

5KS01 Database Management Systems (L-4, T-0, C-4)

Course Prerequisite: Discrete Mathematics, Data Structures and Algorithm

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Database Management Systems by being able to do each of the following:

- To understand the fundamental concepts of database management system.
- To learn database query languages.
- To give systematic database design approaches covering conceptual design, logical design and an overview of physical design.
- To understand the query processing and optimization.
- To learn basics of transaction management and concurrency control.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Model, design and normalize databases for real life applications.
2. Discuss data models, conceptualize and depict a database system using ER diagram.
3. Query Database applications using Query Languages like SQL.
4. Design & develop transaction processing approach for relational databases.
5. Understand validation framework like integrity constraints, triggers and assertions.

Unit I: Introduction to DBMS Hours: 8

Database System Applications, Purpose of database systems, View of Data, Database Languages Database Architecture, Database Users and Administrators, Entity- Relationship Model, Constraints, Removing redundant attributes in Entity sets, E-R diagrams, Reduction to Relational Schemas, E-R design issues, Extended E-R Features. (8)

Unit II: Relational Algebra, SQL Hours: 8

Relational Model: Structure of Relational Databases, Database schema, keys, schema diagram, relational query languages, relational operators, The Relational Algebra, Overview of SQL query language, SQL data definition, Basic Structure of SQL queries, Additional basic operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database Operations, Join expressions, Views.

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Unit III: Relational Database Design Hours: 8

Integrity Constraints, SQL data types and schemas, Authorization, Triggers, Features of good relational designs, atomic domains and First Normal Form, decomposition using functional dependencies, Functional dependency theory, Algorithms for decomposition, Decomposition using multi-valued dependencies, More Normal Forms, Database Design Process.

Unit IV: Query Processing and Query Optimization Hours: 8

Query Processing: Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Query Optimization: Overview, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans, Materialized Views.

Unit V: Transaction Management Hours: 8

Transaction Concept, Simple transaction model, Storage structure, Transaction Atomicity and Durability, transaction isolation, Serializability, transaction isolation and atomicity, transaction isolation levels, Implementation of Isolation levels, Transactions as SQL statements

Unit VI: Concurrency Control and recovery system Hours: 8

Lock-Based Protocols, Deadlock Handling, Multiple Granularities, Timestamp- Based Protocols, Validation-Based Protocols, Multi-version schemes, Recovery system :Failure classification, Storage, Recovery & Atomicity, Recovery algorithm, buffer management, Failure with loss of nonvolatile storage, early lock release and logical undo operations, Remote Backup Systems

Text Book: Abraham Silberschatz, Henry F. Korth, S. Sudarshan, DATABASE SYSTEM CONCEPTS, Sixth Edition, McGraw Hill

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill
2. Shamkant B. Navathe, RamezElmasri, Database Systems, Pearson Higher Education
3. Garcia-Molina, Ullman, Widom: Database System Implementation, Pearson education.
4. S. K. Singh: Database Systems, Concepts, Design and Applications, Pearson Education.
5. G.K. Gupta: Database Management Systems, McGraw Hill.
6. Toledo and Cushman: Database Management Systems, (Schaum's Outlines)

5KS02 COMPILER DESIGN (L-3, T-0, C-3)

Course Pre-requisite: Basic knowledge of Discrete Mathematics, Theory of Computation

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Compiler Design by being able to do each of the following:

- To learn concepts of programming language translation and phases of compiler design
- To understand the common forms of parsers.
- To study concept of syntax directed definition and translation scheme for the representation of language
- To illustrate the various optimization techniques for designing various optimizing compilers

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Describe the fundamentals of compiler and various phases of compilers.
2. Design and implement LL and LR parsers
3. Solve the various parsing techniques like SLR, CLR, LALR.
4. Examine the concept of Syntax-Directed Definition and translation.
5. Assess the concept of Intermediate-Code Generation and run-time environment
6. Explain the concept code generation and code optimization.

Unit I: Introduction to Compiler Hours: 06

Introduction to Compilers: Language Processor, The Structure of a Compiler. Lexical Analysis: The role of lexical analyzer, Input Buffering, Specification of tokens, Recognition of tokens, The lexical analyzer generator Lex, Finite Automata, From Regular Expressions to Finite Automata, State minimization of DFA.

Unit II: Syntax Analysis Hours: 07

Syntax Analysis: The role of the parser, Review of context free grammar for syntax analysis: Parse Tree and Derivation, Ambiguity in Grammar, Elimination of left recursion and left factoring. Top down parsing: recursive descent parsing, predictive parsers, Transition diagrams for predictive parsers, FIRST and FOLLOW, LL (1) Grammars, Construction of predictive parsing tables, Non recursive predictive parsing, Error recovery in predictive parsing.

Unit III: Bottom up parsing Hours: 07

Bottom up parsing: Handle pruning, Stack implementation of Shift Reduce Parsing, conflicts during shift reduce parsing Introduction to LR parsing: Simple LR, Items and the LR(0) Automation, The LR-Parsing algorithm, Construction of SLR parsing table, More powerful LR Parsers: canonical LR(1) Items, Constructing LR(1) sets of items and canonical LR(1) parsing tables, Constructing LALR parsing tables, The parser generator Yacc.

Unit IV: Syntax Directed Translation Hours: 07

Syntax Directed Translation: Syntax directed definitions, Inherited and synthesized attributes, Evaluation orders of SDD's: Dependency Graphs, S-attributed definitions, L-attributed definition. Application of Syntax-Directed Translation: Construction of syntax trees. Syntax-directed Translation Schemes.

Unit V: Intermediate-Code Generation Hours: 07

Intermediate-Code Generation: Variants of Syntax Trees: Directed Acyclic Graphs(DAG), Three Address Code. Run Time Environments: Storage Organization, Static versus Dynamic Storage Organization, Stack Allocation of Space: Activation trees, Activation Records, Calling Sequences, Variable- Length data on stack. Access to Nonlocal Data on the Stack. Heap Manager: The Memory Manager. Introduction to Garbage Collection: Design Goals for Garbage Collectors.

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Unit VI: Code Generation Hours: 06

Code Generation: Issues in Design of a Code generator, The Target Language, Address in the target code, Basic blocks and flow graphs. Optimization of Basic Blocks, Peephole Optimization and The Principal sources of Optimization.

Text Book: Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: "Principles, Techniques and Tools", Pearson Education Second Edition.

Reference Books:

1. D. M. Dhamdhere, Compiler Construction—Principles and Practice, (2/e), Macmillan India.
2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman Compilers: "Principles, Techniques and Tools", Pearson Education (Low Price Edition).
3. Andrew Appel, Modern Compiler Implementation in C, Cambridge University press.
4. K C. Louden "Compiler Construction—Principles and Practice" India Edition, CENGAGE.
5. Bennett J.P., "Introduction to Compiling Techniques", 2/e (TMH).

5KS03 COMPUTER ARCHITECTURE & ORGANIZATION (L-3, T-0, C-3)

Course Pre-requisite: Microprocessor & Assembly Language Programming

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Computer Architecture & Organization by being able to do each of the following:

- To discuss the basic concepts and structure of computers.
- To solve concepts of arithmetic operations.
- To understand addressing modes and memory organization.
- To analyze conceptualize multitasking ability of a computer and pipelining
- To explain IO communication

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Discuss basic structure of computer.
2. Understand the basic operation of CPU.
3. Compare and select various Memory and I/O devices as per requirement.
4. Solve the concepts of number representation and their operation.
5. Explain the concept of parallel processing and pipelining.

Unit I: Basic Structure of Computer Hours: 7

Basic Structure of Computer H/W & S/W: Functional Units, Basic Operational Concepts, Bus structures, Addressing Methods and Machine Program Sequencing: Memory Locations, Addresses, Instruction and instruction sequencing, Addressing Modes. Basic I/O Operations.

Unit II: Memory Unit Hours: 7

Basic Concepts, Memory Hierarchy, Semiconductor RAM Memories, Internal Organization of Memory Chips, Static Memories, Dynamic Memories, Read Only Memories, Speed, Size and Cost.

Unit III: Processing Unit Hours: 8

Fundamental Concepts, Execution of a Complete Instruction, Hardwired Control, Performance Consideration, Microprogrammed Control, Microinstructions, Microprogram Sequencing.

Unit IV: I/O Organization Hours:6

Accessing I/O Devices, Interrupts, Enabling and Disabling Interrupts, Handling Multiple Devices, DMA,I/O Hardware, Standard I/O Interfaces:SCSI

Unit V: Arithmetic Hours: 7

Number Representations, Design of Fast Adders, Signed Addition and Subtraction, Multiplication of Positive Numbers ,Booth Multiplier, Fast Multiplication ,Integer Division, Floating Point Numbers and Operations.

Unit VI: Parallel Organization and Pipelining Hours: 7

Parallel Processing, Array Processors, The Structure of General Purpose Multiple Processors, Symmetric, Multiprocessors, Multithreading and Chip Multiprocessors, Clusters, Multicore Organization, Memory Organization in Multiprocessors. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Text Book: Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill.

Reference Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
- John P. Hayes, "Computer Architecture and Organization", McGraw Hill Publication.
2. DA Patterson and JL Hennessy, Computer Organization and Design, Morgan Kaufmann Publisher, 2nd edition
3. A.S. Tanenbaum, "Structured Computer Organization", PHI Publication.

5KS04 COGNITIVE TECHNOLOGIES (L-3, T-0, C-3)

Course Prerequisite: Basic knowledge of Artificial Intelligence, Programming and Data Structures.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Cognitive Technologies by being able to do each of the following:

- This course intends to introduce concept of cognitive technologies and important approaches of cognitive technologies.
- Student will learn and analyze key concept of cognitive technologies.
- Students will gain an understanding of innovation concepts, terminology, current and future trends in cognitive technologies.
- Introduces students to IBM Watson platform, an artificially intelligent computer system capable of answering questions posed in natural language, developed in IBM's Deep QA project.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Describe the Cognitive computing and principles of cognitive systems.
2. Identify role of Natural Language Processing in cognitive system.
3. Outline application of advanced analytics in cognitive computing.
4. Justify role of Cloud and Distributed Computing in Cognitive Computing.
5. Assess the process of building a Cognitive Application.
6. Identify the Emerging Areas and Future Applications of Cognitive Computing.

Unit I: Foundation of Cognitive Computing & Design Principle of Cognitive Systems Hours: 07

The Foundation of Cognitive Computing: Cognitive Computing as a New Generation, The Uses of Cognitive Systems, What Makes a System Cognitive, Gaining Insights from Data, Domains Where Cognitive Computing Is Well Suited, Artificial Intelligence as the Foundation of Cognitive Computing, Understanding Cognition, Two Systems of Judgment and Choice, Understanding Complex Relationships Between Systems, The Elements of a Cognitive System, Infrastructure and Deployment Modalities.

Design Principles for Cognitive Systems: Components of a Cognitive System, Building the Corpus, Bringing Data into the Cognitive System, Machine Learning, Hypotheses Generation and Scoring, Presentation and Visualization Services.

Unit II: NLP and Big Data in Cognitive System Hours: 07

Natural Language Processing in Support of a Cognitive System: The Role of NLP in a Cognitive System, Semantic Web, Applying Natural Language Technologies to Business Problems.

The Relationship Between Big Data and Cognitive Computing: Dealing with Human-Generated Data, Defining Big Data, The Architectural Foundation for Big Data, Analytical Data Warehouses, Hadoop, Data in Motion and Streaming Data, Integration of Big Data with Traditional Data.

Unit III: Knowledge Representation and Advance Analytics in Cognitive Computing Hours: 06

Representing Knowledge in Taxonomies and Ontologies: Representing Knowledge, Developing a Cognitive System, Defining Taxonomies and Ontologies, Explaining How to Represent Knowledge, Models for Knowledge Representation. Applying Advanced Analytics to Cognitive Computing: Advanced Analytics Is on a Path to Cognitive Computing, Key Capabilities in Advanced Analytics, Using Advanced Analytics to Create Value, Impact of Open Source Tools on Advanced Analytics.

Unit IV: Role of Cloud and Distributed Computing in Cognitive Computing Hours: 07

The Role of Cloud and Distributed Computing in Cognitive Computing: Leveraging Distributed Computing for Shared Resources, Why Cloud Services Are Fundamental to Cognitive Computing Systems, Characteristics of Cloud Computing, Cloud Computing Models, Delivery Models of the Cloud, Managing Workloads, Security and Governance, Data Integration and Management in the Cloud.

The Business Implications of Cognitive Computing: Preparing for Change, Advantages of New Disruptive Models, What Does Knowledge Mean to the Business?, The Difference with a Cognitive Systems Approach, Meshing Data Together Differently, Using Business Knowledge to Plan for the Future, Answering Business Questions in New Ways, Building Business Specific Solutions, Making Cognitive Computing a Reality, How a Cognitive Application Can Change a Market.

Unit V: IBM Watson and Process of Building a Cognitive Application Hours: 07

IBM's Watson as a Cognitive System: Watson Defined, Advancing Research with a "Grand Challenge", Preparing Watson for Jeopardy, Preparing Watson for Commercial Applications, The Components of DeepQA Architecture.

The Process of Building a Cognitive Application: The Emerging Cognitive Platform, Defining the Objective, Defining the Domain, Understanding the Intended Users and Defining their Attributes, Defining Questions and Exploring Insights, Creating and Refining the Corpora, Training and Testing.

Building a Cognitive Healthcare Application: Foundations of Cognitive Computing for Healthcare, Constituents in the Healthcare Ecosystem, Learning from Patterns in Healthcare Data, Building on a Foundation of Big Data Analytics, Cognitive Applications across the Healthcare Ecosystem, Starting with a Cognitive Application for Healthcare, Using Cognitive Applications to Improve Health and Wellness, to Enhance the Electronic Medical Record and to Improve Clinical Teaching.

Unit VI: Emerging Areas and Future Application Hours: 06

Smarter Cities: Cognitive Computing in Government: How Cities Have Operated, The Characteristics of a Smart City, The Rise of the Open Data Movement Will Fuel Cognitive Cities, The Internet of Everything and Smarter Cities, Understanding the Ownership and Value of Data, Smarter Approaches to Preventative Healthcare, Building a Smarter Transportation Infrastructure, Using Analytics to Close the Workforce Skills Gap, Creating a Cognitive Community Infrastructure, The Next Phase of Cognitive Cities.

Emerging Cognitive Computing Areas: Characteristics of Ideal Markets for Cognitive, Computing Vertical Markets and Industries.

Future Applications for Cognitive Computing: Requirements for the Next Generation, Technical Advancements That Will Change the Future of Cognitive Computing, What the Future Will Look Like, Emerging Innovations.

Text Book:

Judith Hurwitz, Marcia Kaufman and Adrian Bowles, "Cognitive Computing and Big Data Analytics", publication John Wiley & Sons, Inc, 2015.

Reference Books:

1. José Luis Bermúdez, Cognitive Science: An Introduction to the Science of the Mind, publication Cambridge University Press, New York, Second Edition.
2. Jay Friedenberg and Gordon Silverman, Cognitive Science: An Introduction to the Study of Mind, Sage Publications, Inc. London, 2014.
3. Huimin Lu (Editor), Cognitive Internet of Things: Frameworks, Tools and Applications, Springer Nature Switzerland AG 2020.
4. Danish Contractor and Aaditya Telang (Editors), Applications of Cognitive Computing Systems and IBM Watson, 8th IBM Collaborative Academia Research Exchange, publication Springer Nature Singapore Pte Ltd., 2017.
5. S. Bird, E. Klein, E. Loper (2009), Natural Language Processing with Python, O' Reilly Media.

5KS04 DATA SCIENCE AND STATISTICS [L-3, T-0, C-3]

Course Prerequisite: Basic knowledge of Mathematics

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science and Statistics by being able to do each of the following:

- Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
- Apply principles of Data Science to the analysis of business problems.
- Apply the learned concepts for the skillful data management.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Demonstrate proficiency with statistical analysis of data.
2. Build skills in transformation and merging of data for use in analytic tools.
3. Perform linear and multiple linear regression analysis.
4. Develop the ability to build and assess data-based models.
5. Evaluate outcomes and make decisions based on data.

Unit I: Data Science and Statistical Learning Hours: 6

Introduction: What Is Data Science?, Statistical Inference, Exploratory Data Analysis, and the Data Science Process, Exploratory Data Analysis, Stages of a Data Science Project, The Data Science Process, Why Statistical Learning: f Estimation- Why and How, Tradeoff Between Prediction Accuracy and Model Interpretability, Supervised vs Unsupervised Learning, Regression vs Classification Problems, Accessing Model Accuracy: Measuring the Quality of Fit, The Bias Variance Trade-off, The Classification Setting.

Unit II: Linear Regression Hours: 7

Simple Linear Regression: Estimating the Coefficients, Assessing the Accuracy of the Coefficient Estimates, Assessing the Accuracy of the Model, Multiple Linear Regression: Estimating the Regression Coefficients, Other Considerations in the Regression Model: Qualitative Predictors, Extensions of the Linear Model, Potential Problems, The Marketing Plan, Comparison of Linear Regression with K-Nearest Neighbors.

Unit III: Classification and Cross Validation Hours: 7

Classification: An Overview of Classification, Why not Linear Regression?, Logical Regression: The Logistic Model, Regression Coefficients, Making Predictions, Multiple Logistic Regression, >2 Response Classes, Linear Discriminant Analysis: Using Bayes' Theorem, LDA for $p = 1$ and $p > 1$, Quadratic Discriminant Analysis, Comparison of Classification Methods, Cross Validation: The Validation Set Approach, Leave-One-Out and k-Fold Cross-Validation, Bias-Variance Trade-Off for k-Fold Cross-Validation, Classification Problems, The Bootstrap

Unit IV: Linear Model Selection and Regularization Hours: 6

Subset Selection: Best Subset Selection, Stepwise Selection, Choosing the Optimal Model, Shrinkage Methods: Ridge Regression, The Lasso, Selecting the Tuning Parameter, Dimension Reduction Methods: Principal Components Regression, Partial Least Squares, Considerations in High Dimensions: High-Dimensional Data, What Goes Wrong in High Dimensions?, Regression in High Dimensions, Interpreting Results in High Dimensions

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Unit V: Nonlinearity and Tree Based Methods Hours: 7

Moving Beyond Linearity: Polynomial Regression, Step Functions, Basis Functions, Regression Splines: Piecewise Polynomials, Constraints and Splines, Representation, Number and Locations of the Knots, Comparison to Polynomial Regression, Smoothing Splines: An Overview and Smoothing Parameter λ , Local Regression, Generalized Additive Models: Regression Problems and Classification Problems, Tree-Based Methods: Decision, Regression and Classification Trees, Trees Versus Linear Models, Advantages and Disadvantages, Bagging, Random Forests, Boosting

Unit VI: SVM and Unsupervised Learning Hours: 7

Maximal Margin Classifier: Hyperplane and Classification, The Maximal Margin Classifier, Construction, The Nonseparable Case, Support Vector Classifiers: Overview and Details, Support Vector Machines: Classification with Non-linear Decision Boundaries, SVM, Application, SVMs with More than Two Classes, Relationship to Logistic Regression, Unsupervised Learning: The Challenge of Unsupervised Learning: Principal Components Analysis, Clustering Methods: K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering.

Text Books:

1. Cathy O'Neil and Rachel Schutt: Doing Data Science, First Edition, 2014, O'reilly Publications, ISBN: 978-1-449-35865-5
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani: An Introduction to Statistical Learning with Applications in R, First Edition, 2013, Springer-Verlag New York, ISBN: 978-1- 4614-7137-0.

Reference Book:

Nina Zumel, John Mount: Practical Data Science with R, First Edition, 2014, Manning Publications Co., ISBN: 9781617291562.

5KS04 (Prof. Elect. – I) (ii) DATA SCIENCE AND STATISTICS (L-3, T-0, C-3)

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science and Statistics by being able to do each of the following:

1. To understand the need of data science and Statistics
2. To understand the knowledge of statistics data analysis techniques utilized in business decision making.
3. To understand and apply the different data modelling strategies.
4. To apply the learned concept for the skillful data management.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Explain basics and need of data science
2. Demonstrate proficiency with statistical analysis of data.
3. Perform linear and multiple linear regression analysis.
4. Develop the ability to build and assess classification-based models
5. Evaluate outcomes and make decisions based on data.
6. Compare machine learning techniques to solve data science business problems.

Unit I: Introduction to Data Science: (Hours:6)

Data Science: Where and relation with other fields, Relationship between Data Science and Information Science, Computational Thinking , Skills for Data Science , Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science Data: Data types, Data Collection, Data Pre-processing.

Unit II: Statistical Learning & Inference : (Hours: 8)

Need of Statistics in Data Science, Measures of central tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, variance, Mean deviation, standard deviation.

Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis , Diagnostic Analytics ,Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis, Regression.

Unit III: Regression and its Techniques: (Hours: 6)

Linear Regression, Multiple Linear Regression, Other Considerations in the Regression Model Comparison of Linear Regression with K-Nearest Neighbours.

Unit IV: Classification: (Hours: 6)

An Overview of Classification, Why Not Linear Regression? Logistic Regression, Linear Discriminant Analysis, Comparison of Classification Methods.

Unit V: Tree Based Methods: (Hours: 6)

Tree-Based Methods: The Basics of Decision Trees, Regression and Classification Trees, Trees Versus Linear Models, Advantages and Disadvantages, Bagging, Random Forests, Boosting.

Unit VI: Supervised and Unsupervised Learning: (Hours: 8)

Supervised Learning: Introduction, Logistic Regression, Softmax Regression, Classification with KNN, Decision Tree, 2.5.1 Decision Rule, Random Forest Naïve Bayes, Support Vector Machine (SVM)

Unsupervised Learning: Introduction, Agglomerative Clustering, Divisive Clustering, Expectation Maximization (EM) Introduction to Reinforcement Learning.

Text Books:

1. Chirag Shah, "A Hands-on Introduction to Data Science", Cambridge University Press (2020) ISBN:978-1-108-47244-9.
2. Data Mining: Concepts and Techniques By Jiawei Han, Jian Pei, Micheline Kamber (Chapter 2: point 2.2)
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani: An Introduction to Statistical Learning with Applications in R, First Edition, 2013, Springer-Verlag New York, ISBN: 978-1- 4614-7137-0.

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Reference Books:

1. Cathy O'Neil and Rachel Schutt: Doing Data Science, First Edition, 2014, O'reilly Publications, ISBN:978-1-449-35865-5.
2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edn.

5KS04 INTERNET OF THINGS [L-3, T-0, C-3]

Course Prerequisite: Basic knowledge of Internet and Microprocessor & Assembly Language Programming

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Internet of Things by being able to do each of the following:

- To learn and understand fundamental of IoT
- To study the design methodology and different IoT platform
- To understand usefulness of IoT for society
- To design and implement application of IoT using various sensor

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand the basics of IoT
2. Understand design methodology and platforms involved in IoT
3. Apply the knowledge to interface various sensors with IoT development
4. Design and Implement IoT system for real time application

Unit I: Hours: 6

Introduction to Internet of Things, Definition & Characteristics of IoT, Physical Design of IoT Logical Design of IoT, IoT Enabled Technologies like Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels & Deployment Templates, Domain Specific IoTs: Home, Cities, Environment, Energy systems, Logistics, Agriculture, Health & Lifestyle.

Unit II: Hours: 7

IOT & M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software defined networks, network function virtualization, IoT Systems Management, Simple Network Management Protocol (SNMP), Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG, NETOPEER.

Unit III: Hours: 7

IoT Platforms Design Methodology, Case Study on IoT System for Weather Monitoring, Motivation for Using Python, IoT Systems - Logical Design using Python, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling I, Date/Time Operations, Classes, Python Packages of Interest for IoT

Unit IV: (Hours: 7) IoT Physical Devices & Endpoints, Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces serial, SPI, I2C, Programming Raspberry Pi with Python, Controlling LED with Raspberry Pi, Interfacing an LED and switch with Raspberry Pi, Interfacing Light Sensor with Raspberry Pi Other IoT Devices, pcDuino, BeagleBone Black, Cubieboard.

Unit V: Hours: 7

IoT Physical Servers & Cloud Offerings, Introduction to Cloud Storage Models & Communication APIs, WAMP - AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework - Django, Designing a RESTful Web API, Amazon Web Services for ,SkyNet IoT Messaging Platform.

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Unit VI: Hours: 7

Case Studies Illustrating IoT Design, Introduction, Home Automation: Smart Lighting, Home Intrusion detection, Cities: Smart parking, Environment: Weather Monitoring System, Weather reporting Bot, Air pollution monitoring, Forest fire detection, Agriculture: Smart Irrigation, Productivity Applications: IoT printer.

Text Book: Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, ISBN:0: 0996025510, 13: 978-0996025515.

Reference Books:

1. Fundamentals of Python, K.A.Lambert and B.L.Juneja, Cengage Learning, 2012.
2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014

5KS04 INTRODUCTION TO CYBER SECURITY [L-3, T-0,C-3]

Course Prerequisite: Computer Programming, Data Structure, Data Communication & Networking.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Introduction to Cyber Security by being able to do each of the following:

- Understand basics of Cybercrime and Information Security.
- To familiarize various cyber threats, attacks, Cyber offenses.
- Understand Cybercrime on Mobile and Wireless devices.
- Understand tools and methods used in Cybercrime.
- Understand Access Control and Authentication.
- Understand Intrusion Detection and Prevention.

Course Outcomes (Expected Outcome): After completion of this course, the students should be able to:

1. Know fundamentals of Cybercrimes and Cyber offenses
2. Realize the Cyber threats, attacks and Vulnerabilities.
3. Explore the industry practices and tools.
4. Comprehend the Access Control and Authentication Process.
5. Implement Intrusion Detection and Prevention.

Unit I: Hours:6

Introduction to Cybercrime: Introduction, Cybercrime, Cybercrime and Information Security, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era.

Unit II: Hours: 6

Cyber offenses: Introduction, Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrime, Botnets, Attack Vector, Cloud Computing.

Unit III: Hours: 6

Cybercrime: Mobile and Wireless Devices Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Cards Frauds in Mobile and Wireless Computing, Security Challenges posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implementations for Organizations, Organizational Measures for Handling Mobile, Devices Related Security Issues Organizational Security Policies and Measures in Mobile Computing, Laptops.

Unit IV: Hours: 6

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Unit V: Hours:6

Access Control and Authorization: Definitions, Access Rights, Access Control Systems, Authorization, Types of Authorization Systems, Authorization Principles, Authorization Granularity, Web Access and Authorization. Authentication: Definition, Multiple Factors and Effectiveness of Authentication, Authentication Elements, Types of Authentication, Authentication Methods.

Unit VI: (Hours: 6) System Intrusion Detection and Prevention: Definition, Intrusion Detection, Intrusion Detection Systems (IDSs), Types of Intrusion Detection Systems, The Changing Nature of IDS Tools, Response to System Intrusion, Challenges to Intrusion Detection Systems, Implementing an Intrusion Detection System, Intrusion Prevention Systems (IPSs), Intrusion Detection Tools

Disaster Management: Introduction, Disaster Prevention, Disaster Response, Disaster Recovery, Make your Business Disaster Ready, Resources for Disaster Planning and Recovery.

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Text Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81- 265-21791,2013
2. Joseph Migga Kizza, "A Guide to Computer Network Security", Springer 2009.

Reference Books:

1. V.K. Pachghare, "Cryptography and information Security", PHI Learning Private Limited, Delhi India.
2. Nina Godbole, "Information Systems Security", Wiley India, New Delhi
3. Kenneth J. Knapp, "Cyber Security & Global Information Assurance", Information Science Publishing.
4. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials" CRC Press.
5. Jeetendra Pande, "Introduction to Cyber Security" Uttarakhand Open University, 2017

5KS05 PRINCIPLES OF MARKETING FOR ENGINEERING [L-3, T-0, C-3]

Course Pre-requisite: Basic knowledge of Computers.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Principles of Marketing for Engineering by being able to do each of the following:

- To provide students with the knowledge about business advantages of the digital marketing and its importance for marketing success;
- To develop a digital marketing plan; to make SWOT analysis;
- To define a target group; to introduced to various digital channels, their advantages and ways of integration;
- To integrate different digital media and create marketing content to manage a digital marketing performance efficiently.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Identify the importance of the digital marketing for marketing success,
2. Manage customer relationships across all digital channels and build better customer relationships,
3. Create a digital marketing plan, starting from the SWOT analysis and defining a target group,
4. Identify digital channels, their advantages and limitations, to perceiving ways of their integration taking into consideration the available budget

Unit I: Introduction to e-Marketing: Hours: 7

Introduction, Wired-up world, B2C, B2B, C2B and C2C Model, Objectives: Sell, Serve, Speak, Save, Sizzle, Introduction to e-strategy.

Unit II: Remix and e-Models Hours: 7

Introduction to Remix: Product, Price, Place, Promotion, People, Process. Introduction to e-Models, e-Marketplace, Digital Communication market, Web & Social Network Models, Customer buying models, Loyalty models

Unit III: e-Customers Hours: 7

Introduction to e-Customers, Motivations, Expectations, Fears & Phobias, Online Buying Process, information processing, relationship & royalty, Communities & social networks, Customer profiles

Unit IV: e-Tools & Site Design Hours:7

Introduction to e-Tools, Technology development & customer impact, Interactive digital TV, Digital Radio, Mobile Devices, Interactive self-service kiosks, Convergence, Integrated Campaigns, Web-site design, Integrated design, online value proposition, Dynamic & aesthetics design

Unit V: Traffic Building Hours: 7

Search Engine Marketing, Online PR & Partnerships, Interactive Advertising, e-mail & viral marketing, Online traffic building, Control, Resourcing

Unit VI: e-CRM & e-Business Hours: 7

Introduction to e-CRM, Database marketing, e-CRM, Profiling, Personalization, Introduction to e-Business, e-Business Architecture & framework, e-business security.

Text Book: E-Marketing excellence: Planning & Optimizing your Digital Marketing, Dave Chaffey & P R Smith, 3rd Edition, Butterworth-Heinemann, Elsevier.

Reference Books:

1. Marketing 4.0: Moving from Traditional to Digital, Philip Kotler, H. Kartajaya, I. Setiawan, Wiley.
2. Business Marketing and Management Principles for IT and Engineering, D. N. Chorafas, CRC Press.
3. Marketing Management, Philip Kotler, Kevin Keller, 12th Edition, Pearson Prentice Hall.
4. Marketing Insights from A to Z, Philip Kotler, John Wiley & Sons..

5KS05 Open Elect. I (i) FUNDAMENTALS OF FINANCE & ACCOUNTING [L-3, T-0, C-3]

Course Prerequisite: Basic Knowledge of Mathematics

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Fundamentals of Finance & Accounting by being able to do each of the following:

- Know and apply accounting and finance theory
- Critically evaluate financial statement information
- Evaluate and compare different investments

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Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Define bookkeeping and accounting
2. Explain the general purposes and functions of accounting
3. Explain the differences between management and financial accounting
4. Describe the main elements of financial accounting information – assets, liabilities, revenue and expenses
5. Identify the main financial statements and their purposes.

Unit I: The basics of Accounting I Hours: 7

The Assets, Liabilities and Balance Sheets, Procedure for creating a Balance Sheet, Different forms of Balance Sheet, Basic concepts of Accounting

Unit II: The basics of Accounting II Hours: 7

The Profit & Loss Account, Cash Flow Statement, Creating Profit & Loss Account, Creating Cash Flow Statement, Book Keeping Basic terminology, Debt & Credit Convention

Unit III: Interpretation of Accounts Hours: 8

Accounting Rules, Reports, Assets, Liabilities, Shareholders' Equity, P&L Statement,

Unit IV: Introduction to Financial Management Hours:6

What is Finance, Forms of Business Organization, Stock Price & Shareholder Value, Intrinsic Value, Stock Price, Business trends and ethics, Conflicts management.

Unit V: Financial Markets and Institutions Hours: 7

Financial Markets, Capital Allocation, Financial Institutions, Stock Market, Market for Common Stock, Stock Market Returns, Stock Market Efficiency

Unit VI: Financial Statements & Analysis Hours: 7

Financial Statements & Reports, Stockholders' Equity, Free Cash Flow, Income Taxes, Analysis of Financial Statements: Ratio Analysis, Liquidity Ratios, Asset & Debt Management Ratio, Profitability Ratio, Trend Analysis

Text Books:

1. Accounts Demystified, 5th Edition, Anthony Rice, Pearson – Prentice Hall
2. Fundamentals of Financial Management, 6th Edition, E. F. Brigham, J.F. Houston, Cengage Learning.

Reference Books:

1. Engineering Economics: Financial Decision Making for Engineering, N. M. Fraser, E. M. Jewkes, 5th Edition, Pearson Publication.
2. Financial Fundamentals for Engineers, Richard Hill & George Slot, Butterworth-Heinemann, Elsevier.
3. Financial Accounting, Jerry Weygandt, Paul Kimmel, Donald Kieso, 9th Edition, Wiley
4. Financial Accounting: Tools for Business Decision Making, Jerry Weygandt, Paul Kimmel, Donald Kieso, 6th Edition, Wiley Plus.

5KS05 ENTREPRENEURSHIP [L-3,T-0,C-3]

Course Prerequisite:

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Entrepreneurship by being able to do each of the following:

- Understand basic concepts in the area of entrepreneurship
- Understand the role and importance of entrepreneurship for economic development
- Develop personal creativity and entrepreneurial initiative,
- Adopt the key steps in the elaboration of business idea

Course Outcomes (Expected Outcome): On completion of this course, the students should be able to:

1. Analyse the business environment in order to identify business opportunities,
2. Identify the elements of success of entrepreneurial ventures,
3. Evaluate the effectiveness of different entrepreneurial strategies,
4. Specify the basic performance indicators of entrepreneurial activity,
5. Explain the importance of marketing and management in small businesses venture,
6. Interpret their own business plan.

Unit I: Hours:6

Introduction to Entrepreneurship: Introduction, Common Myths About Entrepreneurs, Types of Start- Up Firms, Changing Demographics of Entrepreneurs, Entrepreneurship Importance.

Recognizing Opportunities and Generating Ideas: Identifying and Recognizing Opportunities, Finding Gaps in the Marketplace, Techniques for Generating Ideas, Encouraging and Protecting New Ideas.

Unit II: Hours:6

Feasibility Analysis: Product/Service Feasibility Analysis, Industry/Target Market Feasibility Analysis, Organizational Feasibility Analysis and Financial Feasibility Analysis.

Writing A Business Plan: The Business Plan, Outline of the Business Plan, Presenting the Business Plan to Investors.

Unit III: Hours:6

Industry and Competitor Analysis: Industry Analysis, Industry Trends, The Five Competitive Forces Model, The Value of the Five Forces Model, Industry Types and the Opportunities, Competitor Analysis, Identifying Competitors, Sources of Competitive Intelligence, Completing a Competitive Analysis Grid. Developing an Effective Business Model: Business Models, Components of an Effective Business Model.

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Unit IV: Hours: 6

Ethical and Legal Foundation: Initial Ethical and Legal issues facing a New Firm, Drafting a Founders Agreement, Avoiding Legal Disputes, Business Licenses and Permits, Choosing a Form of Business Organization.

Assessing A New Venture's Financial Strength and Viability: Introduction to Financial Management, Financial Statements and Forecasts, Pro forma Financial Statements.

Unit V: Hours: 6

New Venture Team: Creating a New-Venture Team, Rounding out the Team: The Role of Professional Advisers.

Getting Financing or Funding: The Importance of Getting Financing or Funding, Sources of Equity Funding, Sources of DEBT Financing, Creative Sources of Financing and Funding.

Unit VI: Hours:6

Unique Marketing Issues: Selecting a Market and Establishing a Position, Key Marketing issues for New Ventures, The 4Ps of Marketing for New Ventures.

The Importance of Intellectual Property: The Importance of Intellectual Property, Patents, Trademarks, Copyrights, Trade Secrets, Conducting an Intellectual Property Audit.

Text Book: Bruce R. Barringer, R. Duane Ireland, "Entrepreneurship Successfully Launching New Ventures", Pearson Education, Third Edition.

Reference Books:

1. Ram Chandran, "Entrepreneurial Development", Tata McGraw Hill, New Delhi
2. Khanka, S S. "Entrepreneurial Development", S Chand & Company Ltd. New Delhi
3. Badhai, B "Entrepreneurship for Engineers", Dhanpat Rai & Co. (p) Ltd.
4. Gupta and Srinivasan, "Entrepreneurial Development", S Chand & Sons, New Delhi.
5. Arya Kumar, Entrepreneurship, Pearson, Delhi
6. Poornima MCH, Entrepreneurship Development –Small Business Enterprises, Pearson, Delhi
7. Sangeetha Sharma, Entrepreneurship Development, PHI Learning
8. Kanishka Bedi, Management and Entrepreneurship, Oxford University Press, Delhi

5IT05 / 5KSO5 Open Elective –I (i) DATA STRUCTURES & ALGORITHMS [L-3,T-0,C-3]

Course Objectives:

1. To understand the Data Structures and its memory representations
2. To perform different operations on Data Structures such as insertion, deletion, searching and traversing.
3. To understand various data searching and sorting methods with its complexity.
4. To introduce various sorting and searching techniques for representation of the data in the real world.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to-

1. Describe basics of Data Structures and algorithms.
2. Explain Data Structures array and link list.
3. Illustrate with example stack and queues operations.
4. Examine the binary tree traversal methods.
5. Construct Graph and shortest path algorithm in graph.
6. Inspect various sorting and searching techniques.

Unit I: Introduction to algorithms and Data Structures: Introduction, Algorithms, Asymtotic Notation, Introduction to Data Structures, Types of Data Structures, Data Structure Operations.

Unit II: Arrays: Introduction, Types of Arrays, Representation of One-Dimensional Array in Memory, Array Traversal, Insertion and Deletion, Sorting and Searching, Representation of Multi-Dimensional Array in memory, Realizing matrices using Two-Dimensional Arrays, Matrix Operations, **Linked List:** Introduction, Linked List – Basic Concept, Types of Linked List.

Unit III: Stacks: Introduction to Stacks, Stack Operations, Queues: Introduction, Queues- Basic Concept, Queue Operations, Basics of Circular Queues and Priority Queues.

Unit IV: Trees: Introduction, basic concept, Binary Tree, Binary Tree Representation, Binary Tree Traversal, Binary Search Tree, Tree Variants.

Unit V: Graphs: Introduction, Basic Concept, Graph Terminology, Graph Implementation, Shortest Path Algorithm, Graph Traversal.

Unit VI: Sorting and Searching: Introduction, Sorting Techniques, Selection Sort, Insertion Sort, Bubble Sort, Quick Sort, Merge Sort, Bucket Sort, Searching Techniques; Linear Search, Binary Search, Hashing.

Text Book: E. Balagurusay, “Data Structures using C”, McGraw Hill Education, 2018.

Reference Books:

1. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outline Series.
2. Forouzan, Gilberg, “Data Structures and algorithms”, CENGAGE Learning.
3. Reema Thareja, “Data Structures using C”, Oxford University Press, 2011.
4. Arpita Gopal, “Magnifying Data Structures:”, PHI (EEE), 2010.
5. Ellis Horowitz and Sartaj Sahani, “ Fundamentals of Data Structures”, CBS Publications.

5IT05 / 5KSO5 Open Elective –I (ii) COMPUTATIONAL BIOLOGY [L-3,T-0,C-3]

Course Pre-requisite:

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Computational Biology by being able to do each of the following:

1. To familiarize the students with most basic and useful algorithms for sequence analysis
2. To aware the students with basic file formats
3. To transform the basic molecular data for interpreting their patterns for various analysis
4. To compare genomes of different species, gene finding, and gene regulation

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand what types of biological questions can be investigated using computers, and what limitation computational methods impose on the understanding of biology.
2. To know the properties of DNA, RNA, and proteins, the relationships among these molecules.
3. To know how to convert a biological question into a computational problem that can be solved using computers.
4. To know how to read and understand solutions to computational problems, which will be formalized as a series of tasks (an algorithm).
5. To know how implement the algorithms by writing computer programs.

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Unit I: Cellular and Molecular Biology Fundamentals: The structure of DNA & RNA, Gene Structure and control, Tree of Life and evolution, Primary & Secondary Structure of Protein, Implications for Bioinformatics Protein fold to form compact structures. Dealing with Databases: Structure of databases, Types of databases, Data Quality. (Hours: 6)

Unit II: Sequence Alignments: Principles of sequence alignments, scoring alignments, substitution matrices, Inserting gaps, Types of Alignments, Searching Databases, Searching with Nucleic Acid or protein sequences, Protein Sequences Motifs or Patterns, Searching using Motifs and patterns, Patterns & protein function. (Hours: 6)

Unit III: Pair wise Sequence Alignments & Database Searching: Substitution Matrices and scoring, Dynamic Programming Algorithms, Indexing Techniques & Algorithmic approximations, Alignments score significance, aligning complete genome sequences. (Hours: 6)

Unit IV: Patterns Profiles and Multiple Alignments: Profile & sequence logos, Profile Hidden Markov Models, Aligning Profiles, Multiple Sequence Alignment by Gradual Sequence Addition, Sequence Pattern Discovery. (Hours: 6)

Unit V: Revealing Genome Features: Preliminary examination of Genome Sequence, Gene Predictions, Splice site Detection, Prediction of Promoter Regions, Confirming Predictions, Genome Annotation, Large Genome Comparisons. (Hours: 6)

Unit VI: Gene Detection and Genome Annotation: Detection of Functional RNA Molecules using Decision Trees, Algorithms for Gene Detection in Prokaryotes, Features used in Eukaryotic Gene Detection, Predicting Eukaryotic Gene Signals, Predicting Exon / Intron Structure, Beyond the Prediction of Individual Genes. (Hours:6)

Text Books:

1. Understanding Bio-informatics , Marketa Zvelbil and Jeremy O. Baum, Garland Science Taylor & Francis Group, LLC
2. Bioinformatics: Principles and Applications, Bal, H. P. (2005), Tata McGraw-Hill.

Reference Books:

1. Bioinformatics Algorithms – Design and Implementation in Python, Miguel Rocha & Pedro Ferreira, Academic Press, Elsevier Inc.
2. Bioinformatics Algorithms: An Active Learning Approach, Edition 2, Volume 1. Phillip Compeau & Pavel Pevzner.
3. Bioinformatics computing, Bergeron, B. P. (2003), Prentice Hall Professional.
4. Bioinformatics Technologies, Chen, Y. P. P. (Ed.). (2005). Springer.
5. Bioinformatics for dummies, Claverie, J. M., & Notredame, C. (2011), John Wiley & Sons.
6. Fundamental Concepts of Bioinformatics, Dan. E. Krane, & Raymer, M. L. (2003), Pearson Edu. International.

Additional Resources:

1. Bioinformatic Methods I, conducted by University of Toronto, [https:// www.Coursera.org/course/ bioinfo](https://www.coursera.org/course/bioinfo) methods 1
2. Bioinformatics algorithms (Part-I), conducted by University of California San Diego. <http://www.coursera.org/course/bioinformatics>
3. Bioinformatics: introduction and methods conducted by Peking University, <https://www.coursera.org/course/pkubioinfo>
4. <http://www.ncbi.nlm.nih.gov/education/tutorials/>
5. <http://www.ncbi.nlm.nih.gov/books/NBK143764/>
6. Bioinformatics: introduction and method, conducted by Peking University. <https://www.coursera.org/course/pkubioinfo>
7. Bioinformatics: life sciences on your computer, conducted by Johns Hopkins. University. <https://www.coursera.org/course/pkubioinfo>
8. Emergence of life, conducted by University of Illinois Urbana-Champaign campus. <https://www.coursera.org/course/emergenceoflife>
9. Genes and the human condition (from behaviour to biotechnology), conducted by University of Maryland. <https://www.coursera.org/course/genes>.
10. Introduction to biology – the secret of life, conducted by Massachusetts Institute of Technology. <https://www.edx.org/course/mitx-7-00x-introduction-biology-secret-1768>
11. Origins – formation of the universe, solar system, earth and life, conducted by University of Copenhagen. <https://www.coursera.org/course/origins>
12. Preparation for introductory biology: DNA to organisms, conducted by University of California. <https://www.coursera.org/course/introbio>.

5KS06 DATABASE MANAGEMENT SYSTEMS LAB [P-2, C-1]

Course Prerequisite: Basic concept of programming, Basic concepts of data structures

Course Objectives:

- To study the ER model which provides a high level view of the issues in database design, to capture the semantics of realistic applications within the constraints of a data model.
- To study the primary data model (relational model) for commercial data processing applications.
- To study the standard structured query language and retrieve the information from the database in various ways.
- To study the integrity and security constraints of the database by enforcing constraints.

Course Outcomes (Expected Outcome) On completion of the course, the students will be able to

1. Design ER model for any kind of application.
2. Design and develop database.
3. Apply normalization.
4. Query the database.
5. Apply various integrity constraints
6. Build indices, views
7. Implement triggers, assertions

List of Experiments: This is the sample list of Experiments; minimum 12 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

Practical 1: To Study a Database Modeling Tool.

Study of Data Modeling Tools:

- Take a description of the enterprise, create its corresponding ER Diagram and build a database model using any modeling tool. The following basic features of the modeling should be covered while building the model:
- Logical / Physical Modeling
- Adding an entity / its attributes, relationships (all kinds of relationships viz., parent-child, foreign key references, one to many, many to many etc)
- Forward / reverse engineering
- Details of forward engineering / schema generation
- Steps to generate the schema

Practical 2: To Study and implement DDL Commands

Implement the model created in Practical 1, in any of the DBMS like Oracle, MySQL, or Microsoft SQL Server database software.

- Creating the proper tables
- Insert the data into it.
- Study Dropping and Altering the Tables. Study the cascaded deletes.

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Practical 3: To Study and implement DML Commands-I

- SQL queries : Write and execute different SQL queries
- Execute Simple queries using SELECT, FROM, WHERE clauses,
- In Where clause use different predicates involving OR,AND, NOT
- Rename operation
- Tuple Variables
- Write SQL for various String operations (% ,_ ,*)
- Match beginning with
- Match ending with
- Substring
- Match exactly n characters
- Match at least n characters
- Sort the output of the query using Order by
- Write SQL using Having

Practical 4 : To Study and implement DML Commands-II Write SQL queries and perform

- Set membership operations
- In, not in
- Some
- All
- Exists and not exists, Test for emptiness using exists, not exists
- Test for absence of duplicates.
- Nested queries

Practical 5. Study and implement aggregation functions.

- Write different queries using following Aggregate functions
- Min (minimum 3 SQL queries)
- Max (minimum 3 SQL queries)
- Avg (minimum 3 SQL queries)
- Sum (minimum 3 SQL queries)
- Count (minimum 3 SQL queries)

Practical 6: Write SQL to create Views and Indexes.

Practical 7: Write SQL to perform the modifications to the database

Practical 8 : PL /SQL

Practical 9 : Database Access Using Cursors

Write a trigger to find the names and cities of customers who have more than xyz in any account.

Practical 10 : Triggers

- Write a trigger for dealing with the overdrafts (set the account balance to zero, and creating a loan in the

amount of the overdraft. Keep account number as loan number in the loan table)

- Write a trigger for dealing with blank cities (set the city field to null when it is blank)

Practical 11: Procedures, functions

- Write atleast 2 functions, and demonstrate its use
- Write atleast 2 procedures, and demonstrate its use

Practical 12 : Web Programming with PL/SQL. (Contents beyond Syllabus)

HTTP, A Simple Example, Printing HTML Tables., Passing Parameters, Processing HTML Forms., Multi-Valued Parameters.

Practical 13: Develop a JDBC Applications, Retrieve the information by connecting to the database using a host language (JAVA, C, C++) (Contents Beyond Syllabus)

Practical 14: Web Programming with Java Servlets. (Connecting to the database) (Contents beyond Syllabus)

A Simple Servlet., HTTP Servlet API Basics.,HTML Form Processing in Servlets.

Practical 15: PHP : Develop a simple application to access the database using PHP (Contents beyond Syllabus)

Study of Open Source NoSQL Databases

Based on the concepts covered in text create a Mini Project:

Suggested Topics:

- i. Bank database (Given in Korth book)
- ii. University Database (Given in Korth book)
- iii. Airline Flight Information System.
- iv. Library Database Application.
- v. University Student Database.
- vi. Video Chain Database.
- vii. Banking Database.
- viii. BiBTeX Database.
- ix. Music Store Database.
- x. Online Auctions Database.
- xi. A Web Survey Management System.

Text Book: Korth, Sudarshan, Silberschatz, Database System Concept, Mc-Graw Hill Mysql Reference Manual (for Mysql database)

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Reference Books: (may be 5 to 6)

1. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereopy Limited, ISBN: 1743045743, 9781743045749
2. Kristina Chodorow, Michael Dirolf, "MangoDB: The Definitive Guide" ,O"Reilly Publications, ISBN: 978-1-449-34468-9.
3. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628
4. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719.

5KS07 COMPILER DESIGN – Lab [P-2, C-1]

Course Prerequisite: Basic knowledge of C Programming, Data Structures, Theory of Computation.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Compiler Design by being able to do each of the following:

- Know the basic components of a Compiler.
- To implement Lexical Analyzer using Lex tool and Syntax Analyzer using Yacc Tool.
- To implement various parsing methods.
- To implement code optimization techniques .

Course Outcomes (Expected Outcome):

On completion of the course, the students will be able to

1. Identify the fundamentals of compiler and its phases.
2. Use the powerful compiler generation tools such as Lex and Yacc.
3. Write a lexical scanner, either from scratch or using Lex.
4. Develop program for solving parser problems.
5. Examine the various optimization techniques.

List of Experiments: This is the sample list of Experiments; minimum 12 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

List of Experiments based on Syllabus: (Maximum 20)

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Implement a C program to check parenthesis of regular expression is balanced or not.
4. Implement a C program to construct NFA from regular expression.
5. Implement a C program to simulate Deterministic Finite Automation (DFA) for a string which ending with 'a', 'a*b+', 'abb'.
6. Write a C program to construct of DFA from NFA.
7. Implement a Lex program to verify the parenthesis of a given expression is balanced.
8. Implement a Lex program to recognize the token like Digit, Identifier & Delimiter.
9. Implement the Lexical Analyzer using JLex, flex or other lexical analyzer generating tools.
10. Implement a Lex program to a valid arithmetic expression and to recognize the identifier and operators present.
11. Implement a Lex program to count words, characters, lines, vowels and consonants from given input.
12. Implement a Lex program to check given number is positive negative or zero.
13. Implement a Lex program to generate string which is ending with zeros.
14. Implement LEX and Yacc tool to implement desk calculator.
15. Write a C program for constructing of SLR parsing.
16. Write a C program for constructing of LL (1) parsing.
17. Write a C program for constructing of LALR parsing.
18. Write a C program for constructing recursive descent parsing.
19. Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value.
20. Write a C program for Tokenizing the file which reads a source code in C/C++ from an unformatted file and extract various types of tokens from it
21. Write functions to find FIRST and FOLLOW of all the variables / given grammar.
22. Implement a Shift Reduce Parser for the following productions.
23. $E \rightarrow E+E / E*E / a / b$
24. Implement a symbol table containing functions create(), modify(), search(), display() and delete().
25. Implement three address Code for the input $a=b*c$.
26. Implement Recursive Decent Parser for the productions.

List of Experiments beyond Syllabus: (Maximum 05)

1. Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.
2. Write a C program to generate machine code from abstract syntax tree generated by the parser.
3. Write a Lex program to find out total number of vowels, and consonants from the given input string.
4. Implementation of Finite State machines DFA, NFAs .
5. Computation of Leading & Trailing Sets.

Text Book: Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman Compilers: “Principles, Techniques and Tools”, Pearson Education, Second Edition.

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Reference Books:

1. Doug Brown, John Levine, and Tony Mason, “Lex & Yacc”, O’Reilly & Associates, Inc., Second Edition.
2. Andrew Appel, “Modern Compiler Implementation in C”, Cambridge University press.
3. K C. Louden “Compiler Construction - Principles and Practice” India Edition, CENGAGE.
4. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Cerial J.H. Jacobs and Koen Langendoen, “Modern Compiler Design”, Second Edition, John Wiley & Sons Publication.
5. Keith Cooper and Linda Torczon, “Engineering: A Compiler”, Second Edition, Morgan Kaufmann Publication.

5KS09 C-Skill Lab – III [P-2, C-1]

Course Prerequisite: Basic knowledge of Web Development, HTML, CSS, JavaScript and IDE.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of C-Skill Lab - III by being able to do each of the following:

- To develop an ability to set up a local JS Library/Framework development Environment.
- To be able to install and implement different JS Libraries and Frameworks
- To be able to develop single-page/multi-page static and dynamic Web Applications.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Explain the various tools, packages and modules required for Web Development.
2. Discuss the workings of web server, cookies, routes, etc.
3. Develop a mobile application using JS Framework.
4. Design GUI using JS framework and/or Libraries.
5. Create applications using Angular, React, Node and Express.

List of Experiments: This is the sample list of Experiments; minimum 12 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

List of Experiments based on Syllabus: (Maximum 20)

1. Introduction to the Node.js and its installation to print Hello World
2. To study built-in modules and implement the user defined built-in modules in the Node.js
3. To study HTTP module and implement Node.js as a web server
4. To study and implement Node.js File system module to read, write, create, update, delete and rename the file
5. To study the URL module of the Node.js and write a program that opens the requested file and returns the content of the file to the client. If anything goes wrong, throw a 404 error.
6. To convert the output "Hello World!" into upper-case letters by installing the "upper-case" package of NPM.
7. To study event handling in Node.js and demonstrate it using event module and EventEmitter object.
8. To study and implement the Formidable module of Node.js to upload the file on the server.
9. To study and implement the Nodemailer module of Node.js to send emails from your server.
10. To install MySQL and its driver and create connection with it using Node.js.
11. To demonstrate the creation database and table in MySQL using Node.js
12. To demonstrate the insertion of single and multiple records in the MySQL using "INSERT" statement and Node.js
13. To demonstrate the display of records from the MySQL database using "SELECT" statement and display it using Node.js
14. To demonstrate the display the records based on condition from the MySQL database using "WHERE" statement using Node.js
15. To demonstrate deletion of records from database using "DELETE" statement and Node.js
16. To demonstrate updating existing records in a table by using the "UPDATE" statement and Node.js
17. To demonstrate combining rows from two or more tables, based on a related column between them, by using a JOIN statement using Node.js

List of Experiments beyond Syllabus: (Maximum 05)

1. Create an Email sender app using Node.js
2. Create an Basic User database: Site in which User can Sign up/Login and can see other User's Profile Information.
3. Create a User model covering Registration, Email verification(send an email), login (with remember me, display user details and allow to save/update user details(DOB, Location, Hobbies etc or anything)
4. A random number generator web application.

Text Books:

1. Simon Holmes: Getting Mean with Mongo, Express, Angular, and Node, 2nd Edition, Manning.
2. Alex Banks and Eve Porcello: Learning React: Functional Web Development with React and Redux, O'Reilly .

Reference Books:

1. ShyamSeshadri: Angular Up and Running, O'Reilly
2. Akshat Paul and Abhishek Nalwaya: React Native for Mobile development, Apress.
3. Jos Dirksen: Learn Three.js, 3rd Edition, Packt Publishing.
4. Patrick Mulder and Kelsey Breseman: Node.js for Embedded Systems, O'Reilly

5KS08 EMERGING TECHNOLOGY LAB I

5KS08 Emerging Technology Lab 1 is based on 5KS04 Professional Elective-I. Tentative FOSS Tools & Technology for Practical's are as follows:

AI : IBM Watson, Microsoft Cognitive Toolkit , TensorFlow, Apache SystemML, Caffe, OpenNN, Torch, Neuroph

DS :R, Python, Cassandra, Apache Hadoop,

IoT : Arduino, DeviceHive, Kaa, Home Assistant

Cyber Security: Kali Linux, OpenVPN, NMAP, Metasploit Framework

5KS08 DATA SCIENCE AND STATISTICS – LAB [P-2, C-1]

Course Prerequisite: Basic knowledge of Mathematics.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science and Statistics by being able to do each of the following:

- Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
- Apply principles of Data Science to the analysis of business problems.
- Apply the learned concepts for the skillful data management.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to

1. Demonstrate proficiency with statistical analysis of data.
2. Build skills in transformation and merging of data for use in analytic tools.
3. Perform linear and multiple linear regression analysis.
4. Develop the ability to build and assess data-based models.
5. Evaluate outcomes and make decisions based on data.

List of Experiments: This is the sample list of Experiments; minimum 12 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

List of Experiments based on Syllabus:

Introduction to R:

[1] To learn and implement the Basic Commands and Graphics in R

[2] To perform Indexing and Loading Data

Linear Regression:

[3] To learn different Libraries in R and To perform Simple Linear Regression and Multiple Linear Regression

[4] To learn Interaction Terms and to perform Non-linear Transformations of the Predictors

[5] To learn and evaluate Qualitative Predictors

[6] To learn to Write Functions

Logistic Regression, LDA, QDA, and KNN

[7] To perform Logistic Regression

[8] To perform Linear Discriminant Analysis

[9] To perform Quadratic Discriminant Analysis

[10] To implement K-Nearest Neighbors technique

[11] To use Caravan Insurance Data for LR, LDA, QDA, and KNN

Cross-Validation and the Bootstrap

[12] To learn and perform The Validation Set Approach

[13] To learn and perform Leave-One-Out Cross-Validation

[14] To learn and perform k-Fold Cross-Validation

[15] To learn and perform The Bootstrap

Subset Selection Methods

[16] To learn and perform Best Subset Selection

[17] To learn and perform Forward and Backward Stepwise Selection

[18] To learn to Choose Among Models Using the Validation Set Approach and Cross-Validation

Ridge Regression and the Lasso

[19] To learn and perform Ridge Regression

[20] To learn and perform The Lasso

PCR and PLS Regression

[21] To learn and perform Principal Components Regression

[22] To learn and perform Partial Least Squares

Non-linear Modeling

[23] To learn and perform Polynomial Regression and Step Functions

[24] To learn and perform Splines

[25] To learn and perform GAMs

Decision Trees

[26] To learn and perform Fitting Classification Trees

[27] To learn and perform Fitting Regression Trees

[28] To learn and implement Bagging and Random Forests

[29] To learn and perform Boosting

Support Vector Machines

[30] To learn and perform Support Vector Classifier

[31] To learn and perform Support Vector Machine

[32] To learn and perform ROC Curves

[33] To learn and perform SVM with Multiple Classes

[34] To use Gene Expression Data

Clustering

[35] To implement K-Means Clustering

[36] To implement Hierarchical Clustering

NCI60 Data Example

[37] To implement PCA on the NCI60 Data

To Cluster the Observations of the NCI60 Data

List of Experiments beyond Syllabus: (Maximum 05)

1. To implement the Association Rules
2. To implement the kernel method to increase data separation
3. Develop a data model and deploy it as R HTTP Services or by export
4. Develop a data model and present it to end user with proper presentations
5. Carry out your assigned task and present it to other data scientist with proper presentations

Text Books:

1. Cathy O'Neil and Rachel Schutt: Doing Data Science, First Edition, 2014, O'reilly Publications, ISBN: 978-1-449-35865-5

2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani: An Introduction to Statistical Learning with Applications in R, First Edition, 2013, Springer-Verlag New York, ISBN: 978-1- 4614-7137-0

Reference Book:

Nina Zumel, John Mount: Practical Data Science with R, First Edition, 2014, Manning Publications Co., ISBN: 9781617291562