SANGAM UNIVERSITY
where Aspiration meets Opportunity

SANGAM UNIVERSITY

(Established by Govt. of Raj. vide Act. No.14 of 2012 and Notified by UGC u/s 2(f) of the UGC Act, 1956)
NH-79, Bhilwara Chittor By-Pass,Chittor Road, Bhilwara, PIN-311001
Rajasthan, (INDIA) Phone : +91 1482-297455

Date: - 21st March 2025

Ph.D. Course Work Syllabus (w.e.f. April 2025)

SCHEME OF EXAMINATION OF Ph.D. COURSE WORK

Paper Code	Name of the Paper	Assignment Marks / Internal	Semester Exam Marks/Viva	Total	Contact Hours	Paper Credit	Exam Duration
RES-I	Research Methodology	40	60	100	3 L+1 T	4	3 Hrs.
RES-II	ICT Lab Work / Presentation (Practical)	40	60	100	2 P	2	1 Hr.
RES-IV	Research and Publication Ethics	40	60	100	2 L	2	2 Hrs.
	Elective Subject	40	60	100	3 L+1 T	4	3 Hrs.

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
PHENGG101	PROJECT MANAGEMENT	40	60	100	3 L+1 T	4	3 Hrs.
PHENGG102	ADVANCED ROBOTICS & MECHATRONICS	40	60	100	3 L+1 T	4	3 Hrs.
PHENGG103	MACHINE LEARNING FOR ENGINEERING APPLICATIONS	40	60	100	3 L+1 T	4	3 Hrs.
PHENGG104	APPLIED IOT FOR ENGINEERS	40	60	100	3 L+1 T	4	3 Hrs.
PHCSE101	INTRODUCTION TO MACHINE LEARNING	40	60	100	3 L+1 T	4	3 Hrs.
PHCSE102	ARTIFICIAL INTELLIGENCE	40	60	100	3 L+1 T	4	3 Hrs.
PHCSE103	CYBER SECURITY	40	60	100	3 L+1 T	4	3 Hrs.
PHCSE104	BIG DATA ANALYTICS	40	60	100	3 L+1 T	4	3 Hrs.
PHP101	PHARMACEUTICS	40	60	100	3 L+1 T	4	3 Hrs.
PHP102	PHARMACEUTICAL CHEMISTRY	40	60	100	3 L+1 T	4	3 Hrs.
PHP103	PHARMACOLOGY	40	60	100	3 L+1 T	4	3 Hrs.
PHP104	PHARMACOGNOSY	40	60	100	3 L+1 T	4	3 Hrs.
PHL101	CONSTITUTIONAL LAW	40	60	100	3 L+1 T	4	3 Hrs.
PHMG101	CONTEMPORARY DEVELOPMENTS IN BUSINESS MANAGEMENT	40	60	100	3 L+1 T	4	3 Hrs.
PHAG101	ANIMAL SCIENCE	40	60	100	3 L+1 T	4	3 Hrs.
PHMA101	SPECIAL FUNCTIONS, INTEGRAL TRANSFORMS, AND FRACTIONAL CALCULUS	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
Details syllabus of course work is given below.

PRE. PH. D. COURSEWORK SYLLABUS

Paper-I: Research Methodology

Teaching Scheme	Examination Scheme
Lectures: 04 Hrs/week	Duration: 3 Hrs
	Theory: 100 Marks

Course objectives:

- To understand the role of research methodology in engineering
- To understand literature review process and formulation of a research problem
- To understand data collection methods and basic instrumentation
- To learn various statistical tools for data analysis
- To learn technical writing and communication skills required for research
- To create awareness about intellectual property rights and patents

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 modelling, 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.

Unit-VI: IPR

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, 13th 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. S.D. Sharma, Operational Research, Kedar Nath Ram Nath & Co., 1972
5. B.L. Wadehra, Law relating to patents, trademarks, copyright designs and geographical indications, Universal Law Publishing, 2014.
6. C. R. Kothari, Research Methodology: Methods and Trends, New Age International, 2004

Paper-II: ICT LAB WORK

Teaching scheme
Lectures: 02 Hrs/week

Examination Scheme
Theory: 100 Marks
Duration: 1 Hrs

Unit-I: Word Processing:

Word features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard shortcut, Editing, Previewing, Printing and Formatting a document, Advanced Features of MS Word, Find and replace, using thesaurus, Using Auto-Multiple Functions, Mail Merge, Handling Graphics, tables and Charts, Covering a word Document into various Formats like –Text, Rich Text format, WordPerfect, HTML, PDF etc.

Unit-II: Worksheet:

Excel: Worksheet Basics, working with single and multiple workbooks, working with formula & cell referencing, Auto sum, copying formulae, Absolute & relative addressing, Worksheet with ranges, Formatting of worksheet, Previewing and printing Worksheet, Graphs, and charts, Database, Creating and using Macros, Multiple Worksheets-concepts, creating and using, Data analysis and display.

Unit-III: Presentation:

PowerPoint: Creating Slideshow with animations. Auto Wizard, Creating a blank presentation, auto layout, Screen layout, and views, insert a new slide, applying design template, changing slide layout, reordering and hiding slides, slideshow, and editing custom slide, resizing a textbox, Text Box Properties, Delete a text Box, Bulleted Lists, numbered lists, adding notes , video and audio, Adding text editing options, Formatting text, Replace fonts, Line spacing ,change case spelling check, colour schemes, Adding clip art, Adding an image from a file, Editing graphic, Auto Shapes, WordArt, backgrounds, Action Buttons, Slide Animation, Preview Slide transactions, Slide Show options, Slide Master, Header and Footer, Slide Numbers, Date and Time.

Educational and Research Resources on Net: Encyclopaedia, Wikipedia, On-line Tutorials, and lectures, virtual labs, Open Course-wares, Electronic Journals, E-Books, digital Libraries, and Searching research Information.

Unit-IV: Professional Written Communication:

Students prepare E-mails, Letters, memos, proposals, formal and informal reports, work plans, and progress reports.

Unit-V: Oral Communication:

Impromptu and Extemporaneous methods of delivery. Oral Presentations using visual aids such as handouts, overhead transparencies and presentation software such as PowerPoint.

Elective Subjects

PROJECT MANAGEMENT (PHENGG101)

Unit 1: Advanced Theories of Project Management

- Project management theories and paradigms: Classical, Contingency, and Complexity Theory
- Organizational behaviour in project teams: leadership, motivation, and communication
- Strategic project management and alignment with organizational goals
- Dynamic project management frameworks (Agile, Lean, Scrum, etc.)

Unit 2: Advanced Project Planning and Risk Management

- Advanced scheduling techniques: Monte Carlo simulations, Critical Chain Project Management (CCPM)
- Risk management frameworks: Enterprise Risk Management (ERM), Bayesian Networks
- Risk analysis in uncertain environments (Stochastic modelling)
- Game theory and decision-making under uncertainty in projects

Unit 3: Project Performance Metrics and Financial Analysis

- Multi-criteria decision analysis (MCDA) for project selection
- Advanced cost estimation techniques: Parametric modelling, Artificial Intelligence (AI) in cost prediction
- Financial risk modelling and optimization
- Advanced Earned Value Management (EVM) and its integration with performance management systems

Unit 4: Innovation and Sustainability in Project Management

- Managing innovation in projects: Technology and product innovation cycles
- Sustainable project management practices and metrics (Green Project Management)
- Post-project evaluation and organizational learning
- Research methodology in project management (Qualitative and Quantitative methods, mixed-methods)

ADVANCED ROBOTICS & MECHATRONICS (PHENGG102)

Unit 1: Advanced Kinematics and Dynamics of Robotic Systems

- Nonlinear dynamics of robotic manipulators
- Rigid body motion in robotics: Lie groups and Lie algebras
- Multi-body dynamics and the effects of friction, elasticity, and damping
- Modelling and simulation of robotic systems using advanced mathematical techniques (Lagrangian and Hamiltonian formulations)

Unit 2: Robot Perception and Autonomous Decision Making

- Computer vision for robotics: Deep learning approaches to object recognition
- Simultaneous Localization and Mapping (SLAM) in autonomous robots
- Sensor fusion for robotics: Kalman filters, particle filters, and multi-sensor integration
- Autonomous decision-making frameworks: multi-agent systems, reinforcement learning, and planning algorithms

Unit 3: Advanced Control Systems for Robotics

- Robust and adaptive control techniques in robotic systems
- Model predictive control (MPC) for robotic manipulators
- Fault-tolerant control and control under uncertainty
- Optimal control and real-time control in dynamic environments

Unit 4: Advanced Applications and Future Trends in Robotics & Mechatronics

- Soft robotics: Materials, actuators, and design principles
- Human-robot collaboration and biohybrid systems
- Robotics in industrial IoT and Cyber-Physical Systems (CPS)
- Ethical implications and regulation of autonomous robots in industry and society
- Emerging areas: Quantum robotics, neuromorphic computing for robotics

MACHINE LEARNING FOR ENGINEERING APPLICATIONS (PHENGG103)

Unit 1: Theoretical Foundations of Machine Learning

- Mathematical foundations: Optimization theory, convex analysis, and kernel methods
- Statistical learning theory: VC dimension, PAC learning, generalization bounds
- Deep learning theory: Gradient-based optimization, loss landscapes, and convergence properties
- Model complexity and the bias-variance trade-off in deep models

Unit 2: Advanced Supervised and Unsupervised Learning

- Advanced regression and classification: Support Vector Machines (SVM) with kernels, Ensemble methods (Boosting, Bagging)
- Advanced clustering techniques: Spectral clustering, Hierarchical clustering, Graph-based clustering
- Dimensionality reduction in high-dimensional data: Advanced PCA, ICA, t-SNE, and autoencoders
- Semi-supervised and self-supervised learning

Unit 3: Deep Learning and Neural Networks for Engineering Applications

- Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and their engineering applications
- Transfer learning and domain adaptation for real-world engineering problems
- Generative models: GANs, VAEs, and their applications in design and simulation
- Reinforcement learning: Q-learning, Deep Q-Networks (DQNs), Policy Gradient methods for control systems and robotics

Unit 4: Machine Learning in Engineering and Industrial Applications

- Predictive maintenance using machine learning: Case studies in manufacturing and energy sectors
- ML for optimization in engineering design: Topology optimization, multi-objective optimization
- Large-scale engineering problems: Distributed computing, cloud-based ML
- Research methodology in ML: Model interpretability, ethical challenges, and adversarial robustness

APPLIED IOT FOR ENGINEERS (PHENGG104)

Unit 1: Fundamentals of IoT and Sensor Networks

- Overview of IoT: Definitions, architecture, and key components
- IoT protocols and standards (MQTT, CoAP, HTTP/HTTPS)
- Sensor technologies: Types of sensors, transducers, and actuators for IoT systems
- Wireless sensor networks: Zigbee, LoRaWAN, Bluetooth, and 5G
- Energy-efficient IoT communication strategies
- Challenges in IoT: Scalability, interoperability, and security concerns

Unit 2: IoT System Design and Hardware Integration

- Hardware design for IoT: Microcontrollers (Raspberry Pi, Arduino, ESP32)
- IoT embedded systems: Design considerations, real-time operating systems (RTOS)
- Interface electronics: Analog-to-digital conversion, I2C, SPI, UART communication
- System on Chip (SoC) design for IoT
- Power management and low-power design in IoT systems
- Case study: IoT design in smart agriculture or smart cities

Unit 3: Data Analytics and Cloud Integration for IoT

- Data processing techniques in IoT: Stream processing, time-series analysis
- Cloud computing platforms for IoT: AWS IoT, Microsoft Azure, Google Cloud
- Big Data integration with IoT: Data lakes, distributed databases (NoSQL, Hadoop, Spark)
- Edge computing and Fog computing in IoT systems
- Real-time analytics and event-driven architectures
- Case study: Predictive maintenance using IoT data analytics in manufacturing

Unit 4: Security, Privacy, and Future Trends in IoT

- Security challenges in IoT: Device authentication, data encryption, and secure communication
- Privacy concerns and GDPR compliance in IoT systems
- Blockchain for IoT security: Decentralized trust models
- IoT in Industry 4.0: Automation, robotics, and smart factories
- AI and machine learning in IoT for predictive analytics and optimization
- Future of IoT: 6G, Quantum IoT, and IoT in healthcare, automotive, and smart environments

INTRODUCTION TO MACHINE LEARNING (PHCSE101)

COURSE OBJECTIVE:

By the end of the course, students will be able to understand the basic Concepts and mathematical foundation of Genetic Algorithms and machine learning. Implement and observe the results of Genetic Algorithm based applications. Emphasize the Genetic based machine learning and its applications

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, Model-based Reinforcement Learning, Artificial neural network, Perceptron, Multilayer network, Back propagation, Introduction to Deep learning.

ARTIFICIAL INTELLIGENCE (PHCSE102)

COURSE OBJECTIVE:
The principal object of this course is to give the knowledge of Artificial Intelligence as well as study the basic concept and working of artificial intelligence.

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, Supervised learning, Back propagation algorithm, unsupervised learning Kohonen's top field network & Algorithm
UNIT -IV	Fuzzy logic concepts, Fuzzy relation and membership functions Defuzzufication, Fuzzy controllers Genetic algorithm: concepts, coding, reproduction, crossover, mutation, scaling and fitness

REFERENCE BOOK:

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.

CYBER SECURITY (PHCSE103)

UNIT-I

Introduction to Information Security: Introduction to the unit, Definition of Information Security,

Evolution of Information Security, Basics Principles of Information Security (CIA triad), Terminologies in information security, Latest news in information security

UNIT-II

The importance of Cryptography: Overview of Cryptography & Steganography, Understanding the AES and DSA (overview), Private key and public key Cryptography, RSA and Digital Signature

UNIT-III

Threats and vulnerabilities: Types of Hackers, Hacktivism, Common Threats to the data, Vulnerability and Penetration testing and its tools, Malicious Codes, Back Doors, Spoofing, sniffing, Spam, Social Engineering, Denial of Service and Distributed Denial of Service,

UNIT-IV

Network and email security: Planning for Network Security, TCP/IP and OSI models, Firewalls and its

types, VPNs, and Wireless security, Intrusion Detection and Prevention

BIG DATA ANALYTICS (PHCSE104)

COURSE OBJECTIVE:
Understand the Big Data Platform and its Use cases. Provide an overview of Apache Hadoop Provide HDFS Concepts and Interfacing with HDFS. Understand Map Reduce Jobs. Provide hands on Hodoop Eco System Apply analytics on Structured, Unstructured Data.

UNIT –I	INTRODUCTION TO BIG DATA AND HADOOP : Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache, Analysing, Data with Unix tools, Analysing Data with Hadoop, IBM Big Data, Strategy, Introduction to Infosphere Big Insights and Big Sheets.
UNIT –II	HDFS(Hadoop Distributed File System) : The Design of HDFS, HDFS Concepts, Command Line Interface, Big Data In Enterprise : Problems with traditional large-scale systems, Big Data in enterprise, Comparison with other systems, Hadoop Frame work.
UNIT–III	Introduction To Hadoop :History of Hadoop, Data Storage and Analysis, Hadoop -Setup hadoop -Pseudo mode-Cluster mode-IPv6-Installation of java, hadoop-Configurations of hadoopPig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined, Functions, Data Processing operators.
UNIT -IV	The Hadoop Distributed File System-HDFS Design and Architecture-HDFS Concepts-Interacting HDFS using command line-Interacting HDFS using Java APIs-Dataflow-Blocks-Replica-Hadoop Processes-Name node-Secondary name node-Job tracker-Task tracker-Data node Map Reduce:How Map Reduce Works-Anatomy of a Hadoop Cluster-Hadoop Ecosystem Components-Developing Map Reduce Application-Phases in Map Reduce

Pharmacy Department

Pharmaceutics (PHP101)

Unit I: Advanced Analytical and Regulatory Pharmaceutics

- Modern Pharmaceutical Analytical Techniques (UV, IR, NMR, MS, Chromatography)
- Spectro fluorimetry, 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 modelling

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

Pharmaceutical Chemistry (PHP102)

Unit I: Modern Analytical Chemistry and Spectroscopy

- Advanced Spectral Analysis (UV, IR, NMR, MS, XRD, LC-MS/MS, GC-MS)
- Validation of Analytical Methods, Pharmaceutical Process Chemistry

Unit II: Medicinal and Organic Chemistry

- Advanced Organic Chemistry (reaction mechanisms, stereochemistry)
- Drug design strategies: QSAR, SAR, Prodrugs, Target identification, Docking

Unit III: Natural Product Chemistry

- Chemistry of alkaloids, glycosides, marine drugs, steroids, saponins, macrolides

- Biosynthesis, isolation, and semi-synthesis

Unit IV: CADD and Regulatory Chemistry

- Computer-aided drug design, ligand-based and structure-based approaches
- Regulatory documentation, impurity profiling, green chemistry

Pharmacology (PHP103)

Unit I: Advanced Pharmacodynamics and Pharmacokinetics

- Receptor signalling, second messengers, desensitization, tolerance
- Advanced drug-receptor theories, dose-response relationships

Unit II: Molecular and Cellular Pharmacology

- Genetic and molecular targets, cell line pharmacology, cancer biology
- Neuropharmacology, neurodegenerative disease mechanisms (Alzheimer's, Parkinson's)

Unit III: Toxicology and Safety Pharmacology

- Acute/chronic toxicity, genotoxicity, teratogenicity, reproductive toxicity
- Animal ethics (CPCSEA), replacement, reduction, refinement (3Rs)

Unit IV: Screening and Drug Discovery

- In vivo & in vitro models: CNS, CVS, antidiabetic, anti-inflammatory
- Clinical research, pharmacovigilance systems, drug safety monitoring

Pharmacognosy (PHP104)

Unit I: Advanced Pharmacognosy and Phytochemistry

- Phytochemical screening, plant metabolites, biosynthesis, HPTLC, HPLC, LC-MS/MS
- Supercritical extraction, microwave-assisted extraction

Unit II: Molecular Pharmacognosy and Biotechnology

- Medicinal plant biotechnology, callus/cell cultures, gene transfer
- DNA barcoding, metabolic pathway engineering

Unit III: Traditional and Industrial Applications

- Indian Systems of Medicine (Ayurveda, Unani, Siddha), Herbal Cosmetics
- Industrial scale herbal production and standardization

Unit IV: Global Regulations and Pharmacovigilance

- WHO/AYUSH/EMA/FDA guidelines for herbal drugs
- Safety, efficacy and global harmonization in botanical drug development

Elective 5: Pharmaceutical Quality Assurance

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

Law Department

CONSTITUTIONAL LAW (PHL101)

Objective: - The purpose of the course is to acquaint the Research students with the Basic Postulates of the Constitution like the Constitutional Supremacy, Rule of law, and Concept of Liberty. Finally, Research students should be able to articulate their independent views over contemporary crucial constitutional issues.

Unit I	General: 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, 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 II	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 III	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
UNIT IV	Right to Constitutional Remedies - Rights and Remedy- The Relationship Art.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

Suggested Readings: -

- M.P.Jain, Indian Constitutional Law, Wadhwa& Co, Nagpur
- V.N.Shukla, Constitution of India, Eastern Book Company, Lucknow
- Granville Austin, Indian Constitution-Cornerstone of a Nation, OUP, New Delhi
- H.M.Seervai, Constitutional Law of India (in 3 Volumes), N.M. Tripathi, Bombay
- J.N.Pandey, Constitutional Law of India, Central Law Agency, Allahabad

Management & Commerce Dept.

Course Code: (PHMG101)	**Contemporary Developments in Business Management**
Course Outcomes:	**At the end of this course students should be able to:**
CO1.	Understand and critically evaluate contemporary issues affecting business management.
CO2.	Analyse 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.
Course Content:	
Unit-1:	Introduction to Contemporary Management • Overview of traditional vs. modern management • Forces shaping contemporary business environments • Role of the manager today
Unit-2:	Globalization and International Business Trends • Global economic shifts • Cross-cultural management • Managing global supply chains and remote teams
Unit-3:	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-4:	Sustainability and Ethical Management • Corporate social responsibility (CSR) • ESG (Environmental, Social, Governance) frameworks • Ethical leadership and stakeholder management
Unit-5:	Contemporary Leadership Styles

	• Servant leadership, transformational leadership, etc. • Emotional intelligence in leadership • Remote and hybrid leadership challenges
Text Books:	• Harold Koontz, Heinz Weihrich & Mark Cannice : Management: A Global and Entrepreneurial Perspective, Tata McGraw - Hill Education • James A. F. Stoner, R. Edward Freeman, Daniel R. Gilbert: Management,Pearson Education • Koontz and O'Donnell : Essentials of Management • L.M. Prasad : Principles and Practice of Management, Sultan Chand & Sons • Meenakshi Raman, Prakash Singh: Business Communication, Oxford • Courtland L Boove, John Thill, Abha Chatterjee: Business Communication today, Pearson Education.
Reference Books:	• Drucker, Peter F. – *Management: Tasks, Responsibilities, Practices* Publisher: HarperBusiness • Kotler, Philip & Keller, Kevin Lane – *Marketing Management* Publisher: PearsonBarney, Jay B. & Hesterly, William S. – *Strategic Management and Competitive Advantage* Publisher: Pearson • Goleman, Daniel – *Emotional Intelligence: Why It Can Matter More Than IQ* Publisher: Bantam • Sinek, Simon – *Start With Why: How Great Leaders Inspire Everyone to Take Action* Publisher: Portfolio

Agriculture Department

Animal Science (PHAG101)

Unit I: Introduction to Animal Science and Domestication

- Definition and scope of animal science
- Importance of livestock in the national economy
- Domestication of animals – history and significance
- Classification of livestock and poultry
- Breeds of cattle, buffalo, sheep, goat, swine, poultry
- Indigenous and exotic breeds – characteristics and distribution

Unit II: Anatomy and Physiology of Farm Animals

- Basic structure and function of animal body systems: Digestive system (ruminant vs non-ruminant) Respiratory system Circulatory system Reproductive system
- Endocrine system and hormones relevant to animal reproduction and growth
- Physiology of lactation and egg formation

Unit III: Animal Nutrition and Feeding

- Nutritional requirements of livestock and poultry
- Classification and functions of nutrients
- Types of feedstuffs – roughages, concentrates, supplements
- Feed formulation and balanced ration
- Feeding standards (NRC, ICAR)
- Importance of minerals and vitamins

Unit IV: Animal Breeding and Genetics

- Principles of animal breeding
- Mendelian genetics and inheritance
- Systems of breeding: inbreeding, outbreeding, crossbreeding
- Artificial insemination and reproductive technologies
- Selection methods and improvement of breeds
- Breeding policies in India

Unit V: Animal Health, Management, and Welfare

- Common infectious and non-infectious diseases
- Symptoms, prevention, and control measures
- Vaccination schedule for livestock and poultry

- General principles of animal management Dairy cattle management Poultry management Sheep and goat farming practices
- Animal welfare and ethical considerations in animal production

Mathematics Department

Special Functions, Integral Transforms, and Fractional Calculus (PHMA101)

Unit I: Special Functions

• 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 • Hermite and Laguerre polynomials: Generating functions, differential equations • Hypergeometric functions: Generalized hypergeometric series, convergence, transformation formulas

• Confluent hypergeometric functions (Kummer's functions)

Unit II: 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 III: Fractional Calculus – Fundamentals

• Introduction and historical development

• Definitions of fractional derivatives and integral operators

o Pathway integral Operator

o Riemann–Liouville

o MSM fractional differential and integral operator

• Comparison between definitions, properties, and interpretations

• Laplace transforms of fractional derivatives

Unit IV: Applications of Fractional Calculus

• Solution of fractional differential equations

• Modelling physical and engineering systems:

o Visco elasticity

o Diffusion processes

o Control theory

• Mittag-Leffler functions and their role in fractional-order systems

- Numerical methods for fractional equations

References

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4. K.B. Oldham and J. Spanier – The Fractional Calculus

5. Podlubny, I. – Fractional Differential Equations

6. Davies, B. – Integral Transforms and Their Applications