DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

Evaluation Scheme & Syllabus

For

B.Tech. 3rd Year

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

On

Choice Based Credit System

(Effective from the Session: 2022-23)

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW

B.TECH

COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

SEMESTER- V													
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KCS501	Database Management System	3	1	0	30	20	50		100		150	4
2	KDS501	Introduction to Data Analytics and Visualization	3	1	0	30	20	50		100		150	4
3	KCS503	Design and Analysis of Algorithm	3	1	0	30	20	50		100		150	4
4	Dept. Elective-I	Departmental Elective-I	3	0	0	30	20	50		100		150	3
5	Dept. Elective-II	Departmental Elective-II	3	0	0	30	20	50		100		150	3
6	KCS551	Database Management System Lab	0	0	2				25		25	50	1
7	KDS551	Data Analytics and Visualization Lab	0	0	2				25		25	50	1
8	KCS553	Design and Analysis of Algorithm Lab	0	0	2				25		25	50	1
9	KCS554	Mini Project or Internship Assessment*	0	0	2				50			50	1
10	KNC501/ KNC502	Constitution of India. Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			
11		MOOCs (Essential for Hons. Degree)											
		Total										**950**	**22**

***The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

SEMESTER- VI												
Sl. No.	**Subject Codes**	**Subject**	**Periods**			**Evaluation Scheme**				**End Semester**		**Total**	**Credit**
			L	**T**	**P**	**CT**	**TA**	**Total**	**PS**	**TE**	**PE**		
1	KDS601	Big Data and Analytics	3	1	0	30	20	50		100		150	4
2	KCS602	Web Technology	3	1	0	30	20	50		100		150	4
3	KCS603	Computer Networks	3	1	0	30	20	50		100		150	4
4	Deptt. Elective-III	Departmental Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I [Annexure - B(iv)]	3	0	0	30	20	50		100		150	3
6	KCS651	Big Data and Analytics Lab	0	0	2				25		25	50	1
7	KCS652	Web Technology Lab	0	0	2				25		25	50	1
8	KCS653	Computer Networks Lab	0	0	2				25		25	50	1
9	KNC601/ KNC602	Constitution of India. Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			
10		MOOCs (Essential for Hons. Degree)											
		Total										**900**	**21**

Departmental Elective-I

1. KAI051 Mathematical Foundation AI , ML and Data Science
2. KCS052 Web Designing
3. KDS051 Business Intelligence and Analytics
4. KCS054 Object Oriented System Design
5. KDS052 Software Engineering

Departmental Elective-II

1. KCS055 Machine Learning Techniques
2. KAI052 Natural Language Processing
3. KCS056 Application of Soft Computing
4. KDS053 Stream Processing and Analytics
5. KAI053 Intelligent Database System

Departmental Elective-III

1. KOT063 Artificial Intelligence
2. KDS061 Image Analytics
3. KDS062 Social Network Analytics
4. KCS064 Data Compression
5. KDS063 Distributed System

B.TECH.

Computer Science and Engineering (Data Science)

FIFTH SEMESTER (DETAILED SYLLABUS)

KCS 501	**DATABASE MANAGEMENT SYSTEM**	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	Apply knowledge of database for real life applications.	K_3
CO 2	Apply query processing techniques to automate the real time problems of databases.	K_3, K_4
CO 3	Identify and solve the redundancy problem in database tables using normalization.	K_2, K_3
CO 4	Understand the concepts of transactions, their processing so they will familiar with broad range of database management issues including data integrity, security and recovery.	K_2, K_4
CO 5	Design, develop and implement a small database project using database tools.	K_3, K_6

DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.	**08**
II	**Relational data Model and Language:** Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQl Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL	**08**
III	**Data Base Design & Normalization:** Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	**08**
IV	**Transaction Processing Concept:** Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.	**08**
V	**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, Case Study of Oracle.	**08**

Text books:

1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
2. Date C J, "An Introduction to Database Systems", Addision Wesley
3. Elmasri, Navathe, " Fundamentals of Database Systems", Addision Wesley
4. O'Neil, Databases, Elsevier Pub.
5. RAMAKRISHNAN"Database Management Systems",McGraw Hill
6. Leon & Leon,"Database Management Systems", Vikas Publishing House
7. Bipin C. Desai, " An Introduction to Database Systems", Gagotia Publications
8. Majumdar & Bhattacharya, "Database Management System", TMH

KDS 501	INTRODUCTION TO DATA ANALYTICS AND VISUALIZATION	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	K_3
CO 2	Understand and apply Data Analysis Techniques.	K_3, K_4
CO 3	Implement various Data streams.	K_2, K_3
CO 4	Understand item sets, Clustering, frame works & Visualizations.	K_2, K_4
CO 5	Understand the Data Visualizations & Human Vision	K_2, K_3

DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Data Analytics:** Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. **Data Analytics Lifecycle:** Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.	**08**
II	**Data Analysis:** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	**08**
III	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.	**08**
IV	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	**08**
V	Introduction to Visualization and Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space- Rendering Time – Navigation Links. Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects -Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.	**08**

Text books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.
3. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
5. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley

6. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series
7. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier
8. Anil Maheshwari, “Data Analytics”, McGraw Hill Education
9. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill
10. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer
11. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication
12. Pete Warden, Big Data Glossary, O’Reilly
13. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons
14. Pete Warden, Big Data Glossary, O’Reilly.
15. Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, "Handbook of Big Data", CRC Press
16. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, ElsevierRobert Spence, “Information Visualization Design for Interaction”, Second Edition, Pearson Education, 2006.

KCS 503	DESIGN AND ANALYSIS OF ALGORITHM	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
	At the end of course , the student will be able to understand	
CO 1	Design new algorithms, prove them correct, and analyze their asymptotic and absolute runtime and memory demands.	K_4, K_6
CO 2	Find an algorithm to solve the problem (create) and prove that the algorithm solves the problem correctly (validate).	K_5, K_6
CO 3	Understand the mathematical criterion for deciding whether an algorithm is efficient, and know many practically important problems that do not admit any efficient algorithms.	K_2, K_5
CO 4	Apply classical sorting, searching, optimization and graph algorithms.	K_2, K_4
CO 5	Understand basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.	K_2, K_3

DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Performance Measurements, Sorting and Order Statistics - Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time.	**08**
II	**Advanced Data Structures:** Red-Black Trees, B – Trees, Binomial Heaps, Fibonacci Heaps, Tries, Skip List	**08**
III	**Divide and Conquer** with Examples Such as Sorting, Matrix Multiplication, Convex Hull and Searching. **Greedy Methods** with Examples Such as Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths - Dijkstra's and Bellman Ford Algorithms.	**08**
IV	**Dynamic Programming** with Examples Such as Knapsack. All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Backtracking, Branch and Bound with Examples Such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	**08**
V	**Selected Topics:** Algebraic Computation, Fast Fourier Transform, String Matching, Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms	**08**

Text books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
4. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill
5. Richard E.Neapolitan "Foundations of Algorithms" Jones & Bartlett Learning
6. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.
7. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006.
8. Harry R. Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins, 1997
9. Robert Sedgewick and Kevin Wayne, Algorithms, fourth edition, Addison Wesley, 2011.
10. Harsh Bhasin,"Algorithm Design and Analysis",First Edition,Oxford University Press.
11. Gilles Brassard and Paul Bratley,Algorithmics:Theory and Practice,Prentice Hall,1995.

KAI 051	MATHEMATICAL FOUNDATION AI , ML AND DATA SCIENCE	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand and apply the probability distributions, random number generation and density estimations to perform analysis of various kinds of data	$K2, K_4, K_6$
CO 2	Understand and manipulate data, design and perform simple Monte Carlo experiments, and be able to use resampling methods	K_5, K_6
CO 3	Perform statistical analysis on variety of data	K_2, K_5
CO 4	Perform appropriate statistical tests using R and visualize the outcome	K_2, K_4
CO 5	Discuss the results obtained from their analyses after creating customized graphical and numerical summaries	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Descriptive Statistics:** Diagrammatic representation of data, measures of central tendency, measures of dispersion, measures of skewness and kurtosis, correlation, inference procedure for correlation coefficient, bivariate correlation, multiple correlations, linear regression and its inference procedure, multiple regression. **Probability:** Measures of probability, conditional probability, independent event, Bayes' theorem, random variable, discrete and continuous probability distributions, expectation and variance, markov inequality, chebyshev's inequality, central limit theorem.	**08**
II	**Inferential Statistics:** Sampling & Confidence Interval, Inference & Significance. Estimation and Hypothesis Testing, Goodness of fit, Test of Independence, Permutations and Randomization Test, t-test/z-test (one sample, independent, paired), ANOVA, chi-square. **Linear Methods for Regression Analysis:** multiple regression analysis, orthogonalization by Householder transformations (QR); singular value decomposition (SVD); linear dimension reduction using principal component analysis (PCA).	**08**
III	**Pseudo-Random Numbers:** Random number generation, Inverse-transform, acceptance-rejection, transformations, multivariate probability calculations. **Monte Carlo Integration:** Simulation and Monte Carlo integration, variance reduction, Monte Carlo hypothesis testing, antithetic variables/control variates, importance sampling, stratified sampling Markov chain Monte Carlo (McMC): Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence	**08**
IV	**Vector Spaces-** Vector Space, Subspace , Linear Combination, Linear Independence, Basis, Dimension, Finding a Basis of a Vector Space , Coordinates, Change of Basis **Inner Product Spaces-** Inner Product, Length, Orthogonal Vectors, Triangle Inequality, Cauchy-Schwarz Inequality, Orthonormal (Orthogonal) Basis, Gram-Schmidt Process	**08**
V	**Linear Transformations**- Linear Transformations and Matrices for Linear Transformation, Kernel and Range of a Linear Transformations, Change of Basis **Eigenvalues and Eigenvectors**- Definition of Eigenvalue and Eigenvector, Diagonalization , Symmetric Matrices and Orthogonal Diagonalization	**08**

References:

1. S.C. Gupta & V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons
2. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Press.
3. Dudewicz, E.J., Mishra, S.N., “Modern Mathematical Statistics”, Willy
4. Purohit S. G., Gore S. D., Deshmukh S. K., “Statistics using R, Narosa
5. Rizzo, M. L., “Statistical Computing with R”, Boca Raton, FL: Chapman & Hall/CRC Press
6. Normal Maltoff, The Art of R programming, William
7. Dalgaard, Peter, “Introductory statistics with R”, Springer Science & Business Media
8. M. D. Ugarte, A. F. Militino, A. T. Arnholt, “Probability and Statistics with R”, CRC Press
9. Kundu, D. and Basu, A., “Statistical computing – existing methods and recent developments”, Narosa
10. Gentle, James E., Härdle, Wolfgang Karl, Mori, Yuich, “Handbook of Computational Statistics”, Springer
11. Givens and Hoeting, “Computational Statistics”, Wiley Series in Prob. and Statistics
12. Elementary Linear Algebra by Ron Larson, 8th edition, Cengage Learning, 2017

KCS 052	WEB DESIGNING	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand principle of Web page design and about types of websites	K_3, K_4
CO 2	Visualize and Recognize the basic concept of HTML and application in web designing.	K_1, K_2
CO 3	Recognize and apply the elements of Creating Style Sheet (CSS).	K_2, K_4
CO 4	Understand the basic concept of Java Script and its application.	K_2, K_3
CO 5	Introduce basics concept of Web Hosting and apply the concept of SEO	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction :** Basic principles involved in developing a web site, Planning process , Domains and Hosting, Responsive Web Designing , Types of Websites (Static and Dynamic Websites), Web Standards and W3C recommendations, **Introduction to HTML:** What is HTML , HTML Documents, Basic structure of an HTML document , Creating an HTML document , Mark up Tags , Heading-Paragraphs , Line Breaks	**08**
II	**Elements of HTML:** HTML Tags., Working with Text , Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls	**08**
III	**Concept of CSS:** Creating Style Sheet, CSS Properties , CSS Styling(Background, Text Format, Controlling Fonts) , Working with block elements and objects , Working with Lists and Tables , CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties) CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) , CSS Color , Creating page Layout and Site Designs.	**08**
IV	Introduction to Client Side Scripting , Introduction to Java Script , Javascript Types , Variables in JS, Operators in JS , Conditions Statements , Java Script Loops, JS Popup Boxes , JS Events , JS Arrays, Working with Arrays, JS Objects ,JS Functions , Using Java Script in Real time , Validation of Forms, Related Examples	**08**
V	**Web Hosting:** Web Hosting Basics , Types of Hosting Packages, Registering domains , Defining Name Servers , Using Control Panel, Creating Emails in Cpanel , Using FTP Client, Maintaining a Website **Concepts of SEO :** Basics of SEO, Importance of SEO, Onpage Optimization Basics	**08**

Text Books:

1. Steven M. Schafer, "HTML, XHTML, and CSS Bible, 5ed", Wiley India
2. Ian Pouncey, Richard York, "Beginning CSS: Cascading Style Sheets for Web Design", Wiley India

KDS 051	BUSINESS INTELLIGENCE AND ANALYTICS	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand the essentials of BI & data analytics and the corresponding terminologies	K_2
CO 2	Analyze the steps involved in the BI - Analytics process	K_3, K_4
CO 3	Illustrate competently on the topic of analytics	K_2, K_3
CO 4	Understand & Implement the K-Means Clustering with Iris Dataset	K_2, K_3
CO 5	Demonstrate the real time scenario (Case study) by using BI & Analytics techniques	K_5, K_6

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**BUSINESS INTELLIGENCE – INTRODUCTION:** Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.	**8**
II	**BI – DATA MINING & WAREHOUSING:** Data Mining - Introduction to Data Mining, Architecture of Data Mining and How Data mining works(Process) , Functionalities & Classifications of Data Mining, Representation of Input Data, Analysis Methodologies. Data Warehousing - Introduction to Data Warehousing, Data Mart, Online Analytical Processing (OLAP) – Tools, Data Modelling, Difference between OLAP and OLTP, Schema – Star and Snowflake Schemas, ETL Process – Role of ETL	**8**
III	**BI – DATA PREPARTTION:** Data Validation - Introduction to Data Validation, Data Transformation – Standardization and Feature Extraction, Data Reduction – Sampling, Selection, PCA, Data Discretization	**8**
IV	**BI – DATA ANALYTICS PROCESS -** Introduction to analytics process, Types of Analytical Techniques in BI –Descriptive, Predictive, Perspective, Social Media Analytics, Behavioral, Iris Datasets	**8**
V	**IMPLEMENTATION OF BI –** Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis.	**8**

Text Books:

1. Carlo-Vercellis, "Business Intelligence Data Mining and Optimization for Decision-Making", First Edition
2. Drew Bentely, "Business Intelligence and Analytics" ,@2017 Library Pres., ISBN: 978-1-9789-2136-8
3. Larissa T. Moss & Shaku Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle
4. For Decision-Support Applications", First Edition, Addison-Wesley Professional,2003
5. Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., and Becker, B. John, "The Data Warehouse
6. Lifecycle Toolkit: Practical Techniques for Building Data Warehouse and Business Intelligence Systems", Second Edition, Wiley & Sons, 2008.
7. Cindi Howson, "Successful Business Intelligence", Second Edition, McGraw-Hill Education, 2013.

KCS 054	OBJECT ORIENTED SYSTEM DESIGN	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand the application development and analyze the insights of object oriented programming to implement application	K_2, K_4
CO 2	Understand, analyze and apply the role of overall modeling concepts (i.e. System, structural)	K_2, K_3
CO 3	Understand, analyze and apply oops concepts (i.e. abstraction, inheritance)	K_2, K_3, K_4
CO 4	Understand the basic concepts of C++ to implement the object oriented concepts	K_2, K_3
CO 5	To understand the object oriented approach to implement real world problem.	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, generosity, importance of modelling, principles of modelling, object oriented modelling, Introduction to UML, conceptual model of the UML, Architecture.	**08**
II	**Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. Class &Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams. **Collaboration Diagrams:** Terms, Concepts, depicting a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages. **Basic Behavioural Modeling:** Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram. **Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams.	**08**
III	Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations. **Structured analysis and structured design (SA/SD),** Jackson Structured Development (JSD).Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation. **Object oriented programming style:** reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation.	**08**
IV	**C++ Basics :** Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures **C++ Functions :** Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments, friend functions, virtual functions	**08**
V	**Objects and Classes :** Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion. Inheritance : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class **Polymorphism :** Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism	**08**

Text Books

1. James Rumbaugh et. al, "Object Oriented Modeling and Design", PHI
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education
3. Object Oriented Programming With C++, E Balagurusamy, TMH
4. C++ Programming, Black Book, Steven Holzner, dreamtech
5. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia
6. Object Oriented Programming with ANSI and Turbo C++, Ashok Kamthane, Pearson
7. The Compete Reference C++, Herbert Schlitz, TMH

KDS 052	SOFTWARE ENGINEERING	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to		
CO 1	Explain various software characteristics and analyze different software Development Models.	K_1, K_2
CO 2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K_1, K_2
CO 3	Compare and contrast various methods for software design	K_2, K_3
CO 4	Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.	K_3
CO 5	Manage software development process independently as well as in teams and make use of Various software management tools for development, maintenance and analysis.	K_5

DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	**08**
II	**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.	**08**
III	**Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.	**08**
IV	**Software Testing:** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, TopDown and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.	**08**
V	**Software Maintenance and Software Project Management:** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re- Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.	**08**

Text books:

1.RS Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.

2. Pankaj Jalote, Software Engineering, Wiley
3. Rajib Mall, Fundamentals of Software Engineering, PHI Publication.
4. KK Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
5. Ghezzi, M. Jarayeri, D. Manodrioli, Fundamentals of Software Engineering, PHI Publication.
6. Ian Sommerville, Software Engineering, Addison Wesley.
7. Kassem Saleh, "Software Engineering", Cengage Learning.
8. P fleeger, Software Engineering, Macmillan Publication

KCS 055	**MACHINE LEARNING TECHNIQUES**	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able:		
CO 1	To understand the need for machine learning for various problem solving	K_1 , K_2
CO 2	To understand a wide variety of learning algorithms and how to evaluate models generated from data	K_1 , K_3
CO 3	To understand the latest trends in machine learning	K_2 , K_3
CO 4	To design appropriate machine learning algorithms and apply the algorithms to a real-world problems	K_4 , K_6
CO 5	To optimize the models learned and report on the expected accuracy that can be achieved by applying the models	K_4, K_5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION** – Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, Genetic Algorithm), Issues in Machine Learning and Data Science Vs Machine Learning;	**08**
II	**REGRESSION:** Linear Regression and Logistic Regression **BAYESIAN LEARNING -** Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. **SUPPORT VECTOR MACHINE:** Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel,and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.	**08**
III	**DECISION TREE LEARNING** - Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. **INSTANCE-BASED LEARNING** – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	**08**
IV	**ARTIFICIAL NEURAL NETWORKS** – Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; **DEEP LEARNING** - Introduction,concept of convolutional neural network , Types of layers – (Convolutional Layers , Activation function , pooling , fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.	**08**
V	**REINFORCEMENT LEARNING**–Introduction to Reinforcement Learning , Learning Task,Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process , Q Learning - Q Learning function, Q Learning Algorithm),	**08**

	Application of Reinforcement Learning,Introduction to Deep Q Learning. **GENETIC ALGORITHMS:** Introduction, Components, GA cycle of reproduction, Crossover, Mutation, Genetic Programming, Models of Evolution and Learning, Applications.	

Text books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.
5. M. Gopal, "Applied Machine Learning", McGraw Hill Education

KAI 052	**NATURAL LANGUAGE PROCESSING**	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able :		
CO 1	To learn the fundamentals of natural language processing	K_1 , K_2
CO 2	To understand the use of CFG and PCFG in NLP	K_1 , K_2
CO 3	To understand the role of semantics of sentences and pragmatic	K_2
CO 4	To Introduce Speech Production And Related Parameters Of Speech.	K_1 , K_2
CO 5	To Show The Computation And Use Of Techniques Such As Short Time Fourier Transform, Linear Predictive Coefficients And Other Coefficients In The Analysis Of Speech.	K_3, K_4
DETAILED SYLLABUS		**3-0-0**

Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION:** Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance **WORD LEVEL ANALYSIS :** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.	**08**
II	**SYNTACTIC ANALYSIS:** Context Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.	**08**
III	SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.	**08**
IV	**BASIC CONCEPTS of Speech Processing :** Speech Fundamentals: Articulatory Phonetics – Production And Classification Of Speech Sounds; Acoustic Phonetics – Acoustics Of Speech Production; Review Of Digital Signal Processing Concepts; Short-Time Fourier Transform, Filter-Bank And LPC Methods.	**08**
V	**SPEECH-ANALYSIS**: Features, Feature Extraction And Pattern Comparison Techniques: Speech Distortion Measures– Mathematical And Perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances And Filtering, Likelihood Distortions, Spectral Distortion Using A	

	Warped Frequency Scale, LPC, PLP And MFCC Coefficients, Time Alignment And Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths. **SPEECH MODELING** : Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-Estimation, Implementation Issues.	**08**

Text books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Lawrence Rabiner And Biing-Hwang Juang, "Fundamentals Of Speech Recognition", Pearson Education, 2003.
4. Daniel Jurafsky And James H Martin, "Speech And Language Processing – An Introduction To Natural Language Processing, Computational Linguistics, And Speech Recognition", Pearson Education, 2002.
5. Frederick Jelinek, "Statistical Methods Of Speech Recognition", MIT Press, 1997.
6. 1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
7. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015.
8. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
9. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

KCS 056	APPLICATION OF SOFT COMPUTING	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to :		
CO 1	Recognize the feasibility of applying a soft computing methodology for a particular problem	K_2, K_4
CO 2	Understand the concepts and techniques of soft computing and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.	K2,K_4, K_6
CO 3	Apply neural networks to pattern classification and regression problems and compare solutions by various soft computing approaches for a given problem.	K_3, K_5
CO 4	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems	K_3, K_4
CO 5	Apply genetic algorithms to combinatorial optimization problems	K3, K5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Neural Networks-I (Introduction & Architecture) :** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.	**08**
II	**Neural Networks-II (Back propagation networks):** Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications.	**08**
III	**Fuzzy Logic-I (Introduction):** Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.	**08**
IV	**Fuzzy Logic –II (Fuzzy Membership, Rules)** : Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications	**08**
V	**Genetic Algorithm(GA):** Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	**08**

Text books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press. Reference Books:
3. Siman Haykin,"Neural Networks"Prentice Hall of India
4. Saroj Kaushik, Sunita Tiwari, "Soft Computing: Fundamentals, Techniques and Applications", McGraw Hill Education
5. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
6. Kumar Satish, "Neural Networks" Tata Mc Graw Hill

KML 062/KDS 053	STREAM PROCESSING AND ANALYTICS	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Explain the need for stream processing	K_1, K_2
CO 2	Comprehend the architectures of stream processing.	K_2, K_3
CO 3	Explain and run Distributed Processing and Resilience Model	K_1, K_2
CO 4	Design effective streaming solutions using Structured Streaming	K_5, K_6
CO 5	Design effective streaming solutions using Spark Streaming	K_5, K_6

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Fundamentals of Stream Processing:** What Is Stream Processing? Examples of Stream Processing- Scaling Up Data Processing- Distributed Stream Processing- Introducing Apache Spark. Stream-Processing Model: Sources and Sinks- Immutable Streams Defined from One Another- Transformations and Aggregations- Window Aggregations - Stateless and Stateful Processing- The Effect of Time. **Practical Component:** a. Installing and configuring Apache Spark b. Installing and configuring the Scala IDE c. Installing and configuring JDK	**08**
II	**Components of a Data Platform-** Architectural Models- The Use of a Batch-Processing Component in a Streaming Application- Referential Streaming Architectures- Streaming Versus Batch Algorithms. Apache Spark as a Stream-Processing Engine: Spark's Memory Usage- Understanding Latency-Throughput- Oriented Processing- Fast Implementation of Data Analysis. **Practical Component:** a. Write your own Spark Streaming program, to count the number of words in text data received from a data server listening on a TCP socket b. Write a simple Spark Streaming program that prints a sample of the tweets it receives from Twitter every second.	**08**
III	**Spark's Distributed Processing Model:** Running Apache Spark with a Cluster Manager- Spark's Own Cluster Manager - Resilience and Fault Tolerance in a Distributed System- Data Delivery Semantics- Microbatching and One-Element-at-a-Time - Bringing Microbatch and One-Record-at a- Time Closer Together- Dynamic Batch Interval- Structured Streaming Processing Model. Spark's Resilience Model: Resilient Distributed Datasets in Spark - Spark Components - Spark's Fault-Tolerance Guarantees. **Practical Component:** a. Create Spark RDD using parallelize with spark Context. Parallelize () method and using Spark shell b. Write a scripts in Spark to Read all text files from a directory into a single RDD c. Write a spark program to load a CSV file into Spark RDD using a Scala d. Write a Spark Streaming program for adding 1 to the stream of integers in a reliable, fault tolerant manner, and then visualize them.	**08**
IV	**Introducing Structured Streaming-** The Structured Streaming Programming Model – Structured	**08**

	Streaming in Action – Structured Streaming Sources – Structured Streaming Sinks - Event Time–Based Stream Processing. **Practical Component:** a. Develop a streaming application by- Connecting to a Stream, Preparing the Data in the Stream, Performing Operations on Streaming Dataset, creating a Query, Starting the Stream Processing and Exploring the data. b. Create a Structured streaming job by Initializing Spark, acquiring streaming data from sources, declaring the operations we want to apply to the streaming data and outputting the resulting data using Sinks. c. Create a small but complete Internet of Things (IoT)-inspired streaming program. d. Define the schema in Structured Streaming to handle the data at different levels. e. Create custom sinks to write data to systems not supported by the default implementations	
V	**Introducing Spark Streaming** - The Spark Streaming Programming Model - The Spark Streaming Execution Model - Spark Streaming Sources - Spark Streaming Sinks - Time-Based Stream Processing- Working with Spark SQL – Checkpointing - Monitoring Spark Streaming- Performance Tuning. **Practical Component:** (i) Develop any Spark Streaming application and do the following : a) Create a Spark Streaming Context, b) Define one or several DStreams from data sources or other DStreams c) Define one or more output operations to materialize the results of these	**08**

Text Books:

1. Gerard Maas and Francois Garillot , “Stream Processing with Apache Spark: Mastering Structured Streaming and Spark Streaming”, O’Reilly, 2019.
2. Henrique C. M. Andrade, Buğra Gedik and Deepak S. Turaga, “Fundamentals of Stream Processing: Application Design, Systems, and Analytics”, Cambridge University Press, 2014.
3. Bryon Ellis, “Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data”, Wiley, 1st Edition, 2014.
4. Anindita Basak, Krishna Venkataraman, Ryan Murphy, Manpreet Singh, “Stream Analytics with Microsoft Azure”, Packt Publishing, December 2017.

KAI 053	INTELLIGENT DATABASE SYSTEM	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand the concepts of Intelligent database.	K_2
CO 2	Make study of the Database installation then create the database with user and apply SQL.	K_2, K_3
CO 3	Understand the concepts of knowledge-based systems and apply with AI	K_2, K_3
CO 4	Design and create the small applications	K_5, K_6
CO 5	Analyse and Implement for various real-time applications in Intelligent Database System	K_4, K_5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to IDBS-** Informal definition of the domain - General characteristics of IDBSs - Data models and the relational data model - A taxonomy of intelligent database systems - Guidelines for using intelligent database systems. **Practical Component:** (a) Install the LAMP (b) Configure and setup the Connection between back end & Front End.	**08**
II	**Semantic Data Models** Nested and semantic data models – Introduction - The nested relational model - Semantic models - Hyper-semantic data models - Object-oriented approaches to semantic data modeling – Objectoriented database systems - Basic concepts of a core object-oriented data model - Comparison with other data models - Query languages and query processing - Operational aspects – Systems – The ODMG standard - The object-relational data model - Java and databases – Conclusions – Active database systems - Basic concepts – Issues – Architectures - Research relational prototypes—the Starburst Rule System - Commercial relational approaches. **Practical Component:** (a) Design & create the DB user in database. (b) Using SQL - create sample DB for Language –DDL, DML and DCL. (c) Create sample java/PHP pages with database access.	**08**
III	**Knowledge-Based Systems- AI Ccontext** Characteristics and classification of the knowledge-based systems – Introduction - The resolution principle - Inference by inheritance – Conclusion - Deductive database systems - Basic concepts - DATALOG language - Deductive database systems and logic programming systems—differences - Architectural approaches - Research prototypes - Updates in deductive databases - Integration of deductive database and object database technologies - Constraint databases - Conclusions. **Practical Component:** 1. Working on basic commands on datalog 2. Practice on projection and Selection in datalog **3.** Write a program that uses + and - from racket/base as external queries using DATALOG language	**08**
IV	**Advanced Knowledge-Based Systems** Introduction - Architectural solutions - The 'general bridge' solution - Extending a KBS with components proper to a DBMS - The 'tight coupling' approach – Conclusion - Advanced solutions: Introduction - A 'knowledge level' approach to the interaction with an IAS- TELOS - a language for implementing very large 'integral approach' systems- The CYC project - Other	

	projects based on a 'conceptual representation' approach - Lexical approaches to the construction of large KBs. **Practical Component:** Implement the techniques to manage knowledge-based systems.	**08**
V	**Applications in IDBS** Introduction - Temporal databases - Basic concepts - Temporal data models - Temporal query languages – Ontologies -Ontology theoretical foundations - Environments for building ontologies - Structured, semi-structured and unstructured data - Multimedia database - Semi-structured data - Mediators – Motivation – Architecture - Application of mediators to heterogeneous systems –Proposals - Multi-Agents systems - Main issues in designing a multi-agent system - Open problems. Internet indexing and retrieval - Basic indexing methods - Search engines or meta-searchers – Internet spiders - Data mining - Data mining tasks - Data mining tools - Medical and legal information systems - Medical information systems - Legal information systems – Conclusions. **Practical Component:** 1. Implement the temporal databases. 2. Design and develop a project using medical information system.	**08**

Text Books:

1. Elisa Bertino, Barbara Catania, GianPieroZarri, "Intelligent Database Systems",Collection ACM Press.
2. Ngoc ThanhNguyen, RadoslawKatarzyniak,and Shyi-MingChen (Eds.), "Advances in Intelligent Information andDatabase Systems ", Springer, 2010.

KCS 551	**DATABASE MANAGEMENT SYSTEMS LAB**	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand and apply oracle 11 g products for creating tables, views, indexes, sequences and other database objects.	K_2, K_4
CO 2	Design and implement a database schema for company data base, banking data base, library information system, payroll processing system, student information system.	K3, K5, K6
CO 3	Write and execute simple and complex queries using DDL, DML, DCL and TCL	K_4, K_5
CO 4	Write and execute PL/SQL blocks, procedure functions, packages and triggers, cursors.	K_4, K_5
CO 5	Enforce entity integrity, referential integrity, key constraints, and domain constraints on database.	K_3, K_4

DETAILED SYLLABUS

1. Installing oracle/ MYSQL
2. Creating Entity-Relationship Diagram using case tools.
3. Writing SQL statements Using ORACLE /MYSQL:
   a)Writing basic SQL SELECT statements.
   b) Restricting and sorting data.
   c)Displaying data from multiple tables.
   d)Aggregating data using group function.
   e)Manipulating data.
   e)Creating and managing tables.
4. Normalization
5. Creating cursor
6. Creating procedure and functions
7. Creating packages and triggers
8. Design and implementation of payroll processing system

9. Design and implementation of Library Information System
10. Design and implementation of Student Information System
11. Automatic Backup of Files and Recovery of Files
12. Mini project (Design & Development of Data and Application) for following :
    a) Inventory Control System.
    b) Material Requirement Processing.
    c) Hospital Management System.
    d) Railway Reservation System.
    e) Personal Information System.
    f) Web Based User Identification System.
    g) Timetable Management System.
    h) h) Hotel Management System

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (MySQL , SQL server , Oracle ,MongoDB ,Cubrid ,MariaDBetc)

Database Management Systems Lab (KCS-551): Mapping with Virtual Lab

Name of the Lab	Name of the Experiment
Database Management Lab (KCS-551)	Data Definition Language(DDL) Statements: (Create table, Alter table, Drop table)
	Data Manipulation Language(DML) Statements
	Data Query Language(DQL) Statements: (Select statement with operations like Where clause, Order by, Logical operators, Scalar functions and Aggregate functions)
	Transaction Control Language(TCL) statements: (Commit(make changes permanent), Rollback (undo)
	Describe statement: To view the structure of the table created

KDS 551	DATA ANALYTICS AND VISUALIZATION LAB	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
	At the end of course , the student will be able to	
CO 1	Implement numerical and statistical analysis on various data sources	K_3
CO 2	Apply data preprocessing and dimensionality reduction methods on raw data	K_3
CO 3	Implement linear regression technique on numeric data for prediction	K_3
CO 4	Execute clustering and association rule mining algorithms on different datasets	K_3
CO 5	Implement and evaluate the performance of KNN algorithm on different datasets	K_3, K_4

DETAILED SYLLABUS

1. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R.
2. To perform data import/export (.CSV, .XLS, .TXT) operations using data frames in R.
3. To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept in R.
4. To perform statistical operations (Mean, Median, Mode and Standard deviation) using R.
5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization
6. To perform dimensionality reduction operation using PCA for Houses Data Set
7. To perform Simple Linear Regression with R.
8. To perform K-Means clustering operation and visualize for iris data set
9. Learn how to collect data via web-scraping, APIs and data connectors from suitable sources as specified by the instructor.
10. Perform association analysis on a given dataset and evaluate its accuracy.
11. Build a recommendation system on a given dataset and evaluate its accuracy.
12. Build a time-series model on a given dataset and evaluate its accuracy.
13. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
14. Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (R , Python etc.)

KCS 553	DESIGN AND ANALYSIS OF ALGORITHM LAB	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Implement algorithm to solve problems by iterative approach.	K_2, K_4
CO 2	Implement algorithm to solve problems by divide and conquer approach	K_3, K_5
CO 3	Implement algorithm to solve problems by Greedy algorithm approach.	K_4, K_5
CO 4	Implement algorithm to solve problems by Dynamic programming, backtracking, branch and bound approach.	K_4, K_5
CO 5	Implement algorithm to solve problems by branch and bound approach.	K_3, K_4

DETAILED SYLLABUS

1. Program for Recursive Binary & Linear Search.
2. Program for Heap Sort.
3. Program for Merge Sort.
4. Program for Selection Sort.
5. Program for Insertion Sort.
6. Program for Quick Sort.
7. Knapsack Problem using Greedy Solution
8. Perform Travelling Salesman Problem
9. Find Minimum Spanning Tree using Kruskal's Algorithm
10. Implement N Queen Problem using Backtracking
11. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide and- conquer method works along with its time complexity analysis: worst case, average case and best case.
12. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate how the divide and- conquer method works along with its time complexity analysis: worst case, average case and best case.

13.6. Implement , the 0/1 Knapsack problem using

(a) Dynamic Programming method

(b) Greedy method.

14. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
15. Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
16. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
17. Write programs to (a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm.

(b) Implement Travelling Sales Person problem using Dynamic programming.

18. Design and implement to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.
19. Design and implement to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (C, C++ etc)

KDS 601	BIG DATA AND ANALYTICS	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to		
CO 1	Demonstrate knowledge of Big Data Analytics concepts and its applications in business.	K_1,K_2
CO 2	Demonstrate functions and components of Map Reduce Framework and HDFS.	K_1,K_2
CO 3	Discuss Data Management concepts in NoSQL environment.	K_6
CO 4	Explain process of developing Map Reduce based distributed processing applications.	K_2,K_5
CO 5	Explain process of developing applications using HBASE, Hive, Pig etc.	K_2,K_5
DETAILED SYLLABUS		**3-0-0**

Unit	Topic	Proposed Lectures
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications. Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	**06**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map Reduce:** Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce	**08**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface. Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures. **Hadoop Environment:** Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud	**08**
IV	**Hadoop Eco System and YARN**: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features - NameNode high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL Databases:** Introduction to NoSQL **MongoDB:** Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections **Spark:** Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.	**09**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig** - Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators,	**09**

	Hive - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user-defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	

Text books and References:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers and Techniques”, Prentice Hall.
5. Raj Kamal, Preeti Saxena, “Big Data Analytics”, McGraw Hill Education
6. Bart Baesens “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons
7. ArshdeepBahga, Vijay Madisetti, “Big Data Science & Analytics: A HandsOn Approach “, VPT
8. Anil Maheshwari, “Big Data”, Second Edition, McGraw Hill
9. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP
10. Tom White, "Hadoop: The Definitive Guide", O'Reilly.
11. Eric Sammer, "Hadoop Operations", O'Reilly.
12. Chuck Lam, “Hadoop in Action”, MANNING Publishers
13. Deepak Vohra, “Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools”, Apress
14. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly
15. Lars George, "HBase: The Definitive Guide", O'Reilly.
16. Alan Gates, "Programming Pig", O'Reilly.
17. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer
18. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons
19. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons
20. Pete Warden, “Big Data Glossary”, O’Reilly

KCS 602	WEB TECHNOLOGY	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
	At the end of course , the student will be able to	
CO 1	Explain web development Strategies and Protocols governing Web.	K_1, K_2
CO 2	Develop Java programs for window/web-based applications.	K_2, K_3
CO 3	Design web pages using HTML, XML, CSS and JavaScript.	K_2, K_3
CO 4	Creation of client-server environment using socket programming	K_1, K_2,
CO 5	Building enterprise level applications and manipulate web databases using JDBC	K_3, K_4
CO6	Design interactive web applications using Servlets and JSP	K_2, K_3

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction and Web Development Strategies, History of Web and Internet, Protocols Governing Web, Writing Web Projects, Connecting to Internet, Introduction to Internet services and tools, Introduction to client-server computing. Core Java: Introduction, Operator, Data type, Variable, Arrays, Methods & Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O, Java Applet, String handling, Event handling, Introduction to AWT, AWT controls, Layout managers	**08**
II	**Web Page Designing:** HTML: List, Table, Images, Frames, forms, CSS, Document type definition, XML: DTD, XML schemes, Object Models, presenting and using XML, Using XML Processors: DOM and SAX, Dynamic HTML	**08**
III	**Scripting:** Java script: Introduction, documents, forms, statements, functions, objects; introduction to AJAX, **Networking :** Internet Addressing, InetAddress, Factory Methods, Instance Methods, TCP/IP Client Sockets, URL, URL Connection, TCP/IP Server Sockets, Datagram.	**08**
IV	**Enterprise Java Bean:** Preparing a Class to be a JavaBeans, Creating a JavaBeans, JavaBeans Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean **Java Database Connectivity (JDBC):** Merging Data from Multiple Tables: Joining, Manipulating, Databases with JDBC, Prepared Statements, Transaction Processing, Stored Procedures.	**08**
V	**Servlets:** Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resources, Session Tracking, Cookies, Session Tracking with Http Session **Java Server Pages (JSP):** Introduction, Java Server Pages Overview, A First Java Server Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries..	**08**

Text books:

1. Burdman, Jessica, "Collaborative Web Development" Addison Wesley
2. Xavier, C, " Web Technology and Design" , New Age International
3. Ivan Bayross," HTML, DHTML, Java Script, Perl & CGI", BPB Publication
4. Bhave, "Programming with Java", Pearson Education
5. Herbert Schieldt, "The Complete Reference:Java", TMH.
6. Hans Bergsten, "Java Server Pages", SPD O'Reilly
7. Margaret Levine Young, "The Complete Reference Internet", TMH
8. Naughton, Schildt, "The Complete Reference JAVA2", TMH
9. Balagurusamy E, "Programming in JAVA", TMH

KCS 603	COMPUTER NETWORKS	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
	At the end of course , the student will be able to	
CO1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission	K_1,K_2
CO2	Apply channel allocation, framing, error and flow control techniques.	K_3
CO3	Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism.	K_2,K_3
CO4	Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.	K_2,K_3
CO5	Explain the functions offered by session and presentation layer and their Implementation.	K_2,K_3
CO6	Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.	K_2

	DETAILED SYLLABUS	**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introductory Concepts**: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. **Physical Layer:** Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.	**08**
II	**Link layer:** Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).	**08**
III	**Network Layer:** Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.	**08**
IV	**Transport Layer:** Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.	**08**
V	**Application Layer:** Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression, Cryptography – basic concepts.	**08**

Text books:

Text books and References:

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communication", Pearson.
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann
6. W. A. Shay, "Understanding Communications and Networks", Cengage Learning.
7. D. Comer, "Computer Networks and Internets", Pearson.
8. Behrouz Forouzan, "TCP/IP Protocol Suite", McGraw Hill.

KAI 501/KOT 063	ARTIFICIAL INTELLIGENCE	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.	K_2
CO 2	Understand search techniques and gaming theory.	K_2, K_3
CO 3	The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.	K_3 , K_4
CO 4	Student should be aware of techniques used for classification and clustering.	K_2 , K_3
CO 5	Student should aware of basics of pattern recognition and steps required for it.	K_2 , K_4

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**INTRODUCTION :** Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.	**08**
II	**PROBLEM SOLVING METHODS** Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games	**08**
III	**KNOWLEDGE REPRESENTATION** First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information	**08**
IV	**SOFTWARE AGENTS** Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	**08**
V	**APPLICATIONS** AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving	**08**

Text books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones, ―Artificial Intelli□ence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
4. Nils J. Nilsson, ―The Quest for Artificial Intelli□ence‖, Cambrid□e University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
6. Gerhard Weiss, ―Multi A□ent Systems‖, Second Edition, MIT Press, 2013.
7. David L. Poole and Alan K. Mackworth, ―Artificial Intelli□ence: Foundations of Computational A□ents‖, Cambrid□e University Press, 2010.

KDS 061	IMAGE ANALYTICS	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Infer the basics and fundamentals of digital image processing and Apply the various techniques for intensity transformations functions. Implement Color image Smoothing and Sharpening.	K_1, K_2
CO 2	Illustrate Morphological operation and Apply Some Basic Morphological Algorithms.	K_2, K_3
CO 3	Apply image segmentation techniques such as Optimum Global Thresholding using Otsu's Method, Active Contours: Snakes and Level Sets for various real-time applications.	K_3, K_4
CO 4	Analysis various Feature Extraction methods and Implement for various real-time applications.	K_3, K_4
CO 5	Apply and Analysis various Image Pattern Classification methods such as Minimum-Distance Classification, Optimum (Bayes) Statistical Classification, and Deep Convolutional Neural Network.	K_3, K_4

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Fundamentals:** Introduction – Fundamental steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Mathematical Tools Used in Digital Image Processing. Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformations - Histogram Processing. Color Fundamentals - Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters. **Practical Component:** Use Python/ MATLAB 1. Apply various intensity transformations functions. 2. Computing and plotting image histograms and use standard image processing toolbox Spatial filters. 3. Implement color image Smoothing and Sharpening.	**08**
II	**Morphological Image Processing:** Morphological Image Processing: Fundamentals - Erosion and Dilation - Opening and Closing – Hit or Miss Transform - Some Basic Morphological Algorithms – Morphological Reconstruction – Grayscale Morphology **Practical Component:** Use Python/ MATLAB 1. Implement Morphological operations. 2. Implement Morphological Reconstruction. 3. Implement Grayscale Morphology.	**08**
III	**Image Segmentation** Introduction - Point, Line, and Edge Detection – Thresholding: Foundation, Basic Global thresholding, Optimum Global Thresholding using Otsu's Method, Multiple Thresholds, Variable Thresholding –Segmentation by Region Growing and by Region Splitting and Merging – Image Segmentation: Active Contours: Snakes and Level Sets. **Practical Component:** Use Python/ MATLAB 1. Implement Optimum Global Thresholding using Otsu's Method. 2. Implement Image segmentation by Region Growing, Splitting and Merging 3. Implement Image Segmentation by Active Contours using anyone method Snakes and Level Sets.	**08**
IV	**Feature Extraction** Background - Representation – Boundary Preprocessing – Boundary Feature Descriptors: Some Basic Boundary Descriptors, Shape Numbers, Fourier Descriptors, Statistical Moments -	**08**

	Regional Feature Descriptors: Some Basic Descriptors, Topological and Texture Descriptors, Moment Invariants – Principal Components as Feature Descriptors – Whole-image Features Object – Scale-Invariant Feature Transform (SIFT). **Practical Component:** Use Python/ MATLAB 1. Implement Boundary Feature Descriptors 2. Implement Topological and Texture Descriptors 3. Implement Scale-Invariant Feature Transform (SIFT)	
V	**Image Pattern Classification** Background -Patterns and Pattern Classes – Pattern Classification by Prototype Matching: Minimum-Distance Classifier, Using Correlation for 2-D prototype matching, Matching SIFT Features, Matching Structural Prototypes - Optimum (Bayes) Statistical Classifiers - Neural Networks and Deep Learning: Background - The Perceptron - Multilayer Feedforward Neural Networks - Deep Convolutional Neural Networks **Practical Component:** Use Python/ MATLAB 1. Implement Minimum-Distance Classification Algorithm. 2. Implement Optimum (Bayes) Statistical Classification Algorithm. 3. Implement Deep Convolutional Neural Network.	**08**

Text Books:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson, 2018.
2. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
3. Anil K.Jain, "Fundamentals of Digital Image Processing", Person Education, 2003.

KDS 062	SOCIAL NETWORK ANALYTICS	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to:		
CO 1	Understand a social network analysis	K_1, K_2
CO 2	Understand the Web data and semantics in social network applications	K_1, K_2
CO 3	Model and aggregate the social network data	K_2, K_3
CO 4	Develop social–semantic applications	K_6
CO 5	Evaluate the social network extraction with case studies	K_4, K_5

DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Social Network Analysis:** Network analysis- Development of Social network analysis- Key concepts and measures in network analysis –The global structure of networks – The macro-structure of social networks – Personal networks. **Practical Component:** To Searching for the keyword Paris using the geographic search of Flickr.	**08**
II	**Web Semantics in Social Network Applications:** Electronic sources for network analysis – Electronic discussion networks – Blogs and online communities –Web-based networks – Knowledge Representation on the Semantic Web – Ontologies and their role in the Semantic Web Ontology languages for the Semantic Web – The Resource Description Framework (RDF) and RDF Schema – The Web Ontology Language (OWL) – Comparison to the Unified Modelling Language (UML) – Comparison to the Entity/Relationship (E/R) model and the relational model – Comparison to the Extensible Markup Language (XML) and XML Schema. **Practical Component:** Identify the features in web pages that can be used for social network extraction.	**08**
III	**Modelling and Aggregating Social Network Data:** State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Representing identity – On the notion of equality – Determining equality – Reasoning with instance equality – Evaluating smushing **Practical Component** a. Add data to a Sesame repository using the web interface b. Query data through the web interface of Sesame and display the results.	**08**
IV	**Developing Social-Semantic Applications** Building Semantic Web applications with social network features **–** The generic architecture of Semantic Web applications **–**Sesame – Elmo – GraphUtil – The features of Flink – System design – open academia: distributed, semantic-based publication management – The features of open academia – System design. **Practical Component: (Algorithm Implementation)** 1. Creating and write out a FOAF profile Using Elmo.	**08**
V	**Evaluation of Social Network Analysis** Evaluation of web-based social network extraction – Data collection – Preparing the data – Optimizing goodness of fit – Comparison across methods and networks – Predicting the goodness of fit – Evaluation through analysis – Semantic-based Social Network Analysis in the sciences – Data acquisition –Representation, storage and reasoning- Visualization and Analysis – Results – Descriptive analysis – Structural and cognitive effects on scientific performance . **Practical Component: (Algorithm Implementation)**	**08**

	1.Collect personal and social data using a custom-built online survey system which an online survey offers several advantages compared to a paper questionnaire 2. Draw the Histogram for the number of web pages per individual.	

Text Books:

1. Peter Mika , Social Networks and the Semantics Web",Springer, 2007
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.

KCS 064	**DATA COMPRESSION**	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to		
CO 1	Describe the evolution and fundamental concepts of Data Compression and Coding Techniques.	K_1, K_2
CO 2	Apply and compare different static coding techniques (Huffman & Arithmetic coding) for text compression.	K_2, K_3
CO 3	Apply and compare different dynamic coding techniques (Dictionary Technique) for text compression.	K_2, K_3
CO 4	Evaluate the performance of predictive coding technique for Image Compression.	K_2, K_3
CO 5	Apply and compare different Quantization Techniques for Image Compression.	K_2,K_3
DETAILED SYLLABUS		**3-0-0**

Unit	**Topic**	**Proposed Lecture**
I	Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.	**08**
II	The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.	**08**
III	Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Moveto-front coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.	**08**
IV	Distortion criteria, Models, Scalar Ouantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.	**08**
V	Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured VectorQuantizers.	**08**

Text books:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers
2. Elements of Data Compression,Drozdek, Cengage Learning
3. Introduction to Data Compression, Second Edition, Khalid Sayood,The Morgan aufmann Series
4.Data Compression: The Complete Reference 4th Edition byDavid Salomon, Springer
5.Text Compression1st Edition by Timothy C. Bell Prentice Hall

KDS 603	DISTRIBUTED SYSTEM	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to understand		
CO 1	To provide hardware and software issues in modern distributed systems.	K1 , K2
CO 2	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.	K2
CO 3	To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.	K4
CO 4	To know about Shared Memory Techniques and have Sufficient knowledge about file access	K1
CO 5	Have knowledge of Synchronization and Deadlock.	K1
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Characterization of Distributed Systems**: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks ,Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, termination detection.	**08**
II	**Distributed Mutual Exclusion:** Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.	**08**
III	**Agreement Protocols:** Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.	**08**
IV	Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols	**08**
V	**Transactions and Concurrency Control**: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault – tolerant services, highly available services, Transactions with replicated data.	**08**

Text books:

1. Singhal&Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna,Gehrke," Database Management Systems", McGraw Hill
3. Vijay K.Garg Elements of Distributed Compuitng , Wiley
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education 5. Tenanuanbaum, Steen," Distributed Systems", PHI

KCS 651	BIG DATA AND ANALYTICS LAB	
	Course Outcome (CO)	**Bloom's Knowledge Level (KL)**
	At the end of course , the student will be able to	
CO 1	Optimize business decisions and create competitive advantage with Big data analytics	K_3, K_5
CO 2	Practice java concepts required for developing map reduce programs	K_4, K_5
CO 3	Impart the architectural concepts of Hadoop and introducing map reduce paradigm.	K_4, K_5
CO 4	Practice programming tools PIG and HIVE in Hadoop eco system.	K_5
CO 5	Implement best practices for Hadoop development.	K_5, K_6

DETAILED SYLLABUS

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Implement the following file management tasks in Hadoop:
   i. Adding files and directories
   ii. Retrieving files
   iii. Deleting files Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented
5. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
6. Implementation of K-means clustering using Map Reduce
7. Installation of Hive along with practice examples.
8. Installation of HBase, Installing thrift along with Practice examples
9. Patrice importing and exporting data from various data bases .
10. Write PIG Commands: Write Pig Latin scripts sort, group, join, project, and filter your data.
11. Run the Pig Latin Scripts to find Word Count .
12. Run the Pig Latin Scripts to find a max temp for each and every year.

Note: The Instructor may add/delete/modify/tune experiments

KCS 652	WEB TECHNOLOGY LAB	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to		
CO 1	Develop static web pages using HTML	K_2, K_3
CO 2	Develop Java programs for window/web-based applications.	K_2, K_3
CO 3	Design dynamic web pages using Javascript and XML.	K_3, K_4
CO 4	Design dynamic web page using server site programming Ex. ASP/JSP/PHP	K_3, K_4
CO 5	Design server site applications using JDDC,ODBC and section tracking API	K_3, K_4

DETAILED SYLLABUS

This lab is based on the Web Technologies. Some examples are as follows:

1. Write HTML/Java scripts to display your CV in navigator, your Institute website, Department Website and Tutorial website for specific subject

2. Write an HTML program to design an entry form of student details and send it to store at database server like SQL, Oracle or MS Access.
3. Write programs using Java script for Web Page to display browsers information.
5. Write a Java applet to display the Application Program screen i.e. calculator and other.
6. Writing program in XML for creation of DTD, which specifies set of rules. Create a style sheet in CSS/ XSL & display the document in internet explorer.
7. Program to illustrate JDBC connectivity. Program for maintaining database by sending queries. Design and implement a simple servlet book query with the help of JDBC & SQL. Create MS Access Database, Create on ODBC link, Compile & execute JAVA JDVC Socket.
8. Install TOMCAT web server and APACHE. Access the above developed static web pages for books web site, using these servers by putting the web pages developed.
9. Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following. Create a Cookie and add these four user id's and passwords to this Cookie. 2. Read the user id and passwords entered in the Login form and authenticate with the values available in the cookies.
10. Install a database (Mysql or Oracle). Create a table which should contain at least the following fields: name, password, email-id, phone number Write a java program/servlet/JSP to connect to that database and extract data from the tables and display them. Insert the details of the users who register with the web site, whenever a new user clicks the submit button in the registration page.
11. Write a JSP which insert the details of the 3 or 4 users who register with the web site by using registration form. Authenticate the user when he submits the login form using the user name and password from the database
12. Design and implement a simple shopping cart example with session tracking API.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (Java , JSP , Bootstrap Firebug , WampServer , MongoDB, etc)

KCS 653	COMPUTER NETWORKS LAB	
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course , the student will be able to		
CO 1	Simulate different network topologies.	K_3, K_4
CO 2	Implement various framing methods of Data Link Layer.	K_3, K_4
CO 3	Implement various Error and flow control techniques.	K_3, K_4
CO 4	Implement network routing and addressing techniques.	K_3, K_4
CO 5	Implement transport and security mechanisms	K_3, K_4

DETAILED SYLLABUS

1. Implementation of Stop and Wait Protocol and Sliding Window Protocol.
2. Study of Socket Programming and Client – Server model
3. Write a code simulating ARP /RARP protocols.
4. Write a code simulating PING and TRACEROUTE commands
5. Create a socket for HTTP for web page upload and download.
6. Write a program to implement RPC (Remote Procedure Call)
7. Implementation of Subnetting .
8. Applications using TCP Sockets like
   a. Echo client and echo server b. Chat c. File Transfer
9. Applications using TCP and UDP Sockets like d. DNS e. SNMP f. File Transfer
10. Study of Network simulator (NS).and Simulation of Congestion Control Algorithms using NS
11. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer. i. Link State routing ii. Flooding iii. Distance vector
12. To learn handling and configuration of networking hardware like RJ-45 connector, CAT-6 cable, crimping tool, etc.
13. Configuration of router, hub, switch etc. (using real devices or simulators)
14. Running and using services/commands like ping, traceroute, nslookup, arp, telnet, ftp, etc.
15. Network packet analysis using tools like Wireshark, tcpdump, etc.
16. Network simulation-using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.
17. Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
It is also suggested that open source tools should be preferred to conduct the lab (C , C++ , Java , NS3, Mininet, Opnet, TCP Dump, Wireshark etc.

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