**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**

**New Scheme Based On AICTE Flexible Curricula**

**CSE-Artificial Intelligence/ Artificial Intelligence, V-Semester**

## AI- 501 Operating Systems

**COURSE OBJECTIVES:**

To make students understand the importance and overall functioning of an Operating System; To acquaint the students with the concepts and principles that underlie the modern Operating Systems, and to provide them an insight in the working of its various modules.

**COURSE OUTCOMES:**

**After completing the course, student should be able to:**

1. Get clear understanding about the need and objectives of an Operating System and various services provided by the Operating Systems.
2. Gain a detailed knowledge about the functions of different modules of an Operating System, viz. process management, file system management, memory management, device management etc.
3. Visualize the internal implementation of various modules of Operating System and correlate the same with the actual implementation of these modules in Unix/Linux and other contemporary Operating Systems.
4. Acquire the ability to design and implement small modules of Operating System, Shell and Commands, using system calls of Unix/Linux or some educational Operating System.

**COURSE CONTENTS:**

**UNIT1**: **Introduction to Operating Systems**: Function, Evolution, Different types of Operating Systems, Desirable Characteristics and features of an O/S.

**Operating Systems Services**: Types of Services, Different ways of providing these Services– Commands, System Calls. Need of System Calls, Low level implementation of System Calls, Portability issue, Operating System Structures.

**UNIT II: File Systems (Secondary Storage Management):** File Concept, User's and System Programmer's view of File System, Hard Disk Organization, Disk Formatting and File System Creation, Different Modules of a File System, Disk Space Allocation Methods

–Contiguous, Linked, Indexed. Disk Partitioning and Mounting; Directory Structures, File Protection; Virtual and Remote File Systems. Case Studies of File Systems being used in Unix/Linux & Windows; System Calls used in these Operating Systems for file management.

**UNITIII: Process Management**: Concept of a process, Process State Diagram, Different type of schedulers, CPU scheduling algorithms, Evaluation of scheduling algorithms, Concept of Threads: User level & Kernel level Threads, Thread Scheduling; Multiprocessor/ Multicore Processor Scheduling. Case Studies of Process Management in Unix/Linux& Windows; System Calls used in these Operating Systems for

Process Management.

**Concurrency& Synchronization:** Real and Virtual Concurrency, Mutual Exclusion,

Synchronization, Critical Section Problem, Solution to Critical Section Problem: Mutex Locks; Monitors; Semaphores, WAIT/SIGNAL operations and their implementation; Classical Problems of Synchronization; Inter-Process Communication.
**Deadlocks:** Deadlock Characterization, Prevention, Avoidance, Recovery.

**UNIT IV**: **Memory Management**: Different Memory Management Techniques – Contiguous allocation; Non-contiguous allocation: Paging, Segmentation, Paged Segmentation; Comparison of these techniques.
**Virtual Memory** – Concept, Overlay, Dynamic Linking and Loading, Implementation of Virtual Memory by Demand Paging etc.; Memory Management in Unix/Linux& Windows.

**UNIT V: Input/ Output Management**: Overview of Mass Storage Structures, Disk Scheduling; I/O Systems: Different I/O Operations- Program Controlled, Interrupt Driven, Concurrent I/O, Synchronous/Asynchronous and Blocking/Non-Blocking I/O Operations, I/O Buffering, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O requests to hardware operations.

Overview of Protection & Security Issues and Mechanisms, Introduction to Multiprocessor, Real Time, Embedded and Mobile Operating Systems; Overview of Virtualization.

**TEXTBOOKSRECOMMENDED**:


1. Silberschatz, Galvin, Gagne, “Operating System Concepts’’, John Wiley& Sons.
2. William Stalling, “Operating Systems: Internals and Design Principles”, Pearson.


**REFERENCEBOOKS**:


1. Andrew S. Tanenbaum, “Modern Operating Systems”, Prentice Hall.
2. Robert Love, “Linux Kernel Development”, Pearson.
3. Maurice J. Bach, “The Design of Unix Operating System”, Pearson.
4. Bovet &Cesati, “Understanding the Linux Kernel”, O'Reilly.

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**AI-502 Database Management Systems**

**COURSE OBJECTIVES:** The objective of this course is to enable students in developing a high level understanding of the concepts of Database management systems in contrast with traditional data management systems with emphasis on skills to apply these concepts in building, maintaining and retrieving data from these DBMS.

**COURSE OUTCOMES:**

**After completing the course student should be able to:**

1. Describe design of a database at various levels and compare and contrast traditional data processing with DBMS.
2. Design a database using Entity Relationship diagram and other design techniques.
3. Apply fundamentals of relational model to model and implement a sample Database Management System for a given domain.
4. Evaluate and optimize queries and apply concepts of transaction management.

**COURSE CONTENTS:**

**UNIT I**: DBMS Concepts and architecture Introduction, Database approach v/s Traditional file accessing approach, Advantages of database systems, Data models, Schemas and instances, Data independence, Data Base Language and interfaces, Overall Database Structure, Functions of DBA and designer, ER data model: Entitles and attributes, Entity types, Defining the E-R diagram, Concept of Generalization, Aggregation and Specialization. Transforming ER diagram into the tables. Various other data models object oriented data Model, Network data model, and Relational data model, Comparison between the three types of models. Storage structures: Secondary Storage Devices, Hashing & Indexing structures: Single level & multilevel indices.

**UNIT II:** Relational Data models: Domains, Tuples, Attributes, Relations, Characteristics of relations, Keys, Key attributes of relation, Relational database, Schemas, Integrity constraints. Referential integrity, Intension and Extension, Relational Query languages: SQL-DDL, DML, integrity con straints, Complex queries, various joins, indexing, triggers, assertions , Relational algebra and relational calculus, Relational algebra operations like select, Project ,Join, Division, outer union. Types of relational calculus i.e. Tuple oriented and domain oriented relational calculus and its operations.

**UNIT III:** Data Base Design: Introduction to normalization, Normal forms- 1NF, 2NF, 3NF and BCNF, Functional dependency, Decomposition, Dependency preservation and lossless join, problems with null valued and dangling tuples, multivalued dependencies. Query Optimization: Introduction, steps of optimization, various algorithms to implement select, project and join operations of relational algebra, optimization methods: heuristic based, cost estimation based.

**UNIT IV:** Transaction Processing Concepts: -Transaction System, Testing of Serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures. Log based recovery. Checkpoints deadlock handling. Concurrency Control Techniques: Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity. Multi version schemes, Recovery with concurrent transaction. Introduction to Distributed databases, data mining, data warehousing, Object Technology and DBMS, Comparative study of OODBMS Vs DBMS . Temporal, Deductive, Multimedia, Web & Mobile database.

**UNIT V:** Case Study of Relational Database Management Systems through Oracle/ PostgreSQL /MySQL: Architecture, physical files, memory structures, background process. Data dictionary, dynamic performance view. Security, role management, privilege management, profiles, invoker defined security model. SQL queries, Hierarchical quires, inline queries, flashback queries. Introduction of ANSI SQL, Cursor management: nested and parameterized cursors. Stored procedures, usage of parameters in procedures. User defined functions their limitations. Triggers, mutating errors, instead of triggers.

TEXT BOOKS RECOMMENDED:


1. Korth H.F. &Silberschatz A., Sudarshan, "Database Systems", McGraw-Hill
2. Chris J. Date, with Hugh Darwin, Addison-Wesley, "A Guide to SQL Standard".
3. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", Pearson.


REFERENCE BOOKS:


1. Rob, " Database System:Design Implementation& Management", Cengage Learning.
2. AtulKahate , "Introduction to Database Management System", Pearson Educations
3. Oracle 9i Database Administration Fundamental-I, Volume I, Oracle Press,TMH.
4. Paneerselvam,"Database Management System", PHI Learning

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## AI 503 (A) Computational Intelligence

**Course Outcomes:**

After completing the course student will be able to:

1. Describe in-depth about theories, methods, and algorithms in computation Intelligence.
2. Compare and contrast traditional algorithms with nature inspired algorithms.
3. Examine the nature of a problem at hand and determine whether a computation intelligent technique/algorithm can solve it efficiently enough.
4. Design and implement Computation Intelligence algorithms and approaches for solving real-life problems.

**Course Contents:**

**Unit1:** Introduction to Computational Intelligence; types of Computational Intelligence, components of Computational Intelligence. Concept of Learning/Training model. Parametric Models, Nonparametric Models. Multilayer Networks: Feed Forward network, Feedback network.

**Unit2.** Fuzzy Systems: Fuzzy set theory: Fuzzy sets and operations, Membership Functions, Concept of Fuzzy relations and their composition, Concept of Fuzzy Measures; Fuzzy Logic: Fuzzy Rules, Inferencing; Fuzzy Control - Selection of Membership Functions, Fuzzyfication, Rule Based Design & Inferencing, Defuzzyfication.

**Unit3**. Genetic Algorithms: Basic Genetics, Concepts, Working Principle, Creation of Offsprings, Encoding, Fitness Function, Selection Functions, Genetic Operators-Reproduction, Crossover, Mutation; Genetic Modeling, Benefits.

**Unit4**. Rough Set Theory - Introduction, Fundamental Concepts, Set approximation, Rough membership, Attributes, Optimization. Hidden Markov Models, Decision tree model.

**Unit5**. Introduction to Swarm Intelligence, Swarm Intelligence Techniques: Ant Colony Optimization, Particle Swarm Optimization, Bee Colony Optimization etc. Applications of Computational Intelligence.

Recommended Books:


1. Russell C. Eberhart and Yuhui Shi, Computational Intelligence: Concepts to Implementations, Morgan Kaufmann Publishers.
2. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley Publishing.
3. Simon Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall.
4. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Pearson Education.
5. Jagdish Chand Bansal, Pramod Kumar Singh, Nikhil R. Pal, Evolutionary and Swarm Intelligence Algorithms, Springer Publishing, 2019.
6. S. Rajeskaran, G.A. VijaylakshmiPai, “Neural Networks, Fuzzy Logic, GeneticAlgorithms Synthesis and Applications”.
7. J.S. Roger Jang, C.T.Sun, E. Mizutani, “Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning & Machine Intelligence”, PHI, 2002.

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## AI 503(B) Machine Learning

**COURSE OUTCOMES:**
**After Completing the course student will be able to:**

1. Apply knowledge of computing and mathematics to machine learning problems, models and algorithms;
2. Analyze a problem and identify the computing requirements appropriate for its solution;
3. Design, implement, and evaluate an algorithm to meet desired needs; and
4. Apply mathematical foundations, algorithmic principles, and computer science theory to the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

**COURSE CONTENTS:**

**Unit –I**

Introduction to machine learning, scope and limitations, regression, probability, statistics and linear algebra for machine learning, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets, machine learning models, supervised and unsupervised learning.

**Unit –II**

Linearity vs non linearity, activation functions like sigmoid, ReLU, etc., weights and bias, loss function, gradient descent, multilayer network, back propagation, weight initialization, training, testing, unstable gradient problem, auto encoders, batch normalization, dropout, L1 and L2 regularization, momentum, tuning hyper parameters,

**Unit –III**

Convolutional neural network, flattening, sub sampling, padding, stride, convolution layer, pooling layer, loss layer, dance layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow, Keras etc.

**Unit –IV**

Recurrent neural network, Long short-term memory, gated recurrent unit, translation, beam search and width, Bleu score, attention model, Reinforcement Learning, RL-framework, MDP, Bellman equations, Value Iteration and Policy Iteration, , Actor-critic model, Q-learning, SARSA

**Unit –V**

Support Vector Machines, Bayesian learning, application of machine learning in computer vision, speech processing, natural language processing etc, Case Study: ImageNet Competition

**TEXT BOOKS RECOMMENDED:**


1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc., 2nd Edition, 2011.
2. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, First edition, 2017.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016


**REFERENCE BOOKS:**


1. Aurelien Geon, “Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, Shroff/O'Reilly; First edition (2017).

2. Francois Chollet, "Deep Learning with Python", Manning Publications, 1 edition (10 January 2018).
3. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016).
4. Russell, S. and Norvig, N. “Artificial Intelligence: A Modern Approach”, Prentice Hall Series in Artificial Intelligence. 2003.

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## AI 503 (C) Game Theory with Engineering applications

**COURSE CONTENTS:**

**Unit-I** Overview: What is a Game, Game Design Schema, Game Design fundamentals, Engineering application of game theory, Design Process: Iterative design, Commissions, Design & Testing of the Board Game, Introduction to meaningful play, two kinds of meaningful play- discernable & integrated.

**Unit-II** Introducing design, design & meaning, Semiotics: A brief overview, four semiotic Concepts, Context Shapes interpretations.

**Unit-III** Introduction to Systems, elements of a System, Framing Systems, open & closed systems, Introduction to Interactivity, a multivalent model of interactivity, interaction & choice, choice molecules, anatomy of choice, space of possibility.

**Unit-IV** Defining games: overview of digital games, magic circle. Primary Schemas: conceptual framework, rule, play, culture.

**Unit-V** Rules: defining rules, a deck of cards, quality of rules, rules in context, Rules on three levels: Operational, Constituative, Implicit, Identity of a Game, Specificity of Rules, Rules of Digital games. Case Studies: Tic Tac Toe, Deck of Cards.

**TEXT BOOKS RECOMMENDED:-**

1. Brathwaite, Brenda, and Ian Schreiber. Challenges for Game Designers: Non-digital Exercises for Video Game Designers. Boston, MA: Charles River Media/Course Technology, 2009. ISBN: 97815845058081

2. Game Design Workshop: A Play centric Approach to Creating Innovative Games by Tracy Fullerton. ISBN-10: 1482217163.

3. Challenges for Game Designers by Brenda Brathwaite (now: Romero) and Ian Schreiber. ISBN-10: 158450580X

**REFERENCE BOOKS:-**

1. Rules of Play - Game Design Fundamentals, Katie Salen and Eric Zimmerman, The MIT Press Cambridge, Massachusetts London, England, book design and photography.

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**AI 504 (A) Information Retrieval**

**COURSE CONTENTS:**

**UNIT-I:**Introduction - History of IR- Components of IR - Issues -Open source Search engine Frameworks - The Impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a search engine, Characterizing the web.

**UNIT –II:** Boolean and Vector space retrieval models- Term weighting - TF-IDF weighting- cosine similarity - Preprocessing - Inverted indices - efficient processing with sparse vectors Language Model based IR - Probabilistic IR -Latent Semantic indexing - Relevance feedbackand query expansion.

**UNIT- III:** Web search overview, web structure the user paid placement search engine optimization, Web Search Architectures - crawling - meta-crawlers, Focused Crawling - web indexes – Near duplicate detection - Index Compression - XML retrieval.

**UNIT –IV:** Link Analysis -hubs and authorities - Page Rank and HITS algorithms - Searching and Ranking -Relevance Scoring and ranking for Web - Similarity - Hadoop & Map Reduce - Evaluation -Personalized search - Collaborative filtering and content-based recommendation of documents And products - handling invisible Web - Snippet generation, Summarization. Question
Answering, Cross- Lingual Retrieval.

**UNIT –V:** Information filtering: organization and relevance feedback - Text Mining- Text classification and clustering - Categorization algorithms, naive Bayes, decision trees and nearest neighbor -Clustering algorithms: agglomerative clustering, k-means, expectation maximization (EM).

**References:**

1. C. Manning, P. Raghvan and H Schutze: Introduction to Information Retrieval, Cambridge University Press.
2. Ricardo Baeza Yates and Berthier Ribeiro Neto, Modern Information Retrieval :The Concepts and Technology behind Search, ACM Press Books.
3. Bruce Croft, Donald Metzler and Trevor Strohman,Search Engines Information Retrieval in Practice, Addison Wesley.
4. Mark Levene, An Introduction to Search Engines and Web Navigation, Wiley.

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**AI 504 (B) Information Security and Management**

**UNIT-I**
Introduction: Need for Security; Basic security terminologies e.g. threats, vulnerability, exploit etc., Security principles(CIA), authentication, non repudiation; security attacks and their classifications, Mathematical foundation-Prime Number; Modular Arithmetic; Fermat's and Euler's Theorem; The Euclidean Algorithms; The Chinese Remainder Theorem; Discrete logarithms.

**UNIT-II**
Symmetric Key Cryptography: Classical cryptography – substitution, transposition and their cryptanalysis; Symmetric Cryptography Algorithm – DES, 3DES, AES etc.; Modes of operation: ECB,CBC etc.; Cryptanalysis of Symmetric Key Ciphers: Linear Cryptanalysis, Differential Cryptanalysis.

**UNIT-III**
Asymmetric Key Cryptography: Key Distribution and Management, Diffie-Hellman Key Exchange algorithm; Asymmetric Key Cryptography Algorithm–RSA, ECC etc.; Various types of attacks on Cryptosystems.

**UNIT-IV**
Authentication & Integrity–MAC, Hash function, SHA, MD5, HMAC, Digital signature and authentication protocols; Authorization; Access control mechanism; X.509 Digital Certificate.

**UNIT-V**
e-mail, IP and Web Security :e-mails security– PGP,MIME, S/MIME;IP security protocols; Web security–TLS, SSL etc.; Secure Electronic Transaction(SET);Firewall and its types; Introduction to IDPS; Risk Management; Security Planning.

**TEXT BOOKS RECOMMENDED:**

1.MichaelE.Whitman,HerbertJ.Mattord,"PrinciplesofInformationSecurity",6thEdition, Cengage Learning.
2. StallingsWilliam,"CryptographyandNetworkSecurity-PrinciplesandPractice",7th Edition, Pearson.

**REFERENCE BOOKS:**
1. Roberta Bragge, Mark Rhodes, Keith Straggberg, "Network Security the Complete Reference", Tata McGraw Hill Publication,

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**AI504(C) Software Engineering and Agile Methodology**

**Course Outcomes**: After completing the course student should be able to:

1. Describe the Fundamentals of software Engineering.
2. To Understand Software Development Life Cycle phases and their Role in Software Development.
3. Understand the Software development using Agile methodology.
4. Understand the implementation principles and guidelines for software development using Agile methodology
5. Use implementation techniques of Software architecture for effective software development.
6. Apply core values and principles of Agile for enterprise application development

**Unit I**: Introduction to Software Engineering

Software Development Life Cycles, SDLC Models: Waterfall, V-Model, Prototype Model, Incremental, Evolutionary, RAD, Spiral. Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, Requirements Gathering and Analysis, Software Requirements Specification (SRS). Software Product and Process Characteristics, Software Process Models, Evolutionary Process Models and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics, Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications, Requirement Validation, Traceability

**UnitII**: Software Design, Analysis and Testing

The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function oriented Design, SA/SD Component Based Design, Design Metrics. Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Testing Frameworks, Test Plan, Test Metrics, Testing Tools.

**Unit-III**: Software Maintenance & Software Project Measurement

Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program. Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Feasibility Analysis, Project and Process Planning, Resources Allocations, Software efforts, Schedule, and Cost estimations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, Project Metrics.

**Unit-IV**: Fundamentals of Agile Methodology

Introduction to Agile software development methodology, Life Cycle of Agile development, Agile v/s Traditional software development(Waterfall model)Agile Manifesto:Principles,BenefitsandChallengesofAgile,AgileValues,AgileModel,Phases of Agile Model.

**Unit-V**:Software Development using Agile Methodology

Gathering requirement using Agile way, User Stories: The currency of agile development, Characteristics of good user stories, Generating User Stories, Agile estimation and planning, Implementation of agile, Applying an Agile Mindset to a Project, Roles in agile development, Agile Frameworks: Scrum, Kanban, Crystal, XP, ASD, DSDM.

Practical and Lab work: Lab work should include a running case study problem for which different deliverables set at the end of each phase of a software development life cycle are to be developed. This will include modeling the requirements, analysis, detailed design, implementation, testing, deployment, and maintenance. Subsequently the design models will be coded and tested. For modeling, Open Source tools like Star UML and Licensed Tools like Rational Rose products. For coding and testing, IDE like Eclipse, Net Beans, and Visual Studio can be used.

**Text Books:**


1. PankajJalote,"AnIntegratedApproachtoSoftwareEngineering",NarosaPub, 2005
2. RajibMall,"FundamentalsofSoftwareEngineering"SecondEdition,PHILearning
3. JamesShoreandShaneWarden,"TheArtofAgileDevelopment1stEdition", o'reilly books.
4. Dikel,David,D.Kane,andJ.Wilson,"SoftwareArchitecture:OrganizationalPrincipl es and Practices", Prentice-Hall.
5. MikeCohn,"AgileEstimatingandPlanning,1st(first)edition",Prentice-Hall.


**References:**


1. R S. Pressman ,"Software Engineering: A Practitioner's Approach", Sixth edition, 2006, McGraw-Hill.
2. Sommerville, "Software Engineering", Pearson Education.
3. RichardH.Thayer,"SoftwareEngineering&ProjectManagements",WileyIndia.
4. WamanS. Jawadekar, "Software Engineering", TMH.
5. Bob Hughes, M. Cotterell, Rajib Mall "Software Project Management", Mc Graw Hill.
6. Bennett,Douglas,"DesigningHardSoftware:TheEssentialTasks",Prentice-Hall,1997.
7. The Deadline: A Novel about Project Management, Dorset House