

**RULES & REGULATIONS, STRUCTURE and
SYLLABUS**

2017-18

FOR

Ph.D. COURSE WORK



Department of Computer Applications

VBS PURVANCHAL UNIVERSITY, JAUNPUR

DEPARTMENT OF COMPUTER APPLICATIONS

VBS PURVANCHAL UNIVERSITY, JAUNPUR

1. STUDY & EVALUATION SCHEME

Ph.D. (Doctor of Philosophy)

SUB CODE	SUBJECT	L	T	P	TA/CT/ESE	TOTAL
CW-101	Research Methodology	3	0	0	20/30/50	100
CW-102	Academic Ethics	3	0	0	20/30/50	100
CW -103	Algorithms	3	1	2	20/30/50	100
CW-104	Advance Programming Languages	2	1	2	20/30/50	100
CW- 105	Elective	3	1	0	20/30/50	100

***Elective**

- 1. Machine Learning**
- 2. Social Network Analysis**
- 3. Software Metrics**
- 4. Data Mining**
- 5. Information Retrieval**
- 6. Wireless Network**
- 7. Computer Network**

2. Course of Study and Examination:

- (i) A candidate admitted to the Ph.D. course work shall pursue a regular course of study in the semester of the course and attend at least 75% of the classes held to be eligible to appear in the examination otherwise he/she will not be permitted to appear in the examination.
- (ii) Matters pertaining to conduct of examination shall deal with by a Board of examination constituted by the approval of VC. The constitution of the board exam shall be as follows:
 - (a) Director/Head of Department MCA, VBS Purvanchal University, Jaunpur.
 - (b) Two external experts in Computer Application/ Technology.
- (iii) The board of examination constituted as above shall recommend the panel of paper-setters/examiners to the VC. After getting approval from the VC, the appointment letter shall be issued to the concerned paper-setters/examiners by the Registrar/Controller of Examination of University.
- (iv) The Registrar/Controller of Examination with the approval of the VC shall associate one or two member of the board of examinations for the moderation of the papers. The moderated papers shall have got to be printed by the Registrar/Controller of Examination well before the commencement of the examination.
- (v) After printing the papers in sealed covers, shall be handed over to the Director/ Head of college/institute, who will ensure the smooth and fair conduction of examination.
- (vi) After examination are held, the Director/ Head of college/institute shall send the answer books in sealed covers to the office of Registrar/Controller of Examination for evaluation, who shall ensure the evaluation of the answer books and declaration of the result of semester examination within a reasonable time.
- (vii) For appearing in the Ph.D. course work examination each student shall have to fill up the examination form and submit the same to the Director/ Head of college/institute by a date prescribed for the purpose for being forwarded to the Registrar/Controller of Examination.
- (viii) In each of the theory paper prescribed above, there shall be two components:
 - a. **End Semester Examination:** The end semester examination in each theory paper shall be three hours duration and shall carry 50 marks. The question shall be in English only.
 - b. **Sessional:** In each theory paper there shall be sessional of 50 marks, which will be organized by the teachers. Ordinarily break-up of sessional-marks shall be as follows:

Theory Subjects:

(i)	Term Test (two mid-term tests of equal weightage)	60%
(ii)	Teacher Assessment Tutorial/Assignment	20%
	Seminar	20%

The marks in the sessional shall be awarded by the teachers concerned and submitted to the Director/Head of

college/institute who will after due approval send the same to the Registrar/Controller of Examination, VBS Purvanchal University for being incorporated in the examination result.

3. Declaration of the Results:

- (i) The minimum pass marks in each theory and sessional subject separately shall be 40%.
- (ii) A candidate, in order to pass, must secure 50% marks in the aggregate.
- (iii) The result of Ph.D. course examinations shall be declared in two class
 - (a) **Satisfactory:** Who fulfill the above conditions as laid down in the ordinance 3.(i) to 3 (ii)
 - (b) **Non Satisfactory**
- (iv) Those who fail in Ph.D. course work examination shall have to re-appear in the papers in which they had failed along with the students of the next batch, on payment of the prescribed examination fees. The marks obtained by such student in the theory papers shall be submitted in place of the earlier marks and their results shall be declared accordingly.
- (v) In view of the past and frequent changes in the field of Information Technology, the course-curriculum should be revised at regular intervals.

CW-101: Research Methodology

Unit 1: Research Problem

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Unit 2: Basic instrumentation & applied statistics

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis.

Probability Distributions: Binary Variables, Multinomial Variables, The Gaussian distribution, The Exponential Family, Nonparametric Methods

Unit 3: Modelling and prediction of performance

Setting up a computing model to predict performance of experimental system, Multiscale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Unit 4: Developing a Research Proposal

Format of research proposal, Individual research proposal, Institutional proposal Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research.

Unit 5: Term Paper and Seminar

References:

1. 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
2. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville 3. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition
3. 'Research Methodology: Methods and Trends', by Dr. C. R. Kothari
4. 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co.
5. Software Engineering by Pressman

CW-102: Academic Ethics

Unit 1

Ethics & Education; Theories in Ethics; Acad. Governance: Subjectivity vs. Objectivity;

Unit 2

Autonomy in Education; Ethics & Quality Education; Ethics in Teaching; Ethics in Academic Administration; Conflict of Interests;

Unit 3

Non-Ethical Activities & Temptation; Ethics in Research & Publishing; Plagiarism;

Unit 4

Scientometrics/Biblio-Metrics: Quantification of Quality in Publication, Citation, Impact Factor, H & other indices; IPR & Legal Rights.

Unit 5:

Term Paper and Seminar

References:

1. P. Oliver, Writing Your Thesis, New Delhi: Vistaar Publications, 2004.
2. Gregory, Ethics in Research, Continuum, 2005

CW-103: Algorithms

UNIT 1:

Overview: Time and space complexity. Asymptotic notations. Recurrence for divide and Conquer and its solution, the substitution method and recursion-tree method for Solving recurrences. The master method: proof and solving recurrence problems, Merge sort, heap sort, quick sort and their complexity analysis. Advanced data structure: ADT and data structure, linear vs non-linear data Structure. Tree: tree as an ADT, definition and terminologies, threaded binary tree, BST. AVL tree, balance multi way search tree: 2-3 tree, red- black tree, b tree, b+ tree, Tries, spatial data representation using k-d tree, quad tree

UNIT 2

Graph: definition, computer representation of graphs, graph traversals: BFS & DFS, Spanning tree. Graph colouring-chromatic number, algorithm for transitive Closure, topological sort, and critical paths Dynamic programming : matrix-chain multiplication, all pair shortest paths, single Source shortest path, travelling salesman problem, 0-1 knapsack problem, LCS Problem. Greedy method : knapsack problem, job sequencing with deadlines, activity –Selection, Huffman codes, minimum spanning tree by prim's and kruskal's algorithms. Disjoint set manipulation: set manipulation algorithm like union-find, union by Rank, Path compression. Topological sorting Backtracking: use in solving problem, 4 queen and 8-queen problem, subset sum Problem Branch and bound: basic method, applications: the 15-puzzle problem,

UNIT 3

Computational geometry: robust geometric primitives, convex hull, triangulation, Voronoi diagrams, nearest neighbor search, range search, point location, Intersection detection, bin packing, medial-axis transform, polygon partitioning, Simplifying polygons, shape similarity, motion planning, maintaining line arrangements, Minkowski sum.

UNIT 4

Set and string problems: set cover, set packing, string matching, approximate string Matching, text compression, cryptography, finite state machine minimization, Longest Common substring/subsequence, shortest common superstring. Advanced areas: notion of NP-completeness: P class, NP-hard class, NP-complete Class, Circuit satisfiability problem. Approximation algorithms, randomized algorithms, multithreaded Algorithms, parallel algorithms. Amortized analysis and its applications,

Unit 5:

Term Paper and Seminar

Reference books:

1. A.Aho, J.Hopcroft And J.Ullman “The Design And Analysis of Algorithms”, Pe.
2. T Cormen, C Leiserson And R Rivest “Introduction To Algorithms”, Phi.
3. Fundamentals Of Algorithms- G.Brassard,P.Bratlay, PHI.
4. Horowitz Ellis, Sahani Sartaz, R. Sanguthevar " Fundamentals of Computer Algorithms"

CW-104: Advance Programming Languages

UNIT 1

Client & server side programming. Enterprise architecture styles: Single tier, 2-tier, 3-tier, n-tier; Relative comparison of the different layers of architectures. MVC Architecture: Explanation, Need, Drawbacks, J2EE WEB SERVICES, Different components & containers. [4L]

Servlet: Introduction, Advantages over CGI, How it works?, Servlet life cycle, Servlet API (Different interfaces & classes of generic servlet & HTTP servlet), Accessing user information by means of Request & Response, Servlet session management techniques and relative comparison. [4L]

JSP: Introduction, Comparison between JSP & servlet., Architecture/Life cycle, Different types of JSP architectures and relative comparison.; JSP tags ,Directives, Scripting elements, Actions; JSP implicit objects, Accessing user information using implicit objects. [5L]

EJB :Introduction, Comparison of EJB & Java Beans , Applications, Drawbacks, Different types of enterprise beans, Services provided by EJB container. [5L]

UNIT 2

RMI: Introduction and applications, Architecture, Use of RMI Registry. JNDI: Introduction and applications, Comparison between LDAP and JNDI JDO (Java Data Objects): Introduction, Integration of EJB and JDO, JDO & RMI JINI :Introduction, Applications [5L]

JDBC: Introduction, Database driver, Different approaches to connect an application to a database server, Establishing a database connection and executing SQL statements, JDBC prepared statements, JDBC data sources. [5L]

UNIT 3

Introduction to Python Language, Statements and inspection, Builtin datatypes, Functions, Conditions & Recursion, Statements, Functions, Modules, Packages, and Debugging, Iteration. String, Lists, Dictionaries, Tuples, Files, Classes & Objects, Classes and functions, Classes and Methods, Inheritance.

UNIT 4

R and Rstudio set-up, R types, vectors and writing functions, More R types, vectorization and efficient R code, Importing data, time series data and Google Trends, A data science project, Data manipulation with tidyr, Plotting with ggplot2, R style guide, git integration, Maps, plots.

UNIT 5

A Programming Project

Reference:

1. “Professional JAVA Server Programming”, Allamaraju and Buest ,SPD Publication
2. “Beginning J2EE 1.4” Ivor Horton, SPD Publication.
3. “Advanced Programming for JAVA 2 Platform” Austin and Pawlan, Pearson
4. Dive into Python, Mike
5. Learning Python, 4thEdition by Mark Lutz
6. Programming Python, 4thEdition by Mark Lutz
7. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)

Elective

1 Machine Learning

Unit 1:

Introduction to Machine Learning, Probability Theory, Model Selection, The Curse of Dimensionality,
Decision Theory, Information Theory

Unit 2:

Linear Models for Regression: Linear Basis Function Models, The Bias-Variance Decomposition , Bayesian Linear Regression ,Bayesian Model Comparison, The Evidence Approximation, Limitations of Fixed Basis Functions

Unit 3:

Linear Models for Classification L: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models , The Laplace Approximation,, Bayesian Logistic Regression

Unit 4:

Neural Networks and Kernel Methods , Multilayer Feedforward Neural networks with Sigmoidal activation functions; Backpropagation Algorithm; Representational abilities of feed forward networks, Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels.

Unit 5:

Term Paper and Seminar

References:

1. Christopher M. Bishop. 2006. Pattern Recognition and Machine Learning (Information Science and Statistics). Springer-Verlag New York, Inc., Secaucus, NJ, USA.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
3. Boyd and Vandenberghe, Convex Optimization , Cambridge University Press, 2009.
4. Hastie, Tibshirani, Friedman, Elements of Statistical Learning, Second Edition, Springer-Verlag, 2009

Elective

2 Social Network Analysis

Unit-1:

Introduction to SNA, nodes Edges and Network Measure, Networks Structures, Network Visualization, tie strength, trust, understanding structure through user attributes and behavior.

Unit-2:

Building Networks, entity Resolution and Link Prediction, Propagation in Networks, Community Maintained Resources, location based social interaction, social information filtering, social media in public sector, business use of social media, privacy.

Unit-3:

Selected topics from research papers/ reference books as advised by the course instructor

Unit-4:

Random walk processes in complex networks, Markov chain convergence theorem, Diffusion speed in complex networks, Powers of adjacency matrices and algebraic methods, Algebraic connectivity, Fiedler vector, eigen value gap and eigen ratio of complex networks.

Unit 5:

Term Paper and Seminar

References:

1. "Analyzing the Social Web", Jennifer Golbeck, Morgan Kauffman.
2. Vega-Redondo, F. (2007). Complex Social Networks (Econometric Society Monographs). Cambridge: Cambridge University Press.
3. Social Network Analysis: Methods and Applications by Wasserman and Faust (1994)

Elective

3 Software Metrics

Unit-1:

Basics of measurements, Metrics data collection and analysis, measuring internal attributes: Size & structure, measuring external product attributes.

Unit-2:

Software reliability. Resource measurement: productivity, teams and tools.

Unit-3:

Process predictions. Planning and measurement program.

Unit-4:

Measurement in practice. Empirical research in software engineering. A case study.

Unit 5:

Term Paper and Seminar

References:

1. Software Testing Fundamentals: Methods and Metrics, Marnie, Wiley.
2. Software Metrics, Second Edition, Fenton, CRC.
3. Fenton, N.E., and Pfleeger, S.L.. "Software Metrics: A Rigorous and Practical Approach, Revised" Brooks Cole, 1998.

Elective

4 Data Mining

Unit-1:

Introduction: Data Mining, , Motivation, Application, Data Mining—On What Kind of Data?, Data Mining Functionalities, Data Mining Task Primitives, Major Issues in Data Mining.
Data pre-processing: Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

Unit-2:

Association Rule: Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and a Road Map, Association Rules, the Apriori Algorithm

Unit-3:

Classification and Prediction: Classification: Classification, Issues Regarding Classification, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling
Prediction: Prediction, Issues Regarding Prediction, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor.

Unit-4:

Clustering: Cluster Analysis, Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic, Evaluation of Clustering.

Unit 5:

Term Paper and Seminar

References:

1. “Data Mining: Concepts and Techniques”, Second Edition Jiawei Han and Micheline Kamber.
2. Hand, Mannila, and Smyth. *Principles of Data Mining*. Cambridge, MA: MIT Press.
3. Berry and Linoff. *Mastering Data Mining*. New York, NY: Wiley.
4. Delmater and Hancock. *Data Mining Explained*. New York, NY: Digital Press.

Elective

5 Information Retrieval

Unit 1:

Introduction, Basic IR system structure; Retrieval Techniques: Boolean retrieval, term-vocabulary, postings-lists, Dictionaries, Inverted Indices; Preprocessing steps: Tokenization, Stemming, Stopword removal, Term Weighting; Index Compression: Data Compression Techniques, Huffman Coding, Arithmetic Coding, compressing posting lists.

Unit 2:

Retrieval Models: Vector Space Model, Probabilistic Model, Language Models; Evaluation: Standard Test Collection, concept of relevance, Precision-Recall based metrics, Reciprocal Rank, DCG; Relevance Feedback and Query Expansion: Rocchio algorithm; Text Classification: Naïve Bayes, Text Clustering: Flat Clustering, Hierarchical Clustering.

Unit 3:

Web Search: Structure of Web, Web Graph, Hidden Web, User intent, Web crawl; Link Analysis: Web as a graph, PageRank, Hubs and Authorities;

Unit 4:

Social Search: Community-based search activities, Question Answering, Collaborative Searching; XML Retrieval: Basic concepts, Challenges, Evaluation.

Unit 5:

Term Paper and Seminar

References:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Baeza-Yates and Ribeiro-Neto, Modern Information Retrieval, Addison Wesley, 1999.
3. C. Manning, P. Raghavan, and H. Schutze, Introduction to Information Retrieval, Cambridge University Press, 2008.
4. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology behind Search 2nd Edition, ACM Press Books 2011
5. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009.
6. Mark Levene, An Introduction to Search Engines and Web Navigation, 2nd Edition Wiley, 2010.

Elective

6 Wireless Network

Unit 1:

Overview: Wireless vs. Wired -- key differences, types of wireless networks and design constraints, emerging applications. Fundamentals of Ad-hoc and sensor networks, wireless PAN, LAN, MAN, and mesh networks.

Unit 2:

Wireless PHY layer and MAC layer: path modeling, modulation. Centralized and Distributed MAC protocols in wireless networks. Near field communication (NFC), Bluetooth classic, Bluetooth Low Energy (BLE), WiFi, and WiFi Direct.

Unit 3:

Network layer and Transport layer: Ad-hoc networks, routing, TCP for wireless, Congestion control mechanisms for Ad-hoc networks.

Unit 4:

Network Functions Virtualization (NFV): Introduction of NFV, Relationship between NFV and SDN, ETSI NFV ISG Specifications, Concepts, Architecture, Requirements, and Use cases of NFV. SDN control plane architecture and functions, southbound and northbound interface, SDN routing, ITU-T Model, OpenDaylight architecture, OpenDaylight Helium, REST, REST constraints, example REST API, Cooperation and coordination among controllers, Centralized and distributed controllers, High availability clusters, Federated SDN Networks, Routing and QoS between domains.

Unit 5:

Term Paper and Seminar

References:

1. Wireless Communications - Andreas F. Molisch, John Wiley and Sons, 2005 (Indian Edition)
2. Protocols and Architectures for Wireless Sensor Networks - Holger Karl and Andreas Willig, John Wiley and Sons, 2005
3. Foundations of modern networking- SDN, NFV, QoE, IoT, and Cloud, William Stallings, 2016.

Elective

7 Computer Network

Unit 1:

Review of the Internet architecture, layering, wireless channel models, channel diversity, time diversity, frequency diversity, and antenna diversity, and multiplexing. Routing mechanisms in wireless and mobile network, congestion control mechanisms, resource allocation schemes, ad-hoc networks, mobility in networks, mobile IP, Security related issues.

Unit 2:

Advanced topics in networking: Network Virtualization, Networking with virtual machines, software switches, network function virtualization.

Unit 3:

Software Defined Networking, evolving network requirements, Complex traffic patterns, Traditional network architecture, SDN requirement, architecture and characteristics, SDN and NFV related standards, SDN data planes, Data plane functions and protocols, Flow table structure.

Unit 4:

SDN control plane architecture and functions, southbound and northbound interface, Cooperation and coordination among controllers, Centralized and distributed controllers, SDN Application plane architecture, network service abstraction layer, abstractions in SDN, Traffic engineering, measurement, monitoring and security.

Unit 5:

Term Paper and Seminar

References:

1. Computer Networks by A. S Tanenbaum, 4th Edition", Pearson education
2. Data and Computer Communication by W. Stallings, Macmillan Press
3. Computer Networks & Internet with Internet Applications by Comer Pearson Education
4. Internetworking with TCP/IP by PHI
5. Data Communication and Networking by Forouzan TMH
6. Computer Networks with Internet Protocols by W Stallings, Pearson Education
7. Local and Metropolitan Area Networks by W Stallings, VIth edition, Pearson Education