems, 2nd Edition, Prentice Hall, 1996.

5	P. S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers, 2011.
6	I. J. Nagrath and D. P. Kothari, Electric Machines, 5th Edition, McGraw-Hill Education, 2010.
7	Institute of Electrical and Electronics Engineers, IEEE Transactions on Power Systems, IEEE Publications, Latest Issues.

PHEC101-- Antenna Theory & Design

Course objectives

1	To develop a strong foundation in advanced electromagnetic theory and antenna fundamentals for the analysis and design of modern antenna systems
2	To study the operating principles, characteristics, and applications of wire, aperture, array, microwave, and broadband antennas.
3	To apply numerical and simulation-based techniques for antenna modeling, performance evaluation, and optimization.
4	To understand modern antenna technologies such as smart antennas, MIMO systems, reconfigurable antennas, metamaterials, and antennas for 5G/6G communications
5	To develop research-oriented skills for designing innovative antenna systems and exploring emerging applications in wireless communication, satellite systems, radar, IoT, and next- generation communication technologies.

Course Outcomes (COs)

CO1	Analyze electromagnetic wave propagation, radiation mechanisms, and fundamental antenna parameters including gain, directivity, polarization, and impedance.
CO2	Design and evaluate wire, aperture, and array antennas, and apply beamforming and side-lobe control techniques in modern communication systems.
CO3	Design microwave and broadband antennas, including microstrip, dielectric resonator, frequency-independent, and ultra-wideband antennas for various wireless applications.
CO4	Apply numerical methods such as MoM, FEM, and FDTD, and utilize electromagnetic simulation tools for antenna analysis and optimization
CO5	Evaluate and explore emerging antenna technologies such as smart antennas, MIMO systems, reconfigurable antennas, metamaterials, and antennas for 5G/6G, satellite, radar, and IoT communication applications.

UNIT-I	**Advanced Electromagnetic Foundations:** Review of Maxwell's Equations (differential & integral forms),Wave propagation in different media,Boundary conditions and wave reflection/transmission, Green's functions and vector potentials, Radiation mechanism and retarded potentials Antenna Fundamentals: Radiation parameters: Radiation pattern, Beamwidth, Directivity, Gain, Radiation efficiency, Polarization (linear, circular, elliptical),Input impedance and matching techniques, Friis transmission equation, Antenna temperature and noise
UNIT-II	Infinitesimal dipole and finite dipole analysis, Monopole antennas, Loop antennas, Helical antennas, Slot antennas, Horn antennas and waveguide radiators, Babinet's principle and duality Antenna Arrays Array fundamentals and pattern multiplication, Linear, circular, and planar arrays, Array factor and beam steering, Phased arrays and adaptive arrays, Side lobe control techniques, Smart antennas and MIMO systems
UNIT- III	Unit-III Microwave and Broadband Antennas Microstrip (patch) antennas: Design and feeding techniques, Bandwidth enhancement methods, Dielectric resonator antennas (DRA), Frequency-independent antennas (log-periodic, spiral), Ultra-wideband (UWB) antennas Numerical Methods in Antenna Analysis: Method of Moments (MoM), Finite Element Method (FEM), Finite Difference Time Domain (FDTD), Simulation tools: HFSS, CST Microwave Studio

UNIT- IV	Advanced Antenna Technologies: Reconfigurable antennas, Metamaterials and metasurfaces, Fractal antennas, RFID antennas, Antennas for 5G/6G communication, Millimeter-wave and terahertz antennas, Smart antennas and MIMO systems, Applications of modern antennas in wireless communication, satellite, radar, and IoT systems.
UNIT -V	Antenna Measurements and Testing: Radiation pattern measurement, Anechoic chamber design, Gain and directivity measurement techniques, Network analyzer basics, Near- field and far-field measurements, Impedance and VSWR measurement, Antenna efficiency measurement, Measurement errors and calibration techniques, Practical antenna testing procedures and case studies.

Reference/Text Books

1 Constantine A. Balanis, Antenna Theory: Analysis and Design, 4th Edition, John Wiley & Sons, 2016.

2 Warren L. Stutzman and Gary A. Thiele, Antenna Theory and Design, 3rd Edition, John Wiley & Sons, 2012.

3 Thomas A. Milligan, Modern Antenna Design, 2nd Edition, John Wiley & Sons, 2005.

4 Robert C. Hansen and Robert E. Collin, Small Antenna Handbook, John Wiley & Sons, 2011.

5 John D. Kraus and Ronald J. Marhefka, Antennas: For All Applications, 3rd Edition

PHEC102- Recent Advances in Electronics and Communication Engineering

Course objectives

1	Familiarize research scholars with recent developments and emerging technologies in Electronics and Communication Engineering.
2	Develop the ability to identify research gaps and formulate research problems in thrust areas of ECE
3	Provide exposure to interdisciplinary applications of modern communication and electronic technologies
4	To get the knowledge of all the latest sensors and their usage
5	Encourage innovation, technology development, and research publication in frontier areas.

Course Outcomes (COs)

CO1	Understand the principles of Artificial Intelligence, Machine Learning, and Deep Learning techniques and their relevance to Electronics and Communication Engineering applications
CO2	Analyze and apply AI-based approaches for communication systems, including channel estimation, resource allocation, spectrum management, and intelligent networking
CO3	Evaluate and implement advanced signal processing techniques for filtering, classification, pattern recognition, and predictive analysis in real-world ECE applications
CO4	Design and develop AI-enabled embedded and edge computing solutions using Edge AI and TinyML frameworks for low-power and real-time applications
CO5	Identify emerging research opportunities and formulate innovative solutions in AI-driven communication, signal processing, and intelligent electronic systems.

UNIT-I	Next Generation Communication Technologies: Evolution from 4G to 5G and Beyond (6G Vision),Massive MIMO, Beamforming and Millimeter Wave Communication,Software Defined Radio (SDR) and Cognitive Radio

	Networks,Device-to-Device Communication and Network Slicing,Satellite Communication and Non-Terrestrial Networks (NTN),Visible Light Communication and Li-Fi Technologies
UNIT-II	Artificial Intelligence and Signal Processing Applications,Machine Learning and Deep Learning Techniques in ECE ,AI-based Communication Systems, , Intelligent Signal Processing Techniques, Image and Video Processing using AI, Speech Processing and Natural Language Applications, Edge AI and Tiny Machine Learning for Embedded Systems.
UNIT- III	Emerging Trends in Embedded Systems and VLSI, System-on-Chip (SoC) and Network-on-Chip (NoC), Low Power and High-Performance VLSI Design, FPGA-based System Design,Hardware Security and Trusted Electronics, Internet of Things (IoT) and Industrial IoT, Cyber Physical Systems and Embedded Intelligence.
UNIT- IV	Advanced Electronics, Sensors and Photonic Systems, MEMS and NEMS Technologies, Nanoelectronics and Advanced Semiconductor Devices, Flexible and Wearable Electronics,Smart Sensors and Sensor Networks, Optical Communication and Photonic Integrated Circuits, Terahertz Electronics and Quantum Devices
UNIT -V	Frontier Research Areas and Future Technologies, Quantum Communication and Quantum Computing Fundamentals, Green Communication and Energy Efficient Networks, Smart Cities and Intelligent Transportation Systems, Industry 4.0 and Smart Manufacturing, Biomedical Electronics and Healthcare Technologies, Research Trends, Challenges and Future Directions in ECE

Reference/Text Books

1 Simon Haykin, Communication Systems, Wiley.
2 Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson.
3 Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill.
4 S. Salivahanan and A. Vallavaraj, Digital Signal Processing, McGraw Hill.
5 Jan M. Rabaey, Digital Integrated Circuits, Pearson.
6 Recent research papers from IEEE Transactions, IEEE Communications Magazine, Elsevier and Springer journals.

PHME101- Recycling of Machines

Course objectives

1	To enable students to design basic AI-based solutions using search, learning, and inference techniques.
2	To develop understanding of machine components, material classification, dismantling methods, and material recovery processes used in recycling industries.
3	To familiarize students with modern recycling technologies including shredding, sorting, automation, Artificial Intelligence, and robotics in recycling systems.
4	To create awareness about environmental, health, safety, economic, and legal aspects associated with industrial waste management and recycling operations.
5	To create awareness about environmental, health, safety, economic, and legal aspects associated with industrial waste management and recycling operations.

Course Outcomes (COs)

CO1	Understand the principles, importance, and environmental benefits of machine recycling within the framework of sustainable development and the circular economy.
CO2	Identify various machine components and materials and apply appropriate disassembly, dismantling, and material recovery techniques.
CO3	Analyze and utilize modern recycling technologies, including sorting, separation, automation, AI, and robotics in recycling operations.

CO4	Evaluate environmental, health, safety, economic, and legal aspects associated with machine recycling and waste management.
CO5	Apply eco-design principles, life cycle assessment techniques, and recycling process planning for sustainable engineering and industrial waste management solutions.

UNIT-I	Introduction to Machine Recycling: Definition and importance of recycling machinery, Environmental impact of industrial waste, Concepts of Sustainable Development and circular economy, Types of Machines and Materials, Industrial machines (CNC, motors, turbines),Household machines (washing machines, refrigerators), Materials used: metals, plastics, electronics, composites
UNIT-II	Disassembly and Dismantling Techniques Manual vs automated dismantling, Safety procedures and hazard identification Tools and equipment used Material Recovery Processes: Metal recycling (steel, aluminum, copper extraction), Plastic recycling methods (mechanical, chemical), E-waste handling and recovery of precious metals.
UNIT- III	Recycling Technologies: Shredding, sorting, and separation technologies, Use of AI, data science and robotics in recycling systems, Advanced recovery techniques, Environmental and Health Aspects: Pollution control during recycling, Handling hazardous substances ,Worker safety and regulations.
UNIT- IV	Economic and Legal Framework: Cost-benefit analysis of recycling, Government policies and global standards: Extended Producer Responsibility (EPR), Design for Recycling: Eco-design principles, Designing machines for easy disassembly, Life cycle assessment (LCA),
UNIT -V	Case Studies and Applications: Recycling of automobiles, Industrial equipment refurbishment, Real-world recycling plants, Machine dismantling practice, Material identification and sorting, Recycling process design project.

Reference/Text Books

1. Lund, H. F., The McGraw-Hill Recycling Handbook, McGraw-Hill Education
2. Tchobanoglous, G., Kreith, F., Handbook of Solid Waste Management, McGraw-Hill.
3. Rao, P., Resource Recovery and Recycling from Metallurgical Wastes, Elsevier.
4. Chandra, R., Waste Management and Recycling, CBS Publishers.
5. Worrell, E., Reuter, M. A., Handbook of Recycling: State-of-the-Art for Practitioners, Analysts, and Scientists, Elsevier.
6. Das, S. K., Industrial Recycling and Sustainable Engineering, CRC Press.
   European Commission, Guidelines on Waste Electrical and Electronic Equipment (WEEE) Recycling.
7. Relevant BIS, CPCB, and Ministry of Environment, Forest and Climate Change (MoEFCC) guidelines on recycling and waste management.

PHCE101: Advanced Construction Technology

Course objectives

1	To understand modern construction techniques, equipment, and materials used in civil engineering projects.
2	To develop knowledge of prefabrication, modular construction, and sustainable construction practices.
3	To familiarize students with planning, monitoring, and quality control in construction projects.
4	To understand construction safety standards, risk management, and project documentation.
5	To introduce digital technologies such as BIM and automation in construction management.

Course Outcomes (COs)

CO1	Explain modern construction methods and the selection of appropriate equipment for different projects.
CO2	Apply prefabrication, modular construction, and sustainable construction techniques in engineering practice.
CO3	Demonstrate knowledge of quality control, safety management, and construction planning tools.
CO4	Utilize Building Information Modeling (BIM) and digital technologies for construction management.
CO5	Evaluate construction project performance considering cost, quality, safety, and environmental aspects.

UNIT-I	Modern Construction Methods, Introduction to modern construction practices. Conventional and mechanized construction. Formwork systems. Slip form, tunnel form, climbing formwork. Prefabrication and modular construction. Precast concrete systems. Construction equipment selection and productivity.
UNIT-II	Construction Materials and Quality Control, Advanced concrete technologies. High-performance concrete, self-compacting concrete, fiber reinforced concrete, geopolymer concrete. Quality assurance and quality control. Non- destructive testing methods. Construction specifications and standards.
UNIT- III	Construction Planning and Project Management, Project scheduling using CPM and PERT. Resource planning and allocation. Construction cost estimation. Contract management. Site organization. Risk assessment and mitigation. Construction documentation and reporting.
UNIT- IV	Sustainable Construction and BIM Green buildings and sustainable construction practices. Energy-efficient construction materials. Waste management on construction sites. Building Information Modeling (BIM) concepts and applications. Digital construction management. Smart construction technologies.
UNIT - V	Construction Safety and Emerging Technologies, Construction safety regulations. Hazard identification and risk management. Personal protective equipment. Occupational health and safety. Automation, robotics, drones, IoT, AI applications in construction. Future trends in construction engineering.

Reference/Text Books

1 Peurifoy, R. L., Construction Planning, Equipment and Methods, McGraw-Hill.
2 Varghese, P. C., Building Construction, PHI Learning.
3 Punmia, B. C., Building Construction, Laxmi Publications.
4 Chudley, R., Construction Technology, Pearson.
5 Eastman, C., BIM Handbook, Wiley.

PHCE102 Smart and Sustainable Infrastructure

Course objectives

1	To introduce concepts of sustainable infrastructure development and smart cities.
2	To understand intelligent transportation systems and smart utility networks.
3	To develop knowledge of resilient infrastructure planning and climate adaptation.
4	To familiarize students with GIS, remote sensing, and digital technologies used in infrastructure management.
5	To promote sustainable engineering practices and lifecycle assessment.

Course Outcomes (COs)

CO1	Explain the concepts of smart and sustainable infrastructure systems.

CO2	Apply GIS, remote sensing, and digital technologies in infrastructure planning and management.
CO3	Evaluate sustainable transportation, water supply, and urban infrastructure systems.
CO4	Assess infrastructure resilience considering climate change, disaster risk, and environmental sustainability.
CO5	Demonstrate understanding of lifecycle assessment, asset management, and smart infrastructure monitoring.

UNIT-I	Introduction to Smart Infrastructure, Concept of smart infrastructure. Sustainable development goals. Smart cities mission. Urban infrastructure systems. Infrastructure lifecycle. Performance indicators. Sustainable infrastructure planning.
UNIT-II	Intelligent Transportation and Utility Systems, Intelligent transportation systems (ITS). Smart traffic management. Smart roads and highways. Water supply networks. Smart drainage systems. Smart energy infrastructure. IoT applications in civil engineering.
UNIT- III	GIS, Remote Sensing and Infrastructure Planning, Fundamentals of GIS. Remote sensing applications. GPS and geospatial technologies. Infrastructure mapping. Land-use planning. Digital terrain models. Infrastructure monitoring using drones and satellite imagery.
UNIT- IV	Climate Resilient Infrastructure, Climate change impacts on infrastructure. Disaster-resistant design. Flood management. Earthquake resilience. Infrastructure risk assessment. Asset management. Sustainable maintenance strategies.
UNIT - V	Emerging Technologies and Sustainable Practices, Building Information Modeling (BIM). Digital twins. Artificial Intelligence in infrastructure management. Sensor-based structural health monitoring. Lifecycle assessment. Green rating systems. Carbon footprint reduction. Future trends in sustainable infrastructure.

Reference/Text Books

1. Hall, R. E., The Vision of Smart Cities, Springer.
2. Moser, S. C., Climate Change Adaptation in Urban Infrastructure, Wiley.
3. Tomlinson, R., Thinking About GIS, ESRI Press.
4. Eastman, C., BIM Handbook, Wiley.
5. Shen, G. Q., Sustainable Construction, Wiley.

School of Basic & Applied Science

PHPY101- Electronics

Course objectives

1	To provide a comprehensive understanding of operational amplifiers, their characteristics, configurations, feedback techniques, and practical applications in analog circuits.
2	To develop knowledge of oscillators, wave-shaping circuits, voltage regulators, filters, and power supply circuits used in electronic systems.
3	To introduce Boolean algebra, logic gates, combinational and sequential logic circuits, and their applications in digital electronics.
4	To familiarize students with the architecture, organization, memory interfacing, and programming concepts of the 8085 microprocessor.
5	To develop analytical and problem-solving skills for designing, analyzing, and implementing analog, digital, and microprocessor-based electronic systems.

Course Outcomes (COs)

CO1	Analyze and design operational amplifier circuits, evaluate their performance parameters, and apply them in signal conditioning and instrumentation applications.
CO2	Design and analyze oscillators, waveform generation circuits, voltage regulators, clipping and clamping circuits, and electronic filter circuits.
CO3	Apply Boolean algebra and Karnaugh maps to simplify logic functions and design combinational and sequential digital logic circuits using standard logic families.
CO4	Explain the architecture, memory organization, instruction set, and operational features of the 8085 microprocessor and its role in embedded systems.
CO5	Develop, analyze, and debug assembly language programs for the 8085 microprocessor involving arithmetic, logical, branching, looping, counting, and timing operations to solve engineering problems.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Amplification: Operational Amplifiers-I: Differential amplifier: circuit configurations, dual input, balanced output differential amplifier, DC analysis and AC analysis, inverting and non inverting inputs, Block diagram of typical OP-Amplifier, Constant current-bias level translator. Open loop configuration, inverting and non-inverting amplifiers, and Frequency- response. OP-Amp Parameters: input offset voltage, bias currents, input offset current, output offset voltage, CMRR, frequency response, Slew rate. OP-Amp with negative feedback, voltage series feedback, effect of feed-back on closed loop gain, input and output resistance, band width
UNIT-II	Operational Amplifiers based Instrumentations and their applications :DC and AC amplifier, voltage follower, Adder, subtractor, multiplier, phase changer, Active filters, Active Integrator and active differentiator. Oscillators and wave shaping Circuits :Oscillator Principle - Oscillator types, Frequency stability response, the phase shift oscillator, Wien bridge oscillator, LC tunable oscillators, Multivibrators: Monostable and Astable, Comparators, Square and triangle wave form generators
UNIT- III	**Voltage regulators:** Block diagram of Power supply, fixed voltage regulators, adjustable voltage regulators, switching regulators. Clipping and clamping circuits. Filter circuit . **Boolean algebra and logic gates :**Canonical and standard forms, IC logic families, Simplification of Boolean functions: Karnaugh map of up to 4 variables, don't care conditions, NAND and NOR implementation. **Combinational logic:** Adders, subtractors, binary parallel adder, magnitude comparator, decoders/Demultiplexers encoders/multiplexers.
UNIT- IV	**Sequential Logic :**Basic flip-flop, clocked RS flip-flop, T flip-flop, D flip-flop, J-K flip flop, triggering of flip-flops, JK master slave flip-flops; Synchronous and asynchronous counters: Binary counters, Decade counters, Registers **Microprocessors :** Organization of a Micro computer based system, Microprocessor architecture and its operations, Memory, memory map. The 8085 microprocessor unit; Functional block diagram.
UNIT - V	**Assembly Language Programming of 8085 :**Instruction set of 8085: Data transfer operations, Arithmetic operations, Logic operations, Branch operations, Addressing modes of 8085 instructions, Assembly language programmes involving data transfer, arithmetic logic operations and looping, counting and indexing - counters and timing delays.

Reference/Text Books

1 Integrated Electronics, by J. Millman and C.C. Halkias, TMH, New Delhi

2 OP-AMP and Linear Integrated Circuits by Ramakanth, A. Gayakwad, PHI, New Delhi

3 Digital Logic and Computer design by Electronics by Morris Mano

PHPY102-Solid State Physics

Course objectives

1	To develop a fundamental understanding of crystal structures, crystal defects, reciprocal lattices, and X-ray diffraction in crystalline solids.
2	To introduce the concepts of lattice dynamics, phonons, thermal properties, and heat transport mechanisms in solids.
3	To explain the electronic properties of solids using free electron theory, band theory, Fermi statistics, and electron dynamics in crystalline materials.
4	To familiarize students with the principles of superconductivity, including the Meissner effect, BCS theory, and Josephson junctions
5	To provide comprehensive knowledge of magnetic phenomena in solids, including diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, and magnetic domain structures.

Course Outcomes (COs)

CO1	Explain crystal structures, crystal defects, reciprocal lattices, Brillouin zones, and analyze crystal diffraction using structure factor concepts.
CO2	Analyze lattice vibrations, phonon dispersion, specific heat, thermal conductivity, and the role of phonons in determining the thermal properties of solids.
CO3	Apply free electron theory, Fermi-Dirac statistics, and band theory to explain the electrical properties of metals, semiconductors, and insulators.
CO4	Describe the fundamental principles of superconductivity, distinguish between Type-I and Type-II superconductors, and explain the significance of BCS theory and Josephson junctions.
CO5	Interpret various magnetic phenomena in solids, including diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, magnetic domains, and their applications in modern materials science.

UNIT-I	Crystallinity and Forms of Solids: Crystal classes and systems, periodic array of atoms, fundamental types of lattices, 2d and 3d lattices, index system for crystal planes, simple crystal structures, non ideal crystal structures, elementary ideas of point defects: line defects, planar faults, surface and volume defects, lattice vacancies, interstitials, colour centers, F-centers. Reciprocal lattice, diffraction of waves by crystals, scattered wave amplitude, structure factor, Brillouin zones
UNIT-II	Lattice Dynamics: Lattice vibrations, phonons, vibrations of crystals with monoatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, and inelastic scattering by phonons. Specific heat of solids, phonon heat capacity, anharmonic crystal interactions, thermal conductivity.
UNIT- III	**Electrons in Solids:** Free electron theory- Fermi statistics, effect of temperature on the

	Fermi- Dirac distribution, free electron gas in three dimensions, heat capacity of the electron gas, electron motion in magnetic fields. Number of orbitals in a band, energy bands in metals, insulators and semiconductors, tight binding approximations.
UNIT- IV	Idea of reduced and periodic zones, construction of Fermi surfaces, electron orbits, hole orbits, open orbits, de Haas van Alfen effect for Fermi surface (no derivation). Superconductivity, Meissner effect, type-I and type-II superconductors, BCS theory of superconductors, Josephson junctions.
UNIT - V	**Magnetic Phenomena in Solids:** Langevin diamagnetism equation, quantum theory of diamagnetism of mononuclear systems, Para magnetism, quantum theory of paramagnetic, Hund‟s rules. Ferromagnetic order, magnons, neutron magnetic scattering, Antiferromagnetic order, Ferromagnetic domains, single domain particle.

Reference/Text Books

1 Introduction to Solid State Physics by Charles Kittel (Seventh or higher Edition).
2 Solid State Physics by A.J. Dekker
3 Solid State Physics &Electronics R.K. Puri, V.K. Babbar

PHCH101- Environmental Chemistry and Pollution Control

Course objectives

1	Understand chemical processes in the environment.
2	Learn sources and fate of environmental pollutants.
3	Apply analytical techniques for environmental monitoring.
4	Study pollution control and management methods.
5	Explore research issues in environmental contamination.

Course Outcomes (COs)

CO1	Explain environmental chemical processes and interactions
CO2	Analyze sources and impacts of pollutants.
CO3	Apply analytical techniques for pollutant assessment.
CO4	Evaluate pollution control and remediation technologies.
CO5	Develop sustainable solutions for environmental problems.

UNIT-I	Fundamentals of Environmental Chemistry: Introduction to Environmental Chemistry: Scope, importance, and interdisciplinary nature of environmental chemistry. Chemical speciation and environmental fate of pollutants. Thermodynamic and kinetic aspects of environmental reactions. Atmospheric Chemistry: Photochemical reactions in the atmosphere; formation of classical and photochemical smog; ozone layer chemistry and mechanisms of ozone depletion.Greenhouse Gases and Climate Change: Chemical aspects of greenhouse gases, global warming, climate change, and their environmental implications.
UNIT-II	Water and Soil Pollution Chemistry Chemistry of Natural Waters: Physical and chemical properties of water; dissolved oxygen, alkalinity, hardness, and pH.Water Pollutants: Heavy metals (Hg, Cd, Pb, As), nutrients (nitrates and phosphates), and organic contaminants such as pesticides, pharmaceuticals, and dyes.Soil Chemistry and Pollution: Soil composition and soil organic matter; interaction of pollutants with soil minerals and humic substances; mobility and bioavailability of contaminants.Agricultural Pollutants: Fertilizers, pesticides, herbicides, and their environmental impacts.
UNIT- III	Environmental Monitoring and Analytical Techniques Environmental sampling and

	monitoring strategies.Analytical Techniques for Pollutant Detection: Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma–Mass Spectrometry (ICP–MS), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), UV–Visible Spectroscopy, electrochemical sensors, and biosensors.Air Quality Monitoring: Measurement of particulate matter ($PM_{2.5}$ and PM_{10}); monitoring of NO_x, SO_2, CO, and O_3.Water Quality Assessment: Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Organic Carbon (TOC), turbidity, and total dissolved solids (TDS).Data Analysis and Interpretation in Environmental Research.
UNIT- IV	Pollution Control and Remediation Technologies: Air Pollution Control Methods: Cyclone separators, electrostatic precipitators, scrubbers, and catalytic converters.Water and Wastewater Treatment: Primary, secondary, and tertiary treatment processes; chemical treatment methods including coagulation, flocculation, and oxidation; membrane technologies.
UNIT -V	Soil Remediation Techniques: Bioremediation, phytoremediation, and chemical immobilization.Emerging Remediation Technologies: Nanotechnology in pollution control, photocatalytic degradation of pollutants, and green chemistry approaches for sustainable pollution management.

Reference/Text Books

1 Stanley E. Manahan – Environmental Chemistry
2 Colin Baird and Michael Cann – Environmental Chemistry
3 Sawyer, McCarty & Parkin – Chemistry for Environmental Engineering
4 Skoog, Holler & Crouch – Principles of Instrumental Analysis
5 Harrison – Understanding Our Environment

PHCH102- Nano Chemistry and Nanomaterials

Course objectives

1	Develop a fundamental understanding of nanochemistry and the science of nanomaterials
2	Familiarize research scholars with conventional and green synthesis methods for nanomaterials
3	Provide knowledge of advanced characterization techniques for nanomaterials.
4	Explore the applications of nanomaterials in chemical analysis and interdisciplinary research
5	Enable scholars to investigate emerging trends and research opportunities in nanoscience and nanotechnology

Course Outcomes (COs)

CO1	Explain the fundamental principles, structure, classification, and size-dependent properties of nanomaterials.
CO2	Evaluate conventional and green synthesis methods for the preparation of nanomaterials.
CO3	Apply advanced characterization techniques for determining the structural, morphological, optical, and chemical properties of nanomaterials .
CO4	Analyze the applications of nanomaterials in chemical analysis, environmental monitoring, biomedical sciences, and industrial processes
CO5	Design research-based approaches using nanomaterials for analytical applications and sustainable technological innovations

UNIT-I	Fundamentals of Nanochemistry Introduction to nanoscience and nanotechnology; historical development of nanochemistry; classification of nanomaterials; size-dependent physical and

	chemical properties; quantum confinement effect; surface area and surface energy; optical, electrical, magnetic, and catalytic properties of nanomaterials.
UNIT-II	Synthesis of Nanomaterials Top-down approaches: mechanical milling, lithography, laser ablation. Bottom-up approaches: sol–gel synthesis, chemical vapor deposition (CVD), hydrothermal and solvothermal synthesis, chemical reduction, microemulsion techniques. Green synthesis of nanomaterials using plant extracts, microorganisms, and biogenic methods; factors affecting nanoparticle synthesis.
UNIT-III	Characterization Techniques for Nanomaterials Microscopic techniques: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM). Spectroscopic techniques: UV–Visible spectroscopy, FTIR spectroscopy, Raman spectroscopy. Structural and particle analysis: X-ray Diffraction (XRD), Dynamic Light Scattering (DLS), particle size and zeta potential analysis; interpretation of characterization data.
UNIT-IV	Applications of Nanomaterials in Chemical Analysis Nanomaterials in analytical chemistry; nanosensors and biosensors; environmental applications: detection of heavy metals, pollutants, pesticides, water and soil quality monitoring; biomedical applications: drug delivery, biomarker detection, diagnostic nanoprobes; industrial and catalytic applications; nanomaterials in energy storage and conversion.
UNIT-V	Advanced Nanomaterials and Emerging Research Trends Functional nanomaterials (carbon nanotubes, graphene, quantum dots, metal–organic frameworks, magnetic nanoparticles); nanocomposites; nanotoxicology and environmental safety; ethical and regulatory aspects of nanotechnology; current research trends; recent advances in nanomaterials for chemical analysis; research methodology, scientific literature review, and case studies.

Reference/Text Books

1 Nanochemistry: A Chemical Approach to Nanomaterials – Geoffrey A. Ozin& André C. Arsenault

2 Introduction to Nanotechnology – Charles P. Poole Jr. & Frank J. Owens

3 Nanomaterials: Synthesis, Properties and Applications – A. S. Edelstein & R. C. Cammarata

4 Nanostructures and Nanomaterials: Synthesis, Properties and Applications – Guozhong Cao

PHMA101-Special Functions, Integral Transforms, and Fractional Calculus

Course objectives

1	Develop advanced knowledge of special functions, integral transforms, and fractional calculus by studying their theoretical foundations, analytical properties, computational techniques, and Interrelationships. Equip scholars to apply these mathematical tools for solving ordinary and partial differential equations, fractional models, and complex problems arising in scientific research, engineering, and applied mathematics.
2	To study integral transforms and their applications in differential equations.
3	To learn the concepts and operators of fractional calculus.
4	To analyze mathematical models using special functions and fractional operators.
5	To apply fractional calculus techniques to solve scientific and engineering problems.

Course Outcomes (COs)

CO1	**Special Functions I:**Demonstrate proficiency in analyzing Gamma, Beta, Bessel, and Legendre functions, applying their properties, identities, recurrence relations, orthogonality, and integral representations to solve advanced mathematical problems.
CO2	Special Functions II: Analyze Hermite, Laguerre, hypergeometric, and confluent hypergeometric functions, and apply their generating functions, differential equations, convergence properties, and transformation formulas in advanced mathematical analysis.
CO3	Integral Transforms:Apply Fourier, Laplace, Mellin, and Hankel transforms along with operational calculus to solve ordinary and partial differential equations.
CO4	Foundations of Fractional Calculus:Analyze fractional derivatives and integral operators, compare their definitions and properties, and interpret their significance in advanced mathematical modeling.
CO5	Applications of Fractional Calculus: Apply Mittag-Leffler functions and numerical methods to formulate and solve fractional differential equations arising in science, engineering, and applied mathematics.

UNIT-I	Special Functions I: Gamma and Beta functions: Properties, identities, integral representations, Bessel functions of the first and second kind: Recurrence relations, orthogonality, series expansions, Legendre functions: Legendre polynomials, Rodrigues formula, orthogonality
UNIT-II	Special Functions II: Hermite and Laguerre polynomials: Generating functions, differential equations, Hypergeometric functions: Generalized hypergeometric series, convergence,transformation formulas Confluent hypergeometric functions (Kummer's functions)
UNIT- III	Integral Transforms: Fourier Transform: Definitions, properties, inversion formula, applications to PDEs, Laplace Transform: Properties, inverse Laplace, convolution theorem, applications to ODEs, Mellin Transform: Definition, properties, inversion, relation with Laplace and Fourier transforms , Hankel Transform: Bessel function-based transform and applications, Operational calculus using transforms
UNIT- IV	Fractional Calculus – Fundamentals, Introduction and historical development Definitions of fractional derivatives and integral operators, Pathway integral Operator Riemann–Liouville, MSM fractional differential and integral operator, Comparison between definitions, properties, and interpretations
UNIT - V	Applications of Fractional Calculus: Mittag-Leffler functions and their role in fractional-order systems, Numerical methods for fractional equations

Reference/Text Books

1 I.N. Sneddon – Special Functions of Mathematical Physics and Chemistry
2 A. Erdélyi – Higher Transcendental Functions (Bateman Manuscript Project)
3 R. Gorenflo and F. Mainardi – Fractional Calculus: Integral and Differential Equations of Fractional Order
4 K.B. Oldham and J. Spanier – The Fractional Calculus
5 Podlubny, I. – Fractional Differential Equations
6 Davies, B. – Integral Transforms and Their Applications

PHMA102- Advanced Fluid Dynamics

Course Objectives

1	Develop advanced understanding of fluid mechanics by exploring fluid kinematics, governing equations, inviscid and viscous flow theories, boundary layers, turbulence, and compressible flows. Equip scholars with analytical and mathematical techniques to model, analyze, and solve complex fluid flow problems relevant to scientific research, engineering, and interdisciplinary applications.

2	To study integral transforms and their use in solving differential equations.
3	To learn the fundamentals of fractional calculus and fractional operators.
4	To analyze mathematical models using special functions and fractional calculus
5	To apply analytical and numerical methods to solve advanced scientific and engineering problems.

Course Outcomes (COs)

CO1	Analyze fluid properties, kinematics, flow classifications, and governing equations, applying continuum mechanics and stress concepts to formulate and solve advanced fluid flow problems.
CO2	Apply inviscid flow theory, potential flow concepts, complex variable techniques, and circulation theorems to analyze ideal fluid motion and two-dimensional flow fields.
CO3	Analyze viscous flow behavior using Navier–Stokes solutions, boundary layer theory, Reynolds number, and scaling principles to predict flow characteristics and separation phenomena.
CO4	Evaluate turbulence phenomena, transition mechanisms, Reynolds-averaged Navier–Stokes equations, and turbulent boundary layer behavior to analyze complex fluid flow and mixing processes.
CO5	Analyze compressible flow phenomena using governing equations, isentropic relations, nozzle flow theory, shock waves, expansion fans, and linearized supersonic flow models.

UNIT-I	Fundamentals of Fluid Mechanics:Continuum hypothesis and fluid properties, Kinematics of fluid motion: Lagrangian and Eulerian description, Streamlines, pathlines, and streaklines, Deformation, vorticity, and circulation, Classification of flows: Inviscid/viscous, compressible/incompressible, laminar/turbulent Governing equations: Derivation of continuity, momentum (Navier–Stokes), and energy equations Stress tensor, Newtonian and non-Newtonian fluids.
UNIT-II	Inviscid Flow Theory: Euler equations and Bernoulli's equation, Irrotational flows and velocity potential, Stream function formulation, Potential flow theory: Sources, sinks, doublets, and vortices, Blasius theorem,Complex potential and conformal mapping (2D flows),Kelvin's circulation theorem, Helmholtz's vortex theorems.
UNIT- III	Viscous Flow and Boundary Layer Theory: Exact solutions of Navier–Stokes equations (Hagen–Poiseuille, Couette flow, etc.), Laminar boundary layer theory: Prandtl's boundary layer equations, Blasius solution, Boundary layer separation, Reynolds number and scaling arguments.
UNIT- IV	Turbulence Introduction to turbulence: Transition to turbulence, Reynolds-averaged Navier–Stokes (RANS) equations, Turbulent boundary layers and mixing
UNIT - V	Compressible Flow, Basics of compressible flows: Isentropic flow, Speed of sound and Mach number, One-dimensional compressible flows: Nozzle flows, Shock waves and expansion fans, Governing equations for compressible flow, Potential equations for compressible flows, Linearized theory for supersonic flows.

Reference/Text Books

1 G.K. Batchelor – An Introduction to Fluid Dynamics
2 L.D. Landau and E.M. Lifshitz – Fluid Mechanics
3 P. Kundu, I. Cohen, D. Dowling – Fluid Mechanics
4 C. Pozrikidis – Introduction to Theoretical and Computational Fluid Dynamics.
5 D.J. Acheson – Elementary Fluid Dynamics
6 P.G. Drazin, W.H. Reid – Hydrodynamic Stability

PHBO101-Advances in Mycology

Course Objectives

CO1	Explain the development and recent advances in mycology
CO2	Describe microbial interactions and the role of fungi in biogeochemical cycles.
CO3	Evaluate the applications of fungi in industry, biotechnology, and environmental management.
CO4	Analyze the importance of mycorrhizae in agriculture, horticulture, and forestry.
CO5	Apply knowledge of fungi in waste bioconversion, bioremediation, and disease management.

UNIT-I	General introduction, historical development and advances in mycology
UNIT-II	Concepts in microbial ecology, microbe-microbe interactions, microbe-plant interactions, microbe-animal interactions, carbon cycle, nitrogen cycle, sulphur cycle, phosphorous cycle, transformation of other ions, degradation of man-made compounds.
UNIT- III	Fungi in fermentation technology, in the production of antibiotics, immunoregulators, antitumor and antiviral agents, in transformation, in mineral biotechnology, in coal solubilization and paper industry, biosorption, bioremediation, detoxification of pesticides, in treatment of industrial effluents.
UNIT- IV	Type, structure and function of mycorrhizae, role of mycorrhizae in agriculture, horticulture and forestry.
UNIT - V	Bioconversion of waste material through cultivation of fungi, effect of plant parasitic and other fungi on man.

Reference/Text Books

1. **Ainsworth, G. C. & Sussman, A. S.** (1968). *The Fungi*. Academic Press, New York, USA
2. Alexopoulos, C. J., Mims, C. W. & Blackwell, M. (1979). Introductory Mycology. Wiley Eastern Limited, New Delhi, India.
3. Alexopoulos, C. J., Mims, C. W. & Blackwell, M. (1996). Introductory Mycology (4th ed.). John Wiley & Sons, New York, USA.
4. Burnett, J. H. (1976). Fundamentals of Mycology. Edward Arnold, London, UK.
5. Deacon, J. W. (2006). Fungal Biology (4th ed.). Blackwell Publishing, Oxford, UK. (Earlier editions were published as Introduction to Modern Mycology.)
6. Horsfall, J. G. & Cowling, E. B. (Eds.). (1978). Plant Disease: An Advanced Treatise (Vols. I–V). Academic Press, New York, USA.

PHBO102- Instrumentation & Techniques in Plant Sciences

Course Objectives

CO1	Explain the principles and applications of microscopy and analytical instruments.
CO2	Apply spectrophotometric, centrifugation, and chromatographic techniques in biological studies.
CO3	Demonstrate the applications of radioisotopes and bioinformatics in life science research.

CO4	Perform microbial culture and plant tissue culture techniques under laboratory conditions.
CO5	Analyze genomic and proteomic data using advanced molecular biology techniques such as PCR, electrophoresis, blotting, sequencing, and microarray analysis.

UNIT-I	Microscopy: Principles and applications of phase contrast, differential image control, fluorescence, confocal, scanning and transmission electron microscopes
UNIT-II	Spectrophotometry: Principles and applications of UV-Visible, atomic absorption and fluorescence spectrophotometers, NMR spectroscopy Centrifugation:
UNIT- III	Principle and types of centrifuges, ultracentrifugation, density gradient centrifugation and continuous centrifugation Chromatography: Principle and application of TLC, Gas chromatography, HPLC, FPLC. Measurement of radioisotopes and their applications in biological systems. Bioinformatics: Basic concepts and applications
UNIT- IV	Microbial culture techniques: Sterilization, culture media, types of cultures- batch and continuous, culture preservation, Tissue culture techniques: Media preparation, sterilization, in vitro regeneration
UNIT - V	Proteomics: Gel electrophoresis (native, SDS and 2-D), isoelectric focusing, MALDITOF, LC-MS, Gel documentation system. Genomics: Isolation of genomic and plasmid DNA, PCR, RT-PCR, Ribotyping, AFLP, RFLP, FISH, blotting techniques, sequencing, EST, Microarray

Reference/Text Books

1 Agrawal, G. K. & Rakwal, R. (2008). Plant Proteomics: Technologies, Strategies and Applications. John Wiley & Sons, New York, USA.

2 Becker, J. M., Caldwell, G. A. & Zachgo, E. A. (1996). Biotechnology: A Laboratory Course (2nd ed.). Academic Press, California, USA.

3 Grab, R. L. & Barry, E. F. (2004). Modern Practice of Gas Chromatography (4th ed.). John Wiley & Sons, New Jersey, USA.

4 Hames, B. D. (2002). Gel Electrophoresis of Proteins: A Practical Approach. Oxford University Press Inc., New York, USA.

5 Harborne, J. B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Chapman & Hall, London, UK.

6 Wilson, K. & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology (7th ed.). Cambridge University Press, Cambridge, UK.

PHZO101-Advanced Zoology & Integrative Biology

Course Objectives

1	To Deepen Conceptual Understanding: To equip research scholars with advanced theoretical and practical insights into modern biosystematics, evolutionary biology, and physiological adaptations of animals to diverse ecosystems.
2	To Master Applied Entomological Frameworks: To impart detailed knowledge of insect physiology and diversity, and to train scholars in formulating molecular and ecological strategies for Integrated Pest Management (IPM) and vector control.
3	To Advance Field and Conservation Skills: To cultivate the ability to use modern ecological tools, geospatial technologies (GIS), and conservation policies to address human-wildlife conflicts and protect endangered biodiversity.
4	To Train in High-Throughput Molecular Technologies: To provide comprehensive training on eukaryotic gene regulation, functional genomics, and advanced gene-editing mechanisms necessary for high-impact biological research.
5	To Develop Robust Analytical and Research Methodologies: To foster expertise in operating advanced analytical instrumentation (Mass Spectrometry) and applying rigorous biostatistical

	models for accurate data interpretation and experimental design.

Course Outcomes (COs)

CO1	Formulate taxonomic hypotheses using both classical and modern molecular barcoding methods.
CO2	Design and evaluate sustainable Integrated Pest Management (IPM) systems based on deep entomological insights.
CO3	Apply geospatial tools (GIS) and ecological field methodologies to resolve practical wildlife management and conservation issues
CO4	Execute complex molecular biology protocols, including gene editing and high-throughput sequencing data analysis.
CO5	Critique, design, and statistically validate experimental protocols for independent doctoral research

UNIT-I	Biosystematics and Taxonomy: Modern trends in taxonomy—chemotaxonomy, cytotaxonomy, and molecular taxonomy. DNA barcoding and its applications. Evolutionary Biology: Neo-Darwinism, molecular evolution, phylogenetic tree construction (Phylomics), and neutral theory of evolution.
UNIT-II	Insect Diversity and Physiology: Insect classification up to family level for major orders. Physiology of insect respiration, excretion, and endocrine regulation. Pest Management: Integrated Pest Management (IPM) strategies. Molecular mechanisms of insecticide resistance. Biopesticides and transgenic pest-resistant crops (Bt cotton). Vector Biology: Biology and control of insect vectors transmitting human diseases (Malaria, Dengue, Zika).
UNIT- III	Population Ecology: Population dynamics, carrying capacity, population dynamics. Conservation Strategies: In-situ and ex-situ conservation. Protected Area Networks (Biosphere reserves, National Parks, and Sanctuaries).Wildlife Management Techniques: Modern tools in wildlife monitoring—camera trapping, radio telemetry, and GIS applications. Human-wildlife conflict mitigation.
UNIT- IV	Advanced Transcription & Translation: Chromatin remodeling, transcriptional regulation in eukaryotes, post-transcriptional modifications (RNA splicing, editing, miRNA, siRNA interference). DNA Repair & Recombination: Mechanisms of DNA damage, repair pathways (BER, NER, MMR, and DSBR), and homologous recombination. Genomics and Proteomics: Functional genomics, comparative genomics, and high-throughput proteomics techniques (Mass Spectrometry, Maldi-TOF).
UNIT - V	Molecular Techniques: Polymerase Chain Reaction (RT-PCR, qPCR), Next-Generation Sequencing (NGS), and CRISPR-Cas9 genome editing. Analytical Techniques: Chromatography (HPLC, GC-MS), Gel Electrophoresis (2D-PAGE), and Flow cytometry. Biostatistics: Experimental design, ANOVA, regression analysis, and use of statistical software (R/SPSS) in zoological research.

Reference/Text Books

1 Kardong, K.V. Vertebrates: Comparative Anatomy, Function, Evolution. McGraw-Hill. Hill, R.W., Wyse, G.A., & Anderson, M. Animal Physiology. Sinauer Associates. Mayr, E. & Ashlock, P.D. Principles of Systematic Zoology. McGraw-Hill.

2 Chapman, R.F. The Insects: Structure and Function. Cambridge University Press.

3 Gullan, P.J. & Cranston, P.S. The Insects: An Outline of Entomology. Wiley-lackwell

4 Pedigo, L.P. & Rice, M.E. Entomology and Pest Management. Prentice Hall.

5 Sinclair, A.R.E., Fryxell, J.M., & Caughley, G. Wildlife Ecology, Conservation, and Management. Wiley-Blackwell.

6 Primack, R.B. Essentials of Conservation Biology. Sinauer Associates. Silvy, N.J. The

Wildlife Techniques Manual. Johns Hopkins University Press.
7 Watson, J.D. et al. Molecular Biology of the Gene. Cold Spring Harbor Laboratory Press.
8 Alberts, B. et al. Molecular Biology of the Cell. Garland Science.
9 Sambrook, J. & Green, M.R. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press. Zar, J.H. Biostatistical Analysis. Pearson Education.

PHZO102- Tools and Technologies for Zoological Research

Course objectives

1	To introduce students to the fundamental principles and applications of various laboratory instruments used in zoological research
2	To provide hands-on understanding of histological, immunological, and molecular biology techniques
3	To equip students with the skills required for sample preparation, microscopy, and data collection
4	To foster critical thinking regarding the selection of appropriate analytical tools for specific biological questions
5	To familiarize students with ethical guidelines, biosafety, and computational tools in modern zoology.

Course Outcomes (COs)

CO1	Operate and maintain basic and advanced laboratory equipment (microscopes, centrifuges, spectrophotometers) safely and efficiently.
CO2	Prepare and analyze biological samples using microtomy, histochemical staining, and chromatography.
CO3	Apply molecular and immunological techniques like PCR, gel electrophoresis, and ELISA in diagnostic and research contexts.
CO4	Demonstrate an understanding of radioisotopes, biosafety levels, and ethical treatment of laboratory animals
CO5	Utilize basic bioinformatics tools for sequence analysis and biological data interpretation

UNIT-I	Principles of Optics: Light properties, magnification, resolution, numerical aperture, and limit of resolution. Light Microscopy: Principles, construction, and applications of Bright field, Dark field, Phase-contrast, and Fluorescence microscopy. Advanced Electron Microscopy: Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) – principle, sample preparation (fixation,dehydration, shadowing), and applications. Modern Imaging: Introduction to Confocal microscopy and Live-cell imaging
UNIT-II	Centrifugation: Basic principles of sedimentation, types of rotors. Differential, density-gradient, and ultracentrifugation. Chromatography: Principle, instrumentation, and applications of Paper, Thin-Layer (TLC), Column, Ion-exchange, Gas-Liquid (GLC), and High-Performance Liquid Chromatography (HPLC). Electrophoresis: General principles. Agarose gel electrophoresis (for DNA/RNA) and Polyacrylamide Gel Electrophoresis (native and SDS-PAGE for proteins).
UNIT- III	Sample Preparation: Methods of collection, preservation, and fixation of animal tissues. Common fixatives (Formalin, Bouin& fluid). Microtomy: Dehydration, clearing, embedding, block-making, sectioning (rotary microtome), and ribbon preparation. Staining Techniques: Theory of staining. Routine Hematoxylin and Eosin (H&E) staining. Histochemistry: Vital stains and specific staining for carbohydrates (PAS), lipids (Sudan Black), and proteins.
UNIT- IV	Spectroscopy: Beer-Lambert Law. Principle, instrumentation, and quantification of

	biomolecules using UV-Visible Spectrophotometry. Molecular Biology Tools: Polymerase Chain Reaction (PCR) – principle, types (RT- PCR, qPCR), and applications. DNA sequencing methods (Sanger method). Immunological Assays: Antigen-antibody interactions. Principles and applications of ELISA (Direct, Indirect, Sandwich), Western Blotting, and Immunohistochemistry (IHC)
UNIT -V	Biostatistics: Collection of data, sampling methods. Measures of central tendency (Mean, Median, Mode) and dispersion (Standard Deviation, Standard Error). Introduction to hypothesis testing (t-test, Chi-square test). Bioinformatics: Introduction to biological databases (NCBI, PubMed, GenBank, UniProt). Basic sequence alignment using BLAST.Biosafety and Ethics: Biosafety levels (BSL 1–4). Radiation safety and handling of radioisotopes. Ethical guidelines for animal handling and care in zoological research (CPCSEA guidelines).

Reference/Text Books

1 Boyer, R. (2012). Biochemistry Laboratory: Modern Theory and Techniques (2nd Edition). Pearson.

2 Ghatak, K. L. (2011). Techniques and Methods in Biology. PHI Learning Pvt. Ltd.

3 Plummer, D. T. (2001). An Introduction to Practical

4 Marimuthu, R. (2019). Microscopy and Microtechnique. MJP Publishers.

5 Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology (7th Edition). Cambridge University Press.

6 Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics.
Blackwell Publishing.

PHGI101- Geo-informatics in Regional and Urban Planning

Course objectives

1	Understand the principles and applications of remote sensing in urban studies.
2	Develop skills in image interpretation and digital image processing techniques.
3	Learn methods for urban land use and land cover mapping.
4	Apply GIS and remote sensing tools in urban and regional planning.
5	Analyze urban growth, transportation systems, and spatial decision-making processes.

Course Outcomes (COs)

CO1	Explain the fundamentals of remote sensing and image processing techniques
CO2	Analyze urban land use, settlement patterns, and land cover changes using remote sensing data.
CO3	Apply GIS and remote sensing tools for urban planning and infrastructure assessment
CO4	Evaluate urban growth models, transportation networks, and spatial planning strategies.
CO5	Develop geospatial solutions for sustainable urban development and decision-making.

UNIT-I	Fundamentals of Remote Sensing: Introduction to Remote Sensing for detection of urban features; scale and resolution; scope and limitations of remote sensing; interpretation of aerial photographs and satellite imagery; digital image processing techniques; image fusion; applications and case studies.
UNIT-II	Urban Land Use and Settlement Analysis: Classification of settlements and settlement structure; segmentation of built-up areas; classification algorithms; land use and land cover (LULC) mapping; change detection techniques; high-resolution remote sensing applications; relevant case studies.
UNIT- III	GIS Applications in Urban Planning: Urban morphology and housing typology;

	population estimation using remote sensing; infrastructure demand analysis; urban renewal and land suitability analysis; plan formulation at regional, master, and detailed development levels; use of Remote Sensing and GIS in plan preparation; urban information systems; Web GIS applications; case studies.
UNIT- IV	Urban Growth Modeling and Transportation Planning: Urban growth modeling; expert systems in planning; 3D city models;
UNIT -V	Airborne Laser Terrain Mapping (ALTM); land use–transportation interaction models; intelligent transportation systems (ITS); transportation network mapping and classification; optimum and shortest route analysis; applications and case studies.

Reference/Text Books

1. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.
2. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003.
3. Paul Longley, Michael Batty, Spatial Analysis: Modeling in a GIS Environment Wiley,1997.
4. Michael F. Goodchild, Louis T. Steyaert , Bradley O. Parks, Carol Johnston, David Maidment, Michael Crane , Sandi Glendinning, GIS and Environmental Modeling: Progress and Research Issues (Hardcover) by,Publisher: Wiley; 1 edition, 1996.
5. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007

School of Management Studies

PHMG101. Contemporary Developments in Business Management

Course Objectives

1	To understand the concepts and principles of contemporary management.
2	To examine the impact of globalization and international business trends on organizations.
3	To explore the role of digital technologies, AI, and innovation in modern management.
4	To develop an understanding of sustainability, ethics, and corporate governance in business.
5	To analyze contemporary leadership approaches and their application in dynamic organizational environments.

Course Outcomes (COs)

CO1	Understand and critically evaluate contemporary issues affecting business management
CO2	Analyze the impact of globalization, technology, sustainability, and innovation on managerial practices.
CO3	Apply modern management strategies to real-world organizational problems.
CO4	Anticipate and respond to emerging business trends.
CO5	Demonstrate contemporary leadership skills, including transformational, servant, and remote leadership, to effectively manage diverse and dynamic workplaces.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Introduction to Contemporary Management, Overview of traditional vs. modern management, Forces shaping contemporary business environments, Role of the manager today.
UNIT-II	Globalization and International Business Trends, Global economic shifts, Cross-cultural management, Managing global supply chains and remote teams

UNIT- III	Technological Advancements in Management, Digital transformation and Industry 4.0, Artificial Intelligence and data-driven decision making, Automation and its impact on workforce management.
UNIT- IV	Sustainability and Ethical Management,Corporate social responsibility (CSR),ESG (Environmental, Social, Governance) frameworks, Ethical leadership and stakeholder management.
UNIT - V	Contemporary Leadership Styles, Servant leadership, transformational leadership, etc. Emotional intelligence in leadership, Remote and hybrid leadership challenges.

Reference/Text Books

1 Contemporary Management, McGraw-Hill Education (Latest Edition).
2 Strategic Management and Competitive Advantage, Pearson Education (Latest Edition).
3 Artificial Intelligence for Business, McGraw-Hill Education.
4 Leadership: Theory and Practice, Sage Publications.

PHMG102 Contemporary Issues in Management

Course Objectives

Course Outcomes (COs)

CO1	Critically evaluate contemporary management issues and disruptions.
CO2	Analyze the impact of globalization, AI, sustainability, and digital transformation across business functions.
CO3	Apply interdisciplinary management strategies to complex organizational problems.
CO4	Anticipate emerging trends in markets, workforce, and financial systems.
CO5	Assess leadership approaches in technology-driven and dynamic environments.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Introduction to Contemporary Management: Evolution to agile and data-driven management, Business environment forces and managerial roles,Integrated perspective: marketing, HR, finance
UNIT-II	Globalization & Markets: Global economic shifts and digital markets, International marketing and consumer behavior, Cross-cultural HR and global talent, Global finance and supply chains
UNIT- III	Technology & Functional Integration, AI, analytics, and digital transformation, Marketing analytics and digital platforms, HR analytics, hybrid work, gig economy, FinTech, blockchain, and automation
UNIT- IV	Sustainability & Governance, CSR, ESG, and sustainable finance, Green marketing and ethical practices,DEI, corporate governance, stakeholdersClimate risk, circular economy, and long-term value creation
UNIT - V	Leadership & Transformation, Transformational, servant, and digital leadership,Innovation, design thinking, agility, Strategic roles in marketing, HR, finance, Future-ready and resilient organizations

Reference/Text Books

1 Drucker, P. F. – Management Challenges for the 21st Century, Harper Business.
2 Porter, M. E. – Competitive Advantage*, Free Press.

3	Brynjolfsson, E. & McAfee, A. – The Second Machine Age, W.W. Norton.
4	Kaplan, R. S. & Norton, D. P. – The Balanced Scorecard, Harvard Business Review Press.
5	Armstrong, M. – Armstrong's Handbook of Human Resource Management Practice, Kogan Page.
6	Brigham, E. F. & Ehrhardt, M. C. – Financial Management: Theory & Practice, Cengage.

School of Legal Studies

PHLS101- Constitutional Law

Course objectives

1	To understand the Constitution of India by examining its historical evolution, nature, classification, salient features, and the functioning of the Constituent Assembly.
2	To develop a comprehensive understanding of Fundamental Rights and Citizenship, including the significance of the Preamble, constitutional rights, and the relationship between Human Rights and Fundamental Rights.
3	To analyze constitutional guarantees of equality, freedom, and personal liberty by interpreting key constitutional provisions and landmark judicial principles relating to Articles 14–22.
4	To examine constitutional protections relating to religion, exploitation, and minority rights, and evaluate the constitutional balance between individual freedoms and the powers of the State.
5	To understand the constitutional mechanisms for enforcement of rights, including writ jurisdiction, Public Interest Litigation (PIL), and the roles of Articles 32, 226, and 136 in protecting constitutional governance.

Course Outcomes (COs)

CO1	Explain the historical background, nature, salient features, and constitutional framework of the Indian Constitution and its significance in democratic governance.
CO2	Interpret the constitutional provisions relating to the Preamble, Citizenship, Fundamental Rights, and Human Rights, and evaluate their relevance in contemporary India.
CO3	Apply constitutional principles relating to equality, freedom, personal liberty, education, and preventive detention to legal and practical situations using judicial precedents.
CO4	Assess the constitutional provisions concerning religious freedom, secularism, protection against exploitation, and cultural and educational rights of minorities in light of constitutional values and judicial interpretation.
CO5	Demonstrate an understanding of constitutional remedies by analyzing the scope and significance of writs, Public Interest Litigation, and the jurisdictions under Articles 32, 226, and 136 for the protection and enforcement of Fundamental Rights.

UNIT-I	Introduction: Meaning and Significance of Constitution Classification of Constitution Nature of Indian Constitution Historical Background - Government of India Act, Constituent Assembly etc. Salient Features of Indian Constitution
UNIT-II	Preamble: Nature and Significance Citizenship under Indian Constitution -Person vis-s-vis Citizen Rights- Meaning, Nature and Classification Fundamental Rights- Meaning, Nature and Significance Relationship of Human Rights and Fundamental Rights.
UNIT- III	Right to Equality: Concept and Significance-Equality Before Law and Equal Protection of Law Test of reasonable classification-Judicial Interpretation Equality in Public

	Employment Freedoms and Restrictions under Art.19 Protection against Ex-post facto law Right to Life and Personal Liberty Right to Education Protection against Arrest and Preventive Detention.
UNIT- IV	Right Against Exploitation: Prohibition of Forced Labour& Child Labour Right to Religion: Concept of Secularism Religious Freedom to Individual and Religious Denominations Restrictions on Right to Religion-State Responsibility in the Matters of Religion Cultural and Educational Rights - Right to Minorities , Minority- Meaning and Nature Protection against Arrest and Preventive Detention
UNIT - V	Right to Constitutional Remedies: Rights and Remedy- The RelationshipArt.32 Meaning, Nature and Significance- Writs under Art.32 Public Interest Litigation- Art.226- Nature and its Relation with Art.32 Art.136- Special Leave Petitions

Reference/Text Books

1 M. P. Jain, Indian Constitutional Law, 9th Ed., LexisNexis, 2025.
2 V. N. Shukla (Revised by Mahendra Pal Singh), Constitution of India, 14th Ed., Eastern Book Company, 2025.
3 J. N. Pandey, Constitutional Law of India, 62nd Ed., Central Law Agency, 2025.
4 D. D. Basu, Introduction to the Constitution of India, Latest Edition, LexisNexis.
5 D. D. Basu, Commentary on the Constitution of India, Latest Edition.
6 H. M. Seervai, Constitutional Law of India, Latest Available Edition.
7 The Constitution of India (Bare Act), Latest Updated Edition (Universal/EBC/Commercial Law Publishers).

PHLS-102-Environmental Law

Course objectives

1	To understand the fundamental concepts, principles, and evolution of Environmental Law at the national and international levels, including sustainable development and environmental governance.
2	To develop knowledge of various forms of environmental pollution, their causes, impacts, and the legal framework for prevention, control, and environmental protection in India.
3	To examine the constitutional provisions, judicial interventions, and statutory mechanisms that safeguard environmental rights and promote environmental justice.
4	To analyze the legal framework governing the conservation and sustainable management of natural resources, forests, wildlife, wetlands, and water resources.
5	To evaluate the significance of biodiversity conservation, Environmental Impact Assessment (EIA), and the relationship between biological diversity, intellectual property rights, and sustainable development.

Course Outcomes (COs)

CO1	Explain the basic principles, concepts, and international developments in Environmental Law, including major environmental conferences and conventions.
CO2	Interpret and apply the legal provisions relating to water, air, and noise pollution, as well as the Environment (Protection) Act and other environmental legislations.
CO3	Analyze constitutional provisions, landmark judicial decisions, and pollution control laws for the protection and enforcement of environmental rights in India.

CO4	Assess the legal framework for the conservation and sustainable utilization of natural resources, forests, wildlife, wetlands, freshwater, and groundwater.:
CO5	Critically evaluate laws and policies relating to biodiversity conservation, Environmental Impact Assessment (EIA), and the interface between biological diversity and intellectual property rights to promote sustainable environmental management.

UNIT-I	**Introduction** a.Guiding principle: Intergenerational equity, Polluter Pays Principles, Public Trust Doctrines, Sustainable Development. b. International Environmental Conferences: from Stockholm to WSSD. c. International Conventions.
UNIT-II	Types of Pollution a. Water Pollution b. Air Pollution c. Noise Pollution d. Environment Protection Act
UNIT- III	Legal Provisions regarding protection of Environmental laws a. Provisions for protection of Environmental rights under Indian Constitution b. Role of Judiciary in Protecting Environment c. Pollution Control Laws in India
UNIT- IV	Natural Resources a. Law Relating to Natural Resources. b. Protection of wild life and wet lands c. Forest Conservation d. Conservation of freshwater and ground water.
UNIT - V	Bio-Diversity a. Conservation of Bio-Diversity b. Biological Diversity and Intellectual Property Rights c. Environment Impact Assessment

Reference/Text Books

1. Environmental Law – Shyam Divan & Armin Rosencranz (Oxford University Press, 3rd ed., 2022).
2. International Environmental Law – Philippe Sands et al. (Cambridge University Press, 4th ed.).
3. Rosencranz Armin & Divan Shyam; Environmental Law & Policy in India: Cases,
4. World Commission on Environment and Development, (Our Common Future)
5. Cullet Philippe, intellectual Property rights and Sustainable Development

School of Agriculture Science & Technology

PHAG103- Advanced Principles and Practices of Agriculture

Course Objectives:

1	Analyze crop-environment interactions
2	Implement precision agriculture technologies
3	Manage soil health and nutrient dynamics

4	Optimize soil-water systems
5	Integrate biotechnology for climate resilience &Develop regenerative farming models

Course Outcomes (COs)

CO1	Analyze crop–environment interactions, yield physiology, canopy architecture, and physiological responses of crops to biotic and abiotic stresses.
CO2	Apply precision agriculture technologies, including GIS, GPS, remote sensing, IoT, drones, automation, nanotechnology, and data-driven approaches for efficient crop production.
CO3	Evaluate soil health, nutrient transformations, integrated nutrient management, and site-specific nutrient management practices for sustainable soil fertility and crop productivity.
CO5	Apply advanced soil–water–plant relationship concepts, micro-irrigation, fertigation, deficit irrigation, drainage, watershed management, and water conservation techniques for efficient water management.
CO5	Integrate biotechnology, stress-resilient crop production, conservation agriculture, regenerative agriculture, organic/natural farming, and circular bioeconomy approaches to develop climate-resilient and sustainable farming systems.

UNIT-I	Crop Ecology and Yield Physiology Crop-Environment Modeling: Environmental factors limiting crop yield; quantitative agro-biological principles. Yield Laws: Validity of Mitscherlich's yield equation and the inverse yield nitrogen law. Stress Physiology: Molecular and physiological mechanism of plants under biotic and abiotic stressors (drought, salinity, waterlogging, extreme temperatures). Canopy Architecture: Optimization of plant population geometry for solar energy harvesting
UNIT-II	Precision Agriculture, Geoinformatics and Nanotechnology Spatial Diagnostics: Geographic Information Systems (GIS), Global Positioning Systems (GPS), and remote sensing applications. IoT& Automation: Real-time sensor networks for soil moisture monitoring, automated micro-irrigation, and drone-assisted pest detection. Emerging Culture Systems: Hydroponics, aeroponics, vertical farming, robotics, and controlled-environment agriculture (CEA). Big Data in Farming: Predictive modeling, crop weather forecasting, and machine learning for yield prediction.
UNIT- III	Soil health & Nutrient Dynamics

	Advanced Soil Chemistry: Nutrient transformations, transport mechanisms, and dynamics in soil-root interfaces. Integrated Nutrient Management (INM):Synchronizing commercial chemical fertilizers with organic amendments, bio-fertilizers, and bio-fortification methods. Precision Nutrition: Site-specific nutrient management (SSNM) and foliage/sensor-guided variable rate fertilizer applications. Remediation: Reclamation and management strategies for problematic soils (acidic, saline-sodic, and waterlogged terrains).
UNIT- IV	Soil-Water relationship and Irrigation Management Soil-Water-Plant Relationship: Thermodynamics of soil moisture, water absorption pathways, and crop transpiration indices. Micro-Irrigation: Sub-surface drip, automated sprinkler systems, fertigation, and deficit irrigation strategies. Drainage & Conservation: Watershed management, rainwater harvesting, and drainage system designs for flood-prone or waterlogged zones.
UNIT - V	Environmental Stress and Biotechnology Genetically Modified (GM) Crops & Seeds: The role of GM crops, global warming implications, and advanced seed production and certification technologies. Stress Physiology: The physiological principles of crop production under environmental stress (such as dryland conditions) and strategies for competitive advantage in intercropping.
UNIT VI	Conservation Agriculture Conservation Agriculture (CA): Long-term impacts of zero-tillage, residue management, and complex crop rotations on soil physics and weed population dynamics. Regenerative Agriculture: Principles of ecological restoration, integrating crop-livestock systems, and circular bioeconomy concepts on the farm.

School of Arts & Humanities

PHGE101- Applied Geography

1	Understand the principles of applied hydrology and their role in water resource planning and management.
2	Analyze major environmental pollution issues and strategies for sustainable environmental management.

3	Apply Remote Sensing and GIS techniques for geographical data analysis and research.
4	Examine the relationship between population dynamics and socio-economic development.
5	Understand the significance of human resource development with emphasis on women empowerment and global perspectives.

Course objectives

Course Outcomes (COs)

CO1	Explain the concepts of applied hydrology and evaluate water resource management Issues.
CO2	Analyze environmental pollution problems and recommend appropriate management strategies.
CO3	Apply Remote Sensing and GIS tools for spatial data analysis and geographical research.
CO4	Evaluate the impact of population dynamics on economic development and migration.
CO5	Assess the role of human resource development and women empowerment in sustainable development.

UNIT-I	Applied Hydrology: Hydrological cycle, Urban water crisis, River linking planning.
UNIT-II	Environmental Problems and Strategic Management: River pollution and how to plan for cleanliness of the rivers. Industrial pollution and management. Water and Air pollution.
UNIT- III	Remote Sensing & GIS as tools in Geographical Research: Application of remote sensing and GIS, Data representation and analysis in GIS.
UNIT- IV	Population Dividend: Economic development and population. Migration, immigration and population problems.
UNIT - V	Geography of Human Resource Development: Women empowerment, world human resource development.

Reference/Text Books

1. Schwartz, Franklin W. and Zhang, Hubao 2003. Fundamentals of Ground Water. Wiley Science, Chichester UK.
2. Singh, M. B. 1999. Climatology and Hydrology. Tara Book Agency, Varanasi. (In Hindi)
3. Kumra, V. K. 1982. Kanpur City: A Study in Environmental Pollution, Tara Book Agency,Varanasi
4. Lohani, Bindu N. 1984. Environmental Quality Management, South Asian Publisher, New Delhi
5. Martin, D. 1996. Geographic Information Systems: Socioeconomic Implications. Routledge, London.
6. Reddy, M. A. 2001. Textbook of Remote Sensing and Geographic Information Systems. B. S.Publications., Hyderabad.
7. Prasad, B.K. 2004. Population and Family Life Education. Anmol publications, New Delhi.
8. Ranade, Prabha Shastri 1990. Population Dynamics in India. APH Publishing, New Delhi.
9. Misra, R.P. 2007. Geography of Health: A Treatise on Geography of Life and Death in India. Concept Publishing Company, New Delhi.
10. Nalder, L. 1994. The Hand Book of Human Resource Development. John Wiley and Sons, New York

PHGE102- Trends in Geography

Course objectives

1	Understand the concepts of health geography and analyze fertility, mortality, population growth, and the role of the youth population in development.
2	Examine rural resources, employment opportunities, and strategies for sustainable rural development, including Amrit Krishi.
3	Explore urban geography concepts, evaluate urban population issues, and compare the characteristics of megalopolis and smart cities.
4	Understand contemporary approaches in political geography, regional development, regional organizations, and electoral processes including voting behavior.
5	Analyze the relationship between cultural geography, temple economy, pilgrimage, tourism, consumerism, and environmental and cultural conservation.

Course Outcomes (COs)

CO1	Explain the principles of health geography and assess the impact of fertility, mortality, and population growth in society.
CO2	Analyze rural employment, resource utilization, and sustainable rural development practices, including Amrit Krishi.
CO3	Evaluate urban development concepts, identify urban challenges, and differentiate between megalopolis and smart cities.
CO4	Interpret modern approaches to political geography, regional development, regional organizations, and electoral behavior.
CO5	Assess the role of cultural geography in promoting temple economy, pilgrimage, tourism, and the conservation of natural and cultural heritage.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Geography of Health: TFR and youth system, fertility, mortality and growth of population.
UNIT-II	Rural Geography: Employment and cow resources, local resource and rural development. Amrit Krishi.
UNIT- III	Urban Geography: Smart city a concept of urban development, Urban population and problems. Comparative study of Megalopolis city and smart city.
UNIT- IV	New Approaches of Political Geography and Regional Development and Regional organizations: Free Trade Agreement (FTA), voting behavior study, development of parliament and legislative assembly elections.
UNIT - V	Cultural Geography: Temple economy and Teerthatan, Tourism: consumerism and conservation of nature and cultural teerthatan,

Reference/Text Books

1 Choudhary, B.K., Tuberculosis in India: A Political Ecology Approach, VDM Verlag, 2008.

2 Clark, M., Riben, P. & Nowgesic, E., The association of housing density, isolation and tuberculosis in Canadian First Nations communities, international journal of epidemiology, vol. 31, no. 5, pp. 940-936. 2002.

3 Chauhan, Brij Raj 2009. Rural Life: Grass Roots Perspectives: Based on Field Experiences and Assessment of Published Work over Eight Decades of Intensive Studies in Villages of Uttar Pradesh. Concept Publishing Co., New Delhi.

4 Cloke, Paul J.; Marsden, Terry and Mooney, Patrick H. (eds.) 2006. Handbook of Rural Studies.Sage, London.

5 Dutt, Ashok et. al. 1994. The Asian Cities: Processes of Development, Characteristics and Planning. Geo Journal Library, London.

6 Bhat, L.S. 2003. Micro Planning: A Case Study of Karnal Area. KB Publications., New Delhi.
7 Datta, B. 1997. Indian Planning at Crossroad, OUP
8 Singh, Rana P.B. and Rana, Pravin S. 2009. Banaras Region: a Spiritual and Cultural Guide. Indica Books, Varanasi. 2nd Ed.
9 Singh, S.N. 1986. Geography of Tourism and Recreation with special reference to Varanasi. Inter-India Publ., New Delhi.

PHSO101- Perspectives in Indian Sociology

Course objectives

1	Develop an advanced perspective in Indian Society.
2	This course deals with an understanding of various theoretical approaches.
3	To understand change in cultural and societal value systems.
4	Evaluate Socio-Economic Change in India and Rajasthan.
5	To identify the planning and development for social Issues.

Course Outcomes (COs)

CO1	It emphasizes textual rules of Indian Society.
CO2	It reveals a highly fragmented system of thousands of localized, competing sub-castes transition from the traditional Jajmani system.
CO3	To keep property and relationships within the family group. Kinship terms are symmetrical. expanded the service sector .
CO4	Created a consumption-driven middle class, but also widened the rural-urban income gap.
CO5	To understand Indian society and their functional for issues.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Social structure and Function: Varna and Caste (Book view and Field View); Social Mobility and Indian society, Rural changing pattern in Society,
UNIT-II	Family and Household in India: Marriage and Kinship: (Regional, cultural and social implications)
UNIT- III	Socio-Economic change in India and Rajasthan: Colonial and post-colonial,
UNIT- IV	social Reforms Movements in India: Religious Movements, Peasant movements
UNIT - V	Education and Tribal development areas: Empowerment of the women's by the Government planning and issues

Reference/Text Books

1 Appadurai, Arjun. 1997. Modernity At Large : Cultural Dimensions of Globalization. New Delhi : OUP
2 Desai, A.R. 1985. India's Path of Development: A Marxist Approach. Bombay: Popular Prakashan.
3 Shah, A.M., The Family in India
4 Singh, Yogendra., 1974, Modernization of Indian Tradition, Rawat Publications,Jaipur
5 Harrison, D. 1989. The Sociology of Modernization and Development. New Delhi, OUP
6 Moor, Wilbert and Robert Cook. 1967. Social Change New Delhi: Prentice-Hall(India).
7 Sharma, SL 1980. "Criteria of Social Development", Journal of Social Action. Jan-Mar
8 Sharma SL 1986. Development: Socio-Cultural Dimensions. Jaipur: Rawat.(Chapter

1).
9 Srinivas, M.N. 1966. Social Change in Modern India. Berkley: University of Berkley.
10 Giddens, Anthony. 1990. The Consequences of Modernity, Cambridge : Polity Press.

PHSO102- Sociology of Crime and Deviance

Course objectives

1	This course tries to familiarize students with the sociological perspectives on crime .
2	The course having the objective to make understanding of students on the social-structural aspects of criminal behavior
3	To understand the various forms correction and punishment
4	New area to explore societal change.
5	To form the rules and laws of society.

Course Outcomes (COs)

CO1	Trace the historical evolution of criminological thought.
CO2	Evaluate contemporary and recent criminological paradigms.
CO3	To examine of Profile changing demographics of Indian criminals.
CO4	How statutory updates impact modern sentencing .
CO5	Propose reforms for human institutional management

After successful completion of the course, the research scholars will be able to:

UNIT-I	Concept of Sociology of Crime: Meaning, Scope & Subject Matter , Conceptual approaches to Crime, Deviance and Criminology.
UNIT-II	History and Development of Criminological Thoughts (Pre-Classical, Classical and Neo Classical approaches of crime, Typological,Ecological, Geographical and Sociological Theories of Criminology) Recent trends in Crime and deviance Theories
UNIT- III	Types of Crime: Changing Socio-economic profile of criminal in contemporary society,Changing profile of crime and criminals.
UNIT- IV	Penology & Victimology: Conceptual approaches: Theories of Punishment,New Criminal Laws (BNS, BNSS,BSA) in India
UNIT - V	Correction and Reforms: significance of Correction, Forms of Correction, institution & community based Correction, Relation and impact of family & community in Correction

Reference/Text Books

1 Bedi, Kiran. 1998. It is Always Possible. New Delhi : Sterling Publications Pvt. Ltd.
2 Goel, Rakesh M. and Manohar S. Powar. 1994. Computer Crime : Concept,Control and Prevention. Bombay : Sysman Computers Pvt. Ltd.
3 Makkar, S.P. Singh and Paul C. Friday. 1993 Global perspectives in Criminology. Jalandhar : ABC Publications.
4 Ministry of Home Affairs. 1998. Crime in India. New Delhi : Government of India.
5 Shankardas, Rani Dhavan, 2000. Punishment and the Prison : India and International Perspective. New Delhi : Sage Publications.
6 Sharma, Shrinath:(ed.).2001.SamajikVyadhiki; Bhapal M.P. Hindi Granth Academy.
7 Sutherland, Edwin H. and Donald R. Cressey. 1968. Principles of Criminology. Bombay : The Times of India Press.

8 Walklete, Sandra. 1998 Understanding Criminology. Philadelphia : Open University Press.
9 Ministry of Home Affairs. Report of the All India Committee on Jail Reforms. 1980-83.New Delhi : Government of India.
10 Revid, Jonathan. 1995. Economic Crime. London, Kejan Paul.
11 UNDP. Governance for Sustainable Human Development.

PHHI 101- आधुनिक चिंतन और साहित्य

Course objectives

1	आधुनिक चिंतन एवं भारतीय नवजागरण की अवधारणाओं को समझना।
2	हिंदी नवजागरण, आधुनिकता एवं उत्तर आधुनिकतावाद का विश्लेषण करना।
3	गांधीवादी एवं मार्क्सवादी साहित्य चिंतन का मूल्यांकन करना।
4	अस्मितामूलक विमर्शों के साहित्यिक स्वरूप एवं महत्त्व का अध्ययन करना।
5	हिंदी साहित्य में समकालीन वैचारिक प्रवृत्तियों की पहचान एवं व्याख्या करना।

Course Outcomes (COs)

CO1	आधुनिक चिंतन की प्रमुख अवधारणाओं, प्रवृत्तियों और साहित्यिक संदर्भों की व्याख्या कर सकेंगे।
CO2	भारतीय नवजागरण और हिंदी नवजागरण के सामाजिक-सांस्कृतिक आधार तथा साहित्यिक योगदान का आलोचनात्मक मूल्यांकन कर सकेंगे।
CO3	आधुनिकता, आधुनिकतावाद और उत्तर-आधुनिकतावाद के सिद्धांतों की तुलना करते हुए हिंदी साहित्यिक पाठों का विश्लेषण कर सकेंगे।
CO4	गांधीवाद और मार्क्सवाद के वैचारिक पक्षों को समझते हुए हिंदी साहित्य में उनके प्रभाव, प्रतिरोध और पुनर्पाठ का विवेचन कर सकेंगे।
CO5	स्त्री, दलित और आदिवासी विमर्शों के माध्यम से अस्मिता, सत्ता, सामाजिक न्याय, प्रतिनिधित्व और प्रतिरोध से जुड़े साहित्यिक प्रश्नों का विश्लेषण कर सकेंगे।

UNIT-I	आधुनिक चिंतन और भारतीय नवजागरण का व्यापक परिप्रेक्ष्य
UNIT-II	हिंदी नवजागरण अवधारणा एवं स्वरूप
UNIT- III	आधुनिकता, आधुनिकतावाद और उत्तर आधुनिकतावाद
UNIT- IV	गांधीवादी एवं मार्क्सवादी साहित्य चिंतन
UNIT - V	अस्मितामूलक विमर्श और हिंदी साहित्य

Reference/Text Books

1 शर्मा, रामविलास — भारतीय साहित्य की भूमिका, राजकमल प्रकाशन, नई दिल्ली, 1998।
2 सिंह, नामवर — इतिहास और आलोचना, राजकमल प्रकाशन, नई दिल्ली, 1978।
3 पांडेय, मैनेजर — साहित्य और इतिहास-दृष्टि, वाणी प्रकाशन, नई दिल्ली, 2000।
4 द्विवेदी, हजारीप्रसाद — हिंदी साहित्य की भूमिका, राजकमल प्रकाशन, नई दिल्ली।
5 शुक्ल, रामचंद्र — हिंदी साहित्य का इतिहास, नागरी प्रचारिणी सभा, वाराणसी, 1929
6 मिश्र, शिवकुमार — मार्क्सवादी साहित्य-चिंतन, राजकमल प्रकाशन, नई दिल्ली।
7 शर्मा, रामविलास — मार्क्सवाद और प्रगतिशील साहित्य, वाणी प्रकाशन, नई दिल्ली।
8 सिंह, नामवर — कविता के नए प्रतिमान, राजकमल प्रकाशन, नई दिल्ली, 1968
9 गांधी, मोहनदास करमचंद — सत्य के प्रयोग अथवा आत्मकथा, नवजीवन प्रकाशन मंदिर, अहमदाबाद, 1927–1929
10 आंबेडकर, भीमराव — जाति का विनाश, सम्यक प्रकाशन, नई दिल्ली।
11 वाल्मीकि, ओमप्रकाश — दलित साहित्य का सौंदर्यशास्त्र, राधाकृष्ण प्रकाशन, नई दिल्ली,

2001 ।
12 तुलसीराम — दलित साहित्य का समाजशास्त्र, राधाकृष्ण प्रकाशन, नई दिल्ली।
13 .खेतान, प्रभा — स्त्री उपेक्षिता, राजकमल प्रकाशन, नई दिल्ली।
14 कात्यायनी — स्त्रीवादी साहित्य विमर्श, अनामिका प्रकाशन, नई दिल्ली।
15 पुतुल, निर्मला — नगाड़े की तरह बजते शब्द, भारतीय ज्ञानपीठ, नई दिल्ली।
16 चतुर्वेदी, जगदीश्वर — उत्तर-आधुनिकतावाद, वाणी प्रकाशन, नई दिल्ली।
17 पचौरी, सुधीश — उत्तर-आधुनिकता : कुछ विचार, वाणी प्रकाशन, नई दिल्ली।

PHHI102- भारतीय ज्ञान परंपरा एवं हिंदी साहित्य

Course objectives

1	इस पाठ्यक्रम का उद्देश्य शोधार्थियों को आधुनिक चिंतन की अवधारणा, उसके ऐतिहासिक विकास तथा साहित्य के साथ उसके अंतर्संबंध से परिचित कराना है। इसके अंतर्गत भारतीय नवजागरण एवं हिंदी नवजागरण की सामाजिक, सांस्कृतिक, राजनीतिक और साहित्यिक पृष्ठभूमि का आलोचनात्मक अध्ययन कराया जाएगा। साथ ही आधुनिकता, आधुनिकतावाद और उत्तर-आधुनिकतावाद की प्रमुख अवधारणाओं तथा हिंदी साहित्य पर उनके प्रभावों का विवेचन किया जाएगा। पाठ्यक्रम में गांधीवादी और मार्क्सवादी चिंतन की वैचारिक आधारभूमि एवं हिंदी साहित्य में उनकी अभिव्यक्ति का विश्लेषण भी सम्मिलित होगा। इसके अतिरिक्त स्त्री, दलित, आदिवासी तथा अन्य अस्मितामूलक विमर्शों की वैचारिक संरचना, साहित्यिक अभिव्यक्ति और सामाजिक प्रासंगिकता को समझते हुए शोधार्थियों में आधुनिक हिंदी साहित्य के प्रति आलोचनात्मक, तुलनात्मक तथा शोधपरक दृष्टि विकसित की जाएगी।

Course Outcomes (COs)

CO1	भारतीय ज्ञान परंपरा की अवधारणा, स्वरूप, प्रमुख स्रोतों तथा उसके दार्शनिक, सांस्कृतिक और साहित्यिक आधारों को समझ सकेंगे।
CO2	वैदिक, उपनिषदिक, बौद्ध, जैन, भक्ति और सूफी दार्शनिक परंपराओं के साहित्यिक चेतना से संबंध का आलोचनात्मक विवेचन कर सकेंगे।
CO3	भारतीय काव्यशास्त्र के प्रमुख सिद्धांतों—रस, ध्वनि, अलंकार, रीति, वक्रोक्ति और औचित्य—का हिंदी साहित्य के विविध पाठों के विश्लेषण में प्रयोग कर सकेंगे।
CO4	हिंदी साहित्य के विभिन्न कालों और विधाओं में भारतीय ज्ञान परंपरा के रूपांतरण, निरंतरता तथा परिवर्तनशील स्वरूप का अध्ययन कर सकेंगे।
CO5	भारतीय ज्ञान परंपरा के संदर्भ में स्त्री, दलित, आदिवासी, पर्यावरण, लोक, भाषा, संस्कृति और वैश्वीकरण जैसे समकालीन विमर्शों का तुलनात्मक एवं शोधपरक विश्लेषण कर सकेंगे।

UNIT-I	भारतीय परंपरा अवधारणा स्वरूप और स्त्रोत
UNIT-II	दार्शनिक परंपराएं और साहित्यिक चेतना
UNIT- III	भारतीय काव्यशास्त्र और हिंदी साहित्य
UNIT- IV	हिंदी साहित्य में भारतीय ज्ञान परंपरा का रूपांतरण
UNIT - V	भारतीय ज्ञान परंपरा और समकालीन विमर्श

Reference/Text Books

1 राधाकृष्णन, सर्वपल्ली — भारतीय दर्शन, राजपाल एंड सन्स, नई दिल्ली।
2 उपाध्याय, बलदेव — भारतीय दर्शन, शारदा मंदिर, वाराणसी।
3 राधाकृष्णन, सर्वपल्ली — भारतीय संस्कृति : कुछ विचार, राजपाल एंड सन्स, नई दिल्ली, 2005।
4 द्विवेदी, हजारीप्रसाद — हिंदी साहित्य की भूमिका, राजकमल प्रकाशन, नई दिल्ली, 2024।
5 शुक्ल, रामचंद्र — हिंदी साहित्य का इतिहास, नागरी प्रचारिणी सभा, वाराणसी।
6 सिंह, नामवर — इतिहास और आलोचना, राजकमल प्रकाशन, नई दिल्ली।
7 शर्मा, रामविलास — भारतीय साहित्य की भूमिका, राजकमल प्रकाशन, नई दिल्ली, 1998।

8 नगेंद्र — भारतीय काव्यशास्त्र की भूमिका, नेशनल पब्लिशिंग हाउस, नई दिल्ली ।
9 आनंदवर्धन — ध्वन्यालोक, ज्ञानमंडल लिमिटेड, वाराणसी।
10 भरतमुनि — नाट्यशास्त्र, चौखम्बा संस्कृत संस्थान, वाराणसी।
11 मम्मट — काव्यप्रकाश, चौखम्बा संस्कृत संस्थान, वाराणसी।
12 विश्वनाथ — साहित्यदर्पण।
13 कबीर — बीजक, कबीर शोध संस्थान, वाराणसी।
14 तुलसीदास — रामचरितमानस, गीता प्रेस, गोरखपुर।
15 सूरदास — सूरसागर, नागरी प्रचारिणी सभा, वाराणसी।
1 द्विवेदी, हजारीप्रसाद — कबीर, राजकमल प्रकाशन, नई दिल्ली।
17 भारती, धर्मवीर — मानव मूल्य और साहित्य, भारतीय ज्ञानपीठ, नई दिल्ली।
18 पांडेय, गोविंद चंद्र — भारतीय परंपरा और आधुनिकता, लोकभारती प्रकाशन, प्रयागराज

PHEN101- Advanced Literary Theory and Cultural Studies

Course objectives

1	To introduce researchers to the advanced developments in critical theory and cultural studies from the late twentieth century to the contemporary era.
2	To cultivate a deep epistemological understanding of the intersections between literature, politics, power, and identity.
3	To equip research scholars with the theoretical vocabularies required to interrogate complex literary and cultural texts.
4	To foster critical thinking regarding how margins, spaces, and digital realms rewrite conventional canonical narratives.
5	To train students to apply abstract theoretical paradigms directly to their chosen doctoral research problems.

Course Outcomes (COs)

CO1	Analyze and deconstruct literary texts using advanced post-structuralist and deconstructive interpretive frameworks.
CO2	Evaluate how institutional power structures, ideologies, and hegemonies operate within and shape creative cultural production.
CO3	Formulate research questions that critically engage with postcolonial, subaltern, and diasporic experiences.
CO4	Critique normative configurations of gender and sexuality by applying robust intersectional feminist and queer perspectives.
CO5	Synthesize contemporary theories of space, ecology, and technology to assess modern and postmodern literary landscapes

UNIT-I	Structuralism to Deconstruction and Post-Structuralism, Core Concepts: Language as a system, the signifier and signified, death of the author, logocentrism, difference, binary oppositions, and textual instability. Key Thinkers & Texts: Ferdinand de Saussure, Roland Barthes ("The Death of the Author"),Jacques Derrida ("Structure, Sign, and Play in the Discourse of the Human Sciences"),Michel Foucault ("What is an Author?).
UNIT-II	Ideology, Hegemony, and Power Dynamics, Core Concepts: Base and superstructure, state apparatuses, cultural hegemony, discourse, panopticism, and the archeology of knowledge. Key Thinkers & Texts: Louis Althusser (Ideology and Ideological State Apparatuses), Antonio Gramsci (Selections from Prison Notebooks), Michel Foucault (Selections from Discipline and Punish or The History of Sexuality).

UNIT- III	Postcoloniality, Subalternity, and Diaspora Studies, Core Concepts: Orientalism, mimicry, hybridity, nation and narration, strategic essentialism, subaltern voice, and transnationalism. Key Thinkers & Texts: Edward Said (Introduction to Orientalism), Homi Bhabha (The Commitment to Theory or Mimicry and Man), Gayatri Chakravorty Spivak (Can the Subaltern Speak?), Stuart Hall (Cultural Identity and Diaspora).
UNIT- IV	**Gender, Sexuality, and Queer Paradigms**: **Core Concepts:** The social construction of gender, phallogocentrism, ecriture feminine, gender performativity, intersectionality, and heteronormativity.**Key Thinkers and Texts:** Virginia Woolf (*A Room of One's Own*), Hélène Cixous (*The Laugh of the Medusa*), Judith Butler (*Gender Trouble* – selected chapters), Kimberlé Crenshaw (*Demarginalizing the Intersection of Race and Sex*).
UNIT - V	Spatialities, Ecocriticism, and the Digital Turn, Core Concepts: Anthropocene, environmental ethics, spatial production, hyperreality, digital humanities, and the posthuman condition. Key Thinkers & Texts: Lawrence Buell (The Environmental Imagination), Edward Soja (Thirdspace), Jean Baudrillard (Simulacra and Simulation), N. Katherine Hayles (How We Became Posthuman).

Reference/Text Books

1 Baudrillard, Jean. Simulacra and Simulation. Translated by Sheila Faria Glaser, University of Michigan Press, 1994.

2 Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity. Routledge, Classics Edition, 2006.

3 Derrida, Jacques. Writing and Difference. Translated by Alan Bass, Routledge, 2001.

4 Foucault, Michel. The Foucault Reader. Edited by Paul Rabinow, Vintage Books, 2010.

5 Garrard, Greg. Ecocriticism. 3rd ed., Routledge, 2023.

6 Habib, M.A.R. A History of Literary Criticism and Theory: From Plato to the Present. Wiley-Blackwell, 2008.

7 Leitch, Vincent B., editor. The Norton Anthology of Theory and Criticism. 3rd ed., W. W.Norton & Company, 2018.

8 Loomba, Ania. Colonialism/Postcolonialism. 3rd ed., Routledge, 2015.

9 Waugh, Patricia. Literary Theory and Criticism: An Oxford Guide. Oxford University Press, 2006.

PHEN102- Contemporary Global Literature and Research Methodologies

Course objectives

1	To familiarize research scholars with the shifting paradigms of "World Literature" and the cross-cultural movements of contemporary writing.
2	To instill a thorough understanding of historical realities, traumatic memory, and oral traditions preserved in non-Western creative narratives.
3	To introduce specialized research methodologies, textual tools, and bibliographic practices essential for a doctoral dissertation in English.
4	To guide the student in identifying research gaps through comparative and interdisciplinary literature reviews.
5	To train the scholar in academic integrity, research ethics, and publication mechanics tailored to high-impact indexing bodies.

Course Outcomes (COs)

CO1	Evaluate global texts within their complex geopolitical, translated, and transnational marketplace contexts.

CO2	Critique Eurocentric literary models by integrating Indigenous, Tribal, and Subaltern perspectives into contemporary scholarship.
CO3	Appraise the relationship between historical trauma, cultural memory, and the aesthetic strategies of life writing.
CO4	Employ rigorous literary research methods, archival practices, and digital humanities tools to process qualitative textual data.
CO5	Produce highly ethical, properly cited, and methodologically sound academic research papers suitable for peer-reviewed journal publications.

UNIT-I	Transnational and World Literatures, Core Concepts: Deterritorialization, the global marketplace of literature, the politics of translation, neo-cosmopolitanism, and magic realism. Indicative Contexts & Authors: David Damrosch (What is World Literature?), Pascale Casanova (The World Republic of Letters), select fictional/poetic representations from Latin America, Africa, and Central Asia (e.g., Gabriel García Márquez, Salman Rushdie).
UNIT-II	Indigenous, Tribal, and Subaltern Narratives: Core Concepts: Decolonizing the mind, oral historiography, cultural trauma, systemic erasure, Fourth World literatures, and resistance writing. Indicative Contexts and Authors: Ngũgĩ wa Thiong'o (*Decolonising the Mind*), Alexis Wright, Louise Erdrich, Bama, and Sharankumar Limbale.
UNIT- III	Memory Studies, Trauma, and Life Writing, Core Concepts: Collective memory, postmemory, psychological trauma in literature, testimony, autobiographical truth, and graphic narratives. Indicative Contexts & Authors: Marianne Hirsch (The Generation of Postmemory), Cathy Caruth (Unclaimed Experience: Trauma, Narrative, and History), memory narratives regarding the Holocaust, Partition, or Apartheid.
UNIT- IV	Literary Research Methods and Digital Humanities, Core Concepts: Quantitative vs. qualitative research in humanities, archival research methods, textual scholarship, close reading vs. distant reading, data mining in literature, and text encoding (TEI). Indicative Contexts & Authors: Franco Moretti (Graphs, Maps, Trees), Susan Hockey (Electronic Texts in the Humanities), archival methods and manuscript studies.
UNIT - V	Research Ethics, Academic Writing, and Thesis Mechanics, Core Concepts: Formulating a research proposal, the structural anatomy of a thesis, citation styles (MLA 9th Edition, Chicago Manual of Style), checking for plagiarism, intellectual property rights, and navigating peer-reviewed indexing (Scopus, Web of Science, UGC-CARE). Indicative Contexts & Texts: Modern Language Association (MLA Handbook, 9th edition), publication ethics guidelines (COPE), structuring literature reviews.

Reference/Text Books

1 Altbach, Philip G., and Jamil Salmi, editors. The Road to Academic Excellence. The World Bank, 2011.

2 Caruth, Cathy. Unclaimed Experience: Trauma, Narrative, and History. 20th Anniversary Edition, Johns Hopkins University Press, 2016.

3 Damrosch, David. What Is World Literature? Princeton University Press, 2003.

4 Erll, Astrid. Memory in Culture. Translated by Sara B. Young, Palgrave Macmillan, 2011.

5 Gibaldi, Joseph. MLA Handbook. 9th ed., Modern Language Association of America, 2021.

6 Griffin, Gabriele, editor. Research Methods for English Studies. 2nd ed., Edinburgh University Press, 2013.

7 Harner, James L. Literary Research Guide: An Annotated Listing of Reference Sources in English Literary Studies. 6th ed., Modern Language Association of America, 2014.

8 Moretti, Franco. Graphs, Maps, Trees: Abstract Models for a Literary History. Verso,

2005.
9 Ngũgĩ wa Thiong'o. Decolonising the Mind: The Politics of Language in African Literature. James Currey, 1986 (Reprint editions available).

PHPS101- Advance Research in Public Policy and Governance

Course objectives

1	Develop an advanced understanding of public policy theories and governance paradigms.
2	Examine the policy-making process at national and international levels.
3	Analyze contemporary governance challenges using interdisciplinary approaches.
4	Evaluate public policy implementation and impact assessment techniques.
5	Apply research methodologies to policy analysis and governance studies.

Course Outcomes (COs)

CO1	Critically evaluate major theories of public policy and governance.
CO2	Conduct independent research on public policy issues using appropriate methodologies.
CO3	Assess policy implementation and governance effectiveness through empirical analysis.
CO4	Analyze contemporary governance challenges from comparative and global perspectives.
CO5	Produce research-based policy recommendations supported by theoretical and empirical evidence.

UNIT-I	Foundations of Public Policy: Concept, Nature and Scope of Public Policy Models of Public Policy Analysis
UNIT-II	Governance and Administration: Good Governance: Concept and Principles Digital Governance and E-Governance Role of Civil Society and NGOs in Governance Unit-III Policy Formulation and Implementation: Policy Actors and Institutions
UNIT- III	Policy Implementation Models Policy Monitoring and Evaluation, Public Accountability and Transparency
UNIT- IV	Contemporary Public Policy Issues: Health and Education Policy Social Justice and Inclusive Development Gender-sensitive Public Policies
UNIT - V	Research Applications in Public Policy: Policy Research Design Impact Assessment Techniques Case Study Method

Reference/Text Books

1 Anderson, James E. Public Policymaking.
2 Dye, Thomas R. Understanding Public Policy.
3 Jain, R. B. Public Administration in India: 21st Century Challenges for Good Governance. Deep & Deep Publications, New Delhi.
4 Arora, Ramesh K. & Goyal, Rajni. Indian Public Administration: Institutions and Issues. New Age International Publishers.
5 Pierre, Jon & Peters, B. Guy. Governance, Politics and the State.
6 Denhardt, Janet V. & Denhardt, Robert B. The New Public Service.
7 Dror, Yehezkel. Public Policymaking Reexamined.
8 Chakrabarti, Rajesh & Sanyal, Kaushiki. (2017). Public Policy in India. Oxford University Press, New Delhi.

PHPS102- Contemporary Issues in Indian Politics and International Relations

Course objectives

1	Understand emerging trends in Indian politics and democratic governance.
2	Analyze contemporary debates in international relations.
3	Examine India's foreign policy in changing global contexts.
4	Evaluate regional and global political developments using theoretical perspectives.
5	Develop advanced research skills in comparative politics and international relations.

Course Outcomes (COs)

CO1	Critically analyze contemporary political developments in India.
CO2	Apply major theories of international relations to current global issues.
CO3	Evaluate India's strategic and foreign policy priorities.
CO4	Conduct interdisciplinary research on emerging political and global challenges.
CO5	Produce scholarly research integrating theory, empirical evidence, and policy perspectives.

After successful completion of the course, the research scholars will be able to:

UNIT-I	Contemporary Indian Politics: Electoral Reforms and Electoral Politics Coalition Politics Federalism and Centre-State Relations
UNIT-II	Emerging Issues in Indian Politics: Identity Politics: Caste, Religion and Ethnicity Regionalism and Sub-nationalism Gender and Politics, Social Movements Media, Social Media and Democracy
UNIT- III	Contemporary International Relations: United States–China Strategic Competition Russia and Eurasian Politics, Middle East crisis Strategic Studies, International Conflict Resolution Artificial Intelligence and Global Politics
UNIT- IV	India's Foreign Policy: India, South Asia and Major Powers (USA, China, Russia, European Union) Indo-Pacific Strategy India's Role in Multilateral Organizations (UN, BRICS, G20, SCO)
UNIT - V	Emerging Global Challenges: Policy Research Design Impact Assessment Techniques Case Study Method

Reference/Text Books

1. Heywood, Andrew. Global Politics.
2. Baylis, John, Smith, Steve & Owens, Patricia. The Globalization of World Politics.
3. Rajiv Sikri. Challenge and Strategy: Rethinking India's Foreign Policy.
4. David Malone. Does the Elephant Dance? Contemporary Indian Foreign Policy.
5. Andrew Heywood. Politics.
6. Fadia, B. L. Indian Government and Politics.
7. Kashyap, Subhash C. Our Constitution.
8. Basu, D. D. Introduction to the Constitution of India.
9. Cohen, Stephen P. India: Emerging Power.
10. Ministry of External Affairs, Government of India. Annual Reports (Latest Editions)..
11. SIPRI Yearbook (Latest Edition).
12. United Nations Development Programme (UNDP). Human Development Report (Latest Edition).

PHLM101- Library management

Course objectives

1	To familiarize research scholars with the principles and practices of library management.
2	To develop an understanding of financial management and budgeting in libraries.
3	To impart knowledge of human resource management in academic, public, and special libraries.
4	To understand collection development policies, procedures, and management techniques.
5	To introduce scholars to various management functions required for effective library administration.

Course Outcomes (COs)

CO1	CO1: Explain the concepts, principles, functions, and approaches of library management.
CO2	Apply financial management techniques, budgeting processes, and resource allocation practices in library administration
CO3	CO3: Analyze human resource management functions, including staffing, training, motivation, and performance evaluation in libraries.
CO4	CO4: Evaluate collection development policies, procedures, and management practices in academic, public, and special libraries. .
CO5	CO5: Identify and formulate research problems related to library management and information services by critically examining contemporary issues, challenges, and trends in library and information science

UNIT-I	Library Management: Concept, Definition and Scope. Functions and Principles of Management in Libraries. Library Operations: Selection and Acquisition, Collection Building and Development, Technical Processing, Circulation: Charging and Discharging Systems, Serial Control, Stock Verification, Weeding out. Library Authority and Library Committee. Library Personnel: Job Description, Job Analysis, Job Satisfaction, Job Evaluation. Concept, Elements of TQM. Implementing TQM Techniques in Library and Information Centres, Barriers to Implementing TQM.
UNIT-II	Financial Management in Library : Sources of Finance, Financial and Budget Estimation. Budgeting Techniques. Library Building. Library Rules. Budgeting, Library Statistics. Annual Report. Maintenance, Conservation and Preservation of Library Material.
UNIT- III	Human Resources Management in special libraries: Staffing Pattern-Staff Formula of Ranganathan and UGC Qualifications and payscales, Staff requirements, JobAnalysis, Job Description & Evaluation. Staff recruitment and selection. Performance Appraisal, Training and Development.
UNIT- IV	Collection Development and Management of Books, Serials & Non-book Materials. Collection. DevelopmentPolicy.Collectioncare&evaluation.ProblemsofCollectiondevelopmentinIndia Marketing Management in libraries: Marketing strategy, Marketing approach, Market segmentation, Market research, Marketing mix, Implementing marketing programme and their evaluation, marketing of Information.
UNIT - V	Role of UGC, Study of the recommendations of various committees with regard to academic libraries in India. MIS, Time and Motion Study, SWOT (Strength, Weakness, Opportunities, and Threats).Functions of Academic libraries.Public libraries and Special libraries

Reference/Text Books

1 Knowledge management in organizations: A critical introduction. By D.Hislop , 3rdedi.2013. Oxford University Press, UK
2 Knowledge Management by A.T.Raman.2004.Excel Books,New Delhi

3 Academic Library System & Services by Gurudev singh
4 Academic Library Development by K. Rajasekharan, R. Raman Nair
5 Academic Libraries by C.LaL &Kumar.

PHEO101 ADVANCED MICRO-ECONOMIC ANALYSIS

Course Objectives

1.	To provide an advanced understanding of consumer behaviour, duality theory, utility functions, expenditure functions and demand analysis.
2.	To develop the ability to analyse consumer welfare, income and substitution effects, demand systems, household decision-making and labour supply behaviour.
3.	To explain and evaluate different market structures, including perfect competition, monopoly, monopolistic competition and oligopoly, along with their theoretical models.
4.	To develop an understanding of general equilibrium theory, market failure, asymmetric information, externalities and the provision of public goods.
5.	To familiarize students with welfare economics, Pareto optimality, social welfare functions, and the distinction between social and private costs and benefits for economic analysis and policy formulation.

After successful completion of the course, the research scholars will be able to:

Course Outcomes (COs)-

1.	Explain consumer behaviour, duality theory, expenditure and indirect utility functions, and demand analysis.
2.	Analyse consumer welfare, income and substitution effects, demand models, and household labour supply decisions.
3.	Evaluate different market structures, including perfect competition, monopoly, monopolistic competition and oligopoly models.
4.	Explain general equilibrium theory, market failure, asymmetric information, externalities and public goods.
5.	Apply welfare economics concepts, Pareto optimality, social welfare functions, and social versus private costs and benefits to economic problems.

Unit-I	**Theory of Consumer Behaviour and Demand Analysis-** Theory of consumer behaviour; duality in consumer theory; expenditure function and indirect utility function; measurement of income effect and substitution effect; measurement of changes in consumers' welfare; consumer's surplus, compensating variation and equivalent variation; dynamic versions of demand functions; integrability of demand functions; demand models — Linear Expenditure System (LES) and Almost Ideal Demand System (AIDS).
Unit-II	**Applications of Consumer Theory and Market Structures-** Applications of consumer theory; household model and time allocation; labour supply decisions by households; perfect competition; monopoly; monopolistic competition; oligopoly; collusive and non-collusive models of oligopoly; Cournot model, Chamberlin model and Stackelberg solution.
Unit-III	**General Equilibrium Theory-** General equilibrium theory — conceptual overview; general equilibrium conditions with production and consumption; existence, uniqueness and stability of general competitive equilibrium; Walrasian general equilibrium; mathematical derivation of conditions for general equilibrium.
Unit-IV	**Market Failure and Information Economics-** Market failure; incomplete markets; asymmetric information; principal–agent problem; adverse selection; moral hazard; externalities; network externalities; public goods; optimal provision of public goods.
Unit-V	**Welfare Economics-** Welfare economics — concepts, problems, approaches and limitations; Pareto conditions of maximum welfare; criteria for social welfare; social welfare functions; social versus private costs and benefits.

Suggested Readings

Chiang AC. 1981. Fundamental Methods of Mathematical Economics. McGraw - Hill.

Henderson JM & Quandt RE. Microeconomic Theory: A Mathematical Approach. McGraw-Hill.

Koutsoyiannis A. 2003. Modern Microeconomics. The Macmillan Press.

Kreps DM. 1990. A Course in Microeconomic Theory. Princeton Univ. Press.

Silberberg E & Suen W. 2001. The Structure of Economics - A Mathematical Analysis. McGraw-Hill.

Varian HR. 1992. Microeconomic Analysis. WW Norton & Co.

Varian HR. 1999. Intermediate Microeconomics. Affiliated East-West Press.

PHEO102 ADVANCED MACRO-ECONOMIC ANALYSIS

Course Objectives

1.	To develop an advanced understanding of macroeconomic concepts, Keynesian theory, consumption and saving functions, investment theories, and comparative statics.
2.	To explain the IS–LM framework, money demand and supply, monetary policy, inflation, stagflation, unemployment, and the Phillips Curve.
3.	To explain and evaluate different market structures, including perfect competition, To analyse fiscal policy, Social Accounting Matrix (SAM), general equilibrium analysis, neoclassical macroeconomics, and stochastic macroeconomics.
4.	To develop an understanding of Balance of Payments (BOP), adjustment policies, foreign exchange policy, and current and capital accounts.
5.	To evaluate the impact of WTO, IMF and IBRD on the Indian economy and review macroeconomic policies in India.

After successful completion of the course, the research scholars will be able to:**Course Outcomes (COs)-**

1.	Explain macroeconomic concepts, Keynesian theory, consumption and saving functions, and investment theories.
2.	Analyse the IS–LM framework, monetary policy, inflation, stagflation, unemployment, and Phillips Curve controversy.
3.	Evaluate fiscal policy, Social Accounting Matrix, general equilibrium, neoclassical macroeconomics, and stochastic macroeconomics.
4.	Analyse Balance of Payments, foreign exchange policy, adjustment policies, and current and capital accounts.
5.	Assess the impact of WTO, IMF and IBRD on the Indian economy and evaluate macroeconomic policies in India.

Unit-I	**Review of Macroeconomic Concepts and Theories of Consumption, Saving and Investment-** Review of macroeconomic concepts; comparative statics; Keynesian theory; consumption function and theories of consumption; saving function and theories of saving; theories of investment; equality of saving and investment.

Unit-II	**IS–LM Framework, Monetary Policy, Inflation and Unemployment-** IS–LM framework; demand for and supply of money; monetary policy in the static model; inflation; stagflation and supply-side economics; theory of unemployment; Phillips Curve controversy; inflation, productivity and distribution.
Unit-III	**Fiscal Policy, Social Accounting and General Equilibrium-** Fiscal policy: effectiveness and problems; Social Accounting Matrix (SAM) framework; general equilibrium analysis; neoclassical macroeconomics; stochastic macroeconomics.
Unit-IV	**Balance of Payments and Foreign Exchange Policy-** Balance of Payments (BOP) and adjustment policies; foreign exchange policy; foreign sector: capital account and current account.
Unit-V	**International Institutions and Macroeconomic Policies in India-** Impact of the World Trade Organization (WTO) on the Indian economy; impact of the International Monetary Fund (IMF) and International Bank for Reconstruction and Development (IBRD) on the Indian economy; review of macroeconomic policies in India.

Suggested Readings-

Diulio EA. 2006. Macroeconomics. 4th Ed. Schaums' Outlines.

Frogen RT. 1999. Macro-Economic: Theory and Policies. 6th Ed. Prentice Hall.

Samuelson PA & Nordhaus WD. 2004. Economics. McGraw-Hill.

Shapiro E. 1989. Macro-Economic Analysis. Galgotia Publ.

School of Pharmacy

PHPH101- Pharmaceutics

Course objectives

1	To provide comprehensive knowledge of advanced pharmaceutical analytical techniques and regulatory requirements.
2	To develop an understanding of modern drug delivery technologies and personalized medicines.
3	To impart knowledge of molecular pharmaceutics and nanotechnology-based drug delivery systems.
4	To strengthen understanding of advanced biopharmaceutics, pharmacokinetics and industrial pharmaceutical practices.
5	

Course Outcomes(CO)

CO1	Acquire comprehensive knowledge of advanced pharmaceutical analytical techniques and regulatory frameworks applicable to drug development, approval and post-marketing surveillance.
CO2	Develop the ability to integrate modern drug delivery approaches for improving therapeutic efficacy, patient compliance and targeted drug delivery.
CO3	Demonstrate proficiency in the principles and applications of molecular pharmaceutics, nanotechnology and advanced carrier systems for innovative drug delivery.
CO4	Apply advanced concepts of biopharmaceutics and pharmacokinetics for optimization of drug absorption, distribution and dosage regimen design.
CO5	Develop competency in pharmaceutical formulation optimization, process validation, quality management and industrial technology transfer practices.

UNIT-I	Advanced Analytical and Regulatory Pharmaceutics: Modern Pharmaceutical Analytical Techniques (UV, IR, NMR, MS,Chromatography) Spectrofluorimetry, Flame Emission, AAS, Electrophoresis, X-Ray Crystallography, ELISA, Regulatory Affairs: IND, NDA, ANDA, CTD, eCTD, clinical trial protocols, pharmacovigilance.
UNIT-II	Modern Drug Delivery and Targeted Systems: Sustained, Controlled, Rate-Modulated Delivery Systems (CR/SR), Personalized Medicines, 3D Printing, Bioelectronic Medicines Gastro-retentive, Buccal, Ocular, Transdermal, Protein/Peptide & Vaccine Delivery Systems
UNIT- III	Molecular Pharmaceutics and Nanotechnology, Nanoparticles, liposomes, dendrimers, niosomes, aquasomes, phytosomes, Pulmonary and Intranasal DDS, gene therapy and liposomal gene delivery
UNIT- IV	Biopharmaceutics and Pharmacokinetics, ADME, pH-partition, GI transit, solubility, dissolution, Noyes Whitney, Higuchi, Peppas One- and two-compartment models, IVIVC, PBPK modeling
UNIT - V	Industrial GMP and Formulation Optimization, Validation: IQ/OQ/PQ, Statistical Optimization (DoE, RSM, factorial designs), Compression/compaction physics, Micromeritics, Stability Studies, cGMP, TQM, Scale-up, Tech Transfer, Cleanroom design

Reference/Text Books

1 Skoog, D. A., Holler, F. J., & Nieman, T. A. Principles of Instrumental Analysis. 5th

Edition, Eastern Press, Bangalore, 1998.
2 Silverstein, R. M., Webster, F. X., & Kiemle, D. J. Spectrometric Identification of Organic Compounds. 6th Edition, John Wiley & Sons, 2004.
3 Jain, N. K. Controlled and Novel Drug Delivery. CBS Publishers & Distributors, New Delhi, First Edition, 1997 (Reprint 2001).
4 Vyas, S. P., & Khar, R. K. Controlled Drug Delivery: Concepts and Advances. Vallabh Prakashan, New Delhi, First Edition, 2002.
5 Lachman, L., Lieberman, H. A., & Kanig, J. L. Theory and Practice of Industrial Pharmacy. CBS Publishers.
6 Banker, G. S., & Rhodes, C. T. Modern Pharmaceutics. Marcel Dekker Inc.
7 Berry, I. R., & Martin, R. P. (Eds.) The Pharmaceutical Regulatory Process. 2nd Edition, Informa Healthcare Publishers.
8 Guarino, R. A. New Drug Approval Process: Accelerating Global Registrations. 5th Edition, Drugs and the Pharmaceutical Sciences, Vol. 190.
9 Gibaldi, M. Biopharmaceutics and Clinical Pharmacokinetics. 4th Edition, Lea & Febiger, Philadelphia, 1991.
10 Brahmankar, D. M., & Jaiswal, S. B. Biopharmaceutics and Pharmacokinetics: A Treatise. Vallabh Prakashan, New Delhi.
11 Berry, F. R., & Nash, R. A. Pharmaceutical Process Validation. Marcel Dekker.
12 Swarbrick, J. (Ed.) Encyclopaedia of Pharmaceutical Technology. Marcel Dekker Inc., New York.

PHPH102- Pharmaceutical Quality Assurance

Course objectives

1	To provide comprehensive knowledge of pharmaceutical quality management systems.
2	To develop understanding of regulatory affairs and compliance requirements.
3	To strengthen knowledge of quality assurance in pharmaceutical manufacturing.
4	To impart expertise in Quality by Design (QbD) and pharmaceutical risk management.
5	

Course Outcomes (COs)

CO1	Develop comprehensive knowledge of pharmaceutical quality systems, validation principles and internationally accepted quality standards.
CO2	Demonstrate competency in regulatory compliance, documentation systems and pharmaceutical audit practices.
CO3	Apply quality assurance principles in pharmaceutical manufacturing, technology transfer and environmental control systems.
CO4	Integrate Quality by Design (QbD) concepts and scientific risk management tools for continuous quality improvement in pharmaceutical industries.
CO5	

After successful completion of the course, the research scholars will be able to:

UNIT-I	Quality Management Systems: QMS, TQM, ISO 9001:2015, Six Sigma, ICH Q8–Q12, NABL/GLP, Validation of Analytical Methods, Equipment & Cleaning Validation
UNIT-II	Regulatory Affairs and Audit Compliance, GMP/GDP, Schedule M, USFDA/EMA/MHRA audits, SOPs, MFR/BMR, Change control, deviation handling, CAPA, data integrity
UNIT- III	Pharmaceutical Manufacturing Systems, Technology Transfer, Product Development Lifecycle, Environmental monitoring, cleanroom validation, HVAC qualifications
UNIT- IV	Quality by Design and Risk Assessment, QbD implementation, CPPs, CQAs, Design Space, Risk analysis tools: FMEA, FTA, HACCP, root cause analysis

UNIT - V	

Reference/Text Books

1. Juran JM, DeFeo JA. Juran's Quality Handbook. 6th ed. ASQ Quality Press.
2. Loftus BT, Nash RA. Pharmaceutical Process Validation. 3rd ed. Drugs and the Pharmaceutical Sciences Series. Marcel Dekker Inc.
3. Lachman L, Lieberman HA, Kanig JL. The Theory and Practice of Industrial Pharmacy. 3rd ed. Varghese Publishing House, Mumbai.
4. Chan CC, Lam H, Lee YC, Zhang XM. Analytical Method Validation and Instrument Performance Verification. Wiley-Interscience.
5. Huber L. Validation and Qualification in Analytical Laboratories. Informa Healthcare.
6. Willig SH. Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control. 3rd ed. Marcel Dekker Inc.
7. World Health Organization (WHO). Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials. Vol. I & II. WHO Publications, Geneva.
8. Haider SI. Validation Standard Operating Procedures: A Step-by-Step Guide for Achieving Compliance in the Pharmaceutical, Medical Device, and Biotechnology Industries. CRC Press.
9. Patrevale VV, Disouza JI, Rustum AM. Pharmaceutical Product Development. CRC Press.
10. Okes D. Root Cause Analysis: The Core of Problem Solving and Corrective Action. ASQ Quality Press.
11. International Council for Harmonisation (ICH). ICH Guidelines Q8(R2), Q9(R1), Q10, Q11 and Q12. (Latest versions).
12. The Drugs and Cosmetics Act, 1940 and Rules (including Schedule M) and Indian Pharmacopoeia (Latest Edition).