SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus I Semester

CD101 (Introductory Topics in Statistics, Probability and Calculus)

Unit-I Introduction to Statistics: Definition of Statistics, Basic objectives, Applications in various branches of science with examples, Collection of Data: Internal and external data, Primary and secondary Data, Population and sample, Representative sample.

Unit-II Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves, Descriptive measures - central tendency and dispersion, Bivariate data, Summarization, marginal and conditional frequency distribution.

Unit-III Probability: Concept of experiments, sample space, event, Definition of Combinatorial Probability, Conditional Probability, Bayes Theorem.

Unit-IV Probability distributions: Discrete& continuous distributions, Binomial, Poisson and Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions. Expected values and moments: mathematical expectation and its properties, Moments (including variance) and their properties, interpretation, Moment generating function.

Unit-V Calculus: Basic concepts of Differential and integral calculus, application of double and triple integral.

Text Books:

1. S.M. Ross, "Introduction of Probability Models", Academic Press, N.Y.
2. A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I & II, World Press.
3. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.

Reference Books:

1. S.M. Ross, "A first course in Probability", Prentice Hall.
2. I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers", PHI.
3. A.M. Mood, F.A. Graybill, D.C. Boes, "Introduction to the Theory of Statistics", TMH.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", Seventh Edition, Thomson Learning.
5. M. D.Greenberg, "Advanced Engineering Mathematics", Second Edition, Pearson Education.
6. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics", Vol. I & II, Vidyarthi Prakashan.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Analyze data using various statistical methods.
CO2: Understand graphical representation of data.
CO3: Understand the concepts of probability and random variables and apply it in solving real world problems.
CO4: Model and solve real life problems using various discrete and continuous distributions.
CO5: Apply the knowledge of differential calculus in optimizing functions of single variables.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus I Semester

CD102 (Basic Computer Engineering)

Unit-I Introduction to Computer: Definition, Classification, Organization i.e. CPU, processor, Bus architecture, Memory Hierarchy & Storage Systems, I/O Devices, System & Application Software, Computer Application in e-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and Climatology, Computer Gaming, Multimedia and Animation etc. Operating System: Definition, Functions, Types, Introduction to MS word, MS powerpoint, MS Excel

Unit-II Introduction to Algorithms: Flowchart, Introduction to Programming, Machine language, assembly language and high level language, Categories of Programming Languages, Program Design, Programming Paradigms, Procedure Oriented Programming VS object oriented Programming, Introduction to Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, Statements and control structures, I/O operations, Functions

Unit-III Introduction to Data Structures: Types of data structures and their applications, operations on data structures.

Unit-IV Computer Networking: Introduction, Goals, Internetworking Concepts, Devices, Introduction to Internet, World Wide Web, IP address, LAN, MAN, WAN, Network Topology, E-commerce, Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Email spoofing, Denial of Service (DoS), Cyber Stalking, Logic bombs, Hacking Spamming, Cyber Defamation , pharming, Security measures Firewall, Computer Ethics & Good Practices, Introduction of Cyber Laws about Internet Fraud, Good Computer Security Habits.

Unit-V Data Base Management System: Introduction, File oriented approach and Database approach, Architecture of Database System, DBA, centralized and distributed database, Data definition language and Manipulation Languages. Cloud computing: definition, cloud infrastructure, cloud segments or service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public, private, community and hybrid clouds), Pros and Cons of cloud computing.

Suggested List of Experiments:

1. Demonstration of Computer Hardware.
2. Installation of various software.
3. Study and practice of Internal & External DOS commands.
4. Study and Practice of MS windows – Folder related operations, My-Computer, Windows Explorer, and Control Panel.
5. Creation and editing of Text files using MS- word.

6. Creation and operating of spreadsheet using MS-Excel.
7. Creation and editing power-point slides using MS- power point
8. Creation and manipulation of database table using SQL in MS-Access.
9. Algorithm and flowcharts of simple problems.
10. Write a program to illustrate Arithmetic expressions
11. Write a program to illustrate Arrays.
12. Write a program to illustrate functions.

Text Books:

1. E Balagurusamy, "Fundamentals of Computers", TMH.
2. V Rajaraman, "Fundamentals of Computers", PHI.
3. Peter Norton, "Introduction of Computers", TMH.

Reference Books:

1. Ajoy Kumar Ray, Tinku Acharya, "Information Technology Principles and Application", PHI.
2. E.Balagurusamy, "Object Oriented Programming with C++", TMH.
3. Kenneth Hoganson, "Concepts in Computing", Jones & Bartlett.
4. Silberschatz and Galvin "Operating Systems", Wiley India.
5. Andrew Tananbaum, "Computer Networks", PHI.
6. Korth, "Data Base Management Systems", TMH.
7. Dr. Kumar Saurabh, "Cloud Computing", Wiley India.

Course Outcomes:

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

CO1: Explain the components of a computer system.
CO2: Develop algorithms and flowcharts for given problems.
CO3: Understand the application of data structures in various problems.
CO4: Apply the knowledge of computer networking and Network security while using computers.
CO5: Create databases for given attributes.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus I Semester

CD103 (Principles of Electronics)

Unit-I Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels, Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, P-type and N-type semiconductors, drift and diffusion carriers.

Unit-II Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model, Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Unit-III Bipolar Junction Transistors: Formation of PNP / NPN junctions, energy band diagram, transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.
Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type, CS, CG, CD configurations, CMOS: Basic Principles.

Unit-IV Feed Back Amplifier, Oscillators and Operational Amplifiers: Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors, topologies of feedback amplifier, effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability, effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplified and its terminal properties, Application of operational amplifier, inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator.

Unit-V Digital Electronics: Introduction to binary number, Basic Boolean algebra, Logic gates and function realization with OPAMPs.

Suggested List of Experiments:

1. Passive and active components: Familiarize yourself with components like resistors, inductors, capacitors, diodes, and transistors.
2. Equipment: Learn to use equipment like a DC power supply, multimeter, CRO, and function generator.
3. Diodes: Study the V-I characteristics of junction and Zener diodes.
4. Verification of truth table for various gates.

5. Verification of truth table for various Flip-Flops.
6. Realizations of various gates, Flip-Flops etc.
7. Verification of De Morgan's theorems.
8. Rectifiers: Study half-wave and bridge rectifiers, including their regulation efficiency and ripple factor.
9. BJT: Study the input and output characteristics of a BJT in CE configuration.
10. Digital multiplexer and demultiplexer: Study and perform experiments on these devices.
11. Binary to decimal encoder: Study and perform experiments on this device.
12. CMOS integrated circuits: Study and perform experiments on the characteristics of these circuits.
13. Counters and shift registers: Study and perform experiments on various types of these devices.
14. Periodic signals: Study the period and frequency of sine, square, and triangular waves.
15. PN junction diode: Verify the forward and reverse bias characteristics of a PN junction diode.

Text Books:

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits: Theory and Application", 7th Edition, Oxford University Press.
2. M. Morris Mano, "Digital Logic & Computer Design", Pearson Educational.
3. Jacob Millman, Christos Halkias, Chetan D Parikh, "Millman's Integrated Electronics", McGraw Hill education (India) private limited.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson.
2. Ben Streetman, Sanjay Banerjee, "Solid State Electronic Devices", 6th Edition, Prentice Hall.
3. Albert Malvino, David J. Bates, "Electronic Principles (SIE)", McGraw Hill Education.
4. Kumar A. Anand, "Fundamentals of Digital Circuits", PHI.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the fundamentals of semiconductors.
CO2: Learn the principles of diodes and diode circuits.
CO3: Understand the principles of bipolar junction transistors and field effect transistors.
CO4: Learn the working principles of feedback amplifiers and oscillators.
CO5: Understand the working of operational amplifiers and digital electronic fundamentals.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus I Semester

CD104 (Fundamentals of Physics)

Unit-I Oscillation: Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring mass system. Resonance-definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators.

Unit-II Interference-Principle of Superposition-Young's experiment: Theory of interference fringes, types of interference, Fresnel's prism-Newton's rings, Diffraction, Two kinds of diffraction, Difference between interference and diffraction, Fresnel's half period zone and zone plate, Fraunhofer diffraction at single slit, Plane diffraction grating, Temporal and Spatial Coherence.

Unit-III Polarization of light: Polarization-Concept of production of polarized beam of light from two SHM acting at right angle, plane, elliptical and circularly polarized light, Brewster's law, double refraction.
Basic Idea of Electromagnetisms: Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium.

Unit-IV Quantum Mechanics: Introduction- Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box, Heisenberg Picture.
Crystallography: Basic terms-types of crystal systems, Bravais lattices, miller indices,dspacing, Atomic packing factor for SC, BCC, FCC and HCP structures.
Semiconductor Physics: Conductor, Semiconductor and Insulator, Basic concept of Band theory.

Unit-V Laser and Fiberoptics: Einstein's theory of matter radiation interaction and A and B coefficients, amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers, Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers.
Thermodynamics: Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

Suggested List of Experiments:

1. Magnetic field along the axis of current carrying coil – Stewart and Gee.
2. Determination of Hall coefficient of semi-conductor.
3. Determination of Energy Band-Gap of a Semiconductor Material/ Resistivity of Semiconductors by Four Probe Method at Different Temperatures.
4. Determination of Plank constant.

5. Determination of wave length of light by Laser diffraction method.
6. Determination of wave length of light by Newton's Ring method.
7. Determination of wavelength of sodium light using a plane diffraction grating.
8. Determination of laser and optical fiber parameters.
9. Determination of Stefan's Constant.
10. Study the characteristics of LED and laser sources.

Text Books:

1. A Beiser, "Concepts of Modern Physics", Fifth Edition, McGraw Hill International.
2. David Halliday, Robert Resnick and Jearl Walker, "Fundamentals of Physics", Wileyplus.

Reference Books:

1. Ajoy Ghatak, "Optics", Fifth Edition, Tata McGraw Hill.
2. Hugh D. Young, Roger A. Freedman, A. Lewis Ford, "Sears & Zemansky's University Physics With Modern Physics", Addison-Wesley.
3. Jenkins and White, "Fundamentals of Optics", Third Edition, McGraw-Hill.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the principles of interference and polarization of light.
CO2: Understand the principles lying behind crystallography and oscillations.
CO3: Understand the basics of electromagnetism and thermodynamics.
CO4: Learn the principles of semiconductor physics and quantum mechanics.
CO5: Learn the fundamentals of lasers and Fiber Optics principles.

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Syllabus I Semester

CD105 (Communication Skills)

Unit-I Overview of Leadership Oriented Learning (LOL): Include activity on introducing self, class activity, presentation on favorite captain in any team sport also present the skills and values they demonstrate self-work with immersion, interview a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them, overview of business communication.
Activity: Write a newspaper report on an cricket/football match.
Activity: Record a conversation between a celebrity and an interviewer.
Quiz, self awareness identity, body awareness, stress management.

Unit-II Essential Grammar-I: Refresher on Parts of Speech – Listen to an audio clip and note down the different parts of speech followed by discussion, Tenses: Applications of tenses in functional grammar–take a quiz and then discuss, sentence formation (general & technical), common errors, voices.

Unit-III Communication Skills: Overview of Communication Skills, Barriers of communication, Effective communication, Types of communication- verbal and non – verbal – Role-play based learning, Importance of Questioning, Listening Skills: Law of nature- Importance of listening skills, Difference between listening and hearing, Types of listening, expressing self, connecting with emotions, visualizing and experiencing purpose
Activity: Skit based on communication skills, Evaluation on Listening skills – listen to recording and answer questions based on them.

Unit-IV Email Writing: Formal and informal emails, activity, Verbal communication: Pronunciation, clarity of speech, Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, significant abbreviations formal business vocabulary – Read Economic Times, Reader's Digest, National Geographic and take part in a GD, using the words you learnt/liked from the articles.
Group discussion using words learnt, Practice: Toastmaster style Table Topics speech with evaluation, Written Communication: Summary writing, story writing, Build your CV – start writing your comprehensive CV including every achievement in your life, no format, no page limit

Unit-V Understanding Life Skills: Movie based learning – Pursuit of Happiness. What are the skills and values you can identify, what can you relate to Introduction to life skills, What are the critical life skills, Multiple Intelligences, Embracing diversity – Activity on appreciation of diversity, Life skill: Community service – work with an NGO and make a presentation, Life skill: Join a trek – Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation.

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Suggested List of Experiments:

1. Listening Skills
    a. The student should be able to listen a text and read aloud in normal speed with focus on intonation.
    b. After listening, the student can fill-in-blanks, choose a suitable title, make a summary, supply required information and is able to answer comprehension questions from the passage read aloud.
2. Speaking Skill
    a. Reading aloud of dialogues, texts, poems, speeches focusing on intonation.
    b. Self-introduction
    c. Role plays on any two-situations.
    d. Telephonic Conversations.
3. Writing Skills
    a. Email writing
    b. CV writing
    c. Business letter writing
    d. Story writing
    e. Summary writing
4. Personality Development
    a. Initiation
    b. Physical Appearance
    c. Audience Purpose
5. Interpersonal Skills
    a. Appropriate use of non-verbal skills in face to face communication [i.e. Viva – Voice, group–interviews, GDs and seminars.]
6. Presenting in GD, Seminars and Conferences.
    a. Leadership Quality
    b. Time Management
    c. Achieving the target

Text Books:

1. Alan McCarthy and Felicity O'dell, "English Vocabulary in Use", Cambridge University Press.
2. Dr. Saroj Hiremath, "Business Communication", Nirali Prakashan.
3. Lesikar, V. Raymond, & D. John, Jr. Pettit, "Report Writing for Business", Tenth Edition. Delhi, McGraw-Hill.

Reference Books:

1. Adair, John, "Effective Communication", Pan Macmillan Ltd.
2. Bovee, Courtland L, John V. Thill & Barbara E. Schatzman, "Business Communication Today", Tenth Edition, Prentice Hall.
3. Guffey, Mary Ellen, "Essentials of Business Writing", South Western College Pub.

4. Hasson, Gill, "Brilliant Communication Skills", Pearson Education.
5. Monippally, M. Matthukutty, "Business Communication Strategies", TMH.
6. Moore, Ninja-Jo, "Nonverbal Communication: Studies and Applications", Oxford University Press.
7. H. M. Prasad, "How to Prepare for Group Discussion and Interview", TMH.
8. APAART: Speak Well 1 (English language and communication).
9. APAART: Speak Well 2 (Soft Skills).
10. Dr. Saroj Hiremath, "Business Communication", Nirali Prakashan.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Comprehend conversations and talks presented in English.
CO2: Use the acquired knowledge of essential grammar in forming sentences.
CO3: Understand the basic tenets of communication.
CO4: Demonstrate skills in email writing and verbal communication.
CO5: Apply the life skills to different situations.

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Syllabus I Semester

CD106 (Computer Programming I)

(C Language)

Unit-I Introduction to Programming: Machine Level Languages, Assembly Level Languages, High Level Languages, Program Execution and Translation Process, Problem solving using Algorithms and Flowcharts. Introduction to C Programming: Data Types, Constants, Keywords, Operators & Expressions, Precedence of operators and input/output functions.

Unit-II Control Statements and Decision Making: The goto statement, The if statement, The if-else statement, Nesting of if statements, The conditional expression, The switch statement, The while loop, The do…while loop, The for loop, The nesting of for loops, The break and continue statement.

Unit-III Arrays, Strings & Pointers: One dimensional Arrays, Passing Arrays to Functions, Multidimensional Arrays, Strings, Basics of Pointers & Addresses, Pointer to Pointer, Pointer to Array, Array of Pointers, Types of pointers, Pointer to Strings.

Unit-IV Functions & Structures: Function Basics, Function Prototypes, Passing Parameter by value and by reference, Passing string to function, Passing array to function, Function returning address, Recursion, Structures & Union, Pointer to Structure, Self-Referential Structures, Dynamic memory allocation by malloc/calloc function, Storage Classes.

Unit-V File Handling: Defining and Opening a file, Closing Files, Input/output Operations on Files, Predefined Streams, Error Handling during I/O Operations, Command Line Arguments.

Suggested List of Experiments:

1. Algorithm and flowcharts of small problems like GCD.
2. Structured code writing with:
    i. Small but tricky codes
    ii. Proper parameter passing
    iii. Command line Arguments
    iv. Variable parameter
    v. Pointer to functions
    vi. User defined header
    vii. Make file utility
    viii. Multi file program and user defined libraries
    ix. Interesting substring matching / searching programs
    x. Parsing related assignments

Text Books:

1. Brian W. Kernighan, Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India.
2. Yashavant Kanetkar, "Let Us C", BPB publication.

Reference Books:

1. Paul Deitel, Harvey M. Deitel, "How to Program", Pearson Publication.
2. E. Balagurusamy, "Programming in ANSI C", Tata McGraw-Hill.
3. Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Identify situations where computational methods and computers would be useful.
CO2: Describe the basic principles of imperative and structural programming.
CO3: Develop a pseudo-code and flowchart for a given problem.
CO4: Analyze the problems and choose suitable programming techniques to develop solutions.
CO5: Design computer programs to solve real world problems.

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Syllabus II Semester

CD201 (Discrete Structures)

Unit-I Set Theory, Relation, Function, Theorem Proving Techniques: Set Theory: Definition of sets, countable and uncountable sets, Venn Diagrams, proofs of some general identities on sets Relation: Definition, types of relation, composition of relations, Pictorial representation of relation, Equivalence relation, Partial ordering relation, Job-Scheduling problem Function: Definition, type of functions, one to one, into and onto function, inverse function, composition of functions, recursively defined functions, pigeonhole principle. Theorem proving Techniques: Mathematical induction, Proof by contradiction.

Unit-II Algebraic Structures: Definition, Properties, types: Semi Groups, Monoid, Groups, Abelian group, properties of groups, Subgroup, cyclic groups, Cosets, factor group, Permutation groups, Normal subgroup, Homomorphism and isomorphism of Groups, example and standard results, Rings and Fields: definition and standard results.

Unit-III Propositional Logic: Proposition, First order logic, Basic logical operation, truth tables, tautologies, Contradictions, Algebra of Proposition, logical implications, logical equivalence, predicates, Normal Forms, Universal and existential quantifiers. Introduction to finite state machine Finite state machines as models of physical system equivalence machines, Finite state machines as language recognizers.

Unit-IV Graph Theory: Introduction and basic terminology of graphs, Planer graphs, Multigraphs and weighted graphs, Isomorphic graphs, Paths, Cycles and connectivity, Shortest path in weighted graph, Introduction to Eulerian paths and circuits, Hamiltonian paths and circuits, Graph coloring, chromatic number, Isomorphism and Homomorphism of graphs.

Unit V Posets, Hasse Diagram and Lattices: Introduction, ordered set, Hasse diagram of partially, ordered set, isomorphic ordered set, well ordered set, properties of Lattices, bounded and complemented lattices. Combinatorics: Introduction, Permutation and combination, Binomial Theorem, Multimonial Coefficients Recurrence Relation and Generating Function: Introduction to Recurrence Relation and Recursive algorithms , Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions, Total solutions , Generating functions, Solution by method of generating functions.

Text Books:

1. C.L. Liu, “Elements of Discrete Mathematics”, Tata Mc Graw-Hill Edition.
2. J.P Tremblay, R Manohar, “Discrete Mathematical Structure with Application CS”, McGraw Hill.

Reference Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its applications", McGraw Hill.
2. Bisht, "Discrete Mathematics", Oxford University Press.
3. Biswal, "Discrete Mathematics & Graph Theory", PHI.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Prove mathematical theorems using mathematical induction.
CO2: Understand sets and perform operations and algebra on sets.
CO3: Demonstrate an understanding of relations and functions and be able to determine their properties.
CO4: Understand groups, rings and fields.
CO5: Analyze logical propositions via truth tables.
CO6: Define graphs, digraphs and trees, and identify their main properties.
CO7: Evaluate combinations and permutations on sets.

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Syllabus II Semester

CD202 (Statistical Methods)

Unit-I Linear Statistical Models: Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance (one way, two way with as well as without interaction).

Unit-II Estimation and Sufficient Statistic: Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation. Sufficient Statistic: Concept & examples, complete sufficiency, their application in estimation.
Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing.

Unit-III Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test, Spearman‘s and Kendall‘s test, Tolerance region.

Unit-IV Time Series Analysis: Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

Unit-V R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R.

Suggested List of Experiments:

(Note: Use of various functions in R)

1. Descriptive statistics: Used to group data into variables and examine their typical values and spread.
2. Data Visualization: Visualize data distributions and relationships between variables.
3. Hypothesis testing: Used to make decisions based on experimental data, and can be thought of as an educated claim about a population or property.
4. Logistic Regression: Model binary outcome variables.
5. Correlation: Used to determine if two variables are related, and is a mathematical relationship between two numerical variables.
6. Experimental design: A subfield of statistics that involves selecting and evaluating a model, and requires an understanding of statistical hypothesis tests and estimation statistics.
7. Time Series Analysis: Analyze and model time-dependent data.
8. Cluster Analysis: Group similar data points into clusters.
9. Method comparison: Used to determine if observed differences in an experiment are likely to be real differences.

10. T-test: Used to determine if there is a significant difference between the means of two groups.
11. Measurement error: Statistical analysis can be used to estimate the error in a derived quantity by propagating the measurement error through a mathematical model.

Text Books:

1. I.R. Miller, J.E. Freund and R. Johnson, "Probability and Statistics for Engineers", 9th Edition, Pearson.
2. A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I & II, World Press.
3. Chris Chatfield, "The Analysis of Time Series: An Introduction", 6th edition, Chapman and Hall/CRC.
4. D.C. Montgomery & E.Peck, "Introduction to Linear Regression Analysis", 5th edition, Wiley.

Reference Books:

1. A.M. Mood, F.A. Graybill & D.C. Boes, "Introduction to the Theory of Statistics", 3rd edition, McGraw Hill.
2. N. Draper & H. Smith, "Applied Regression Analysis", 3rd edition, Wiley.
3. Garrett Grolemund, "Hands-on Programming with R", 1st edition, O′Reilly.
4. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", 2nd edition, Addison-Wesley Professional.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand various linear statistical models and acquire knowledge in hypothesis testing.
CO2: Apply methods of estimation in statistical analysis.
CO3: Understand Non-Parametric tests and its applications.
CO4: Design and forecast models using Time series data.
CO5: Understand and apply R language in data visualization.

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Syllabus II Semester

CD203 (Digital Logic Design)

Unit-I Introduction to Digital Electronics: Needs and Significance, Different Number System: Binary Numbers, Octal and Hexadecimal Numbers, Conversions, Complement's, Signed Binary Numbers, Binary Arithmetic's, Binary Codes: BCD, ASCII Codes.

Unit-II

Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Boolean Relations, Digital Logic Gates, De Morgan's Theorem, Karnaugh Maps and simplifications.

Unit-III Combinational Circuits: Half Adder, Full Adder, Binary Adder-Subtractor, Binary Multiplier, Comparator, Decoders, Encoders, Multiplexers, Programmable Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL).

Unit-IV Sequential Circuits: Latches, Flip-Flops: RS Latches, Level Clocking, D Latches, Edge-triggered D Flip-flop, Edge-triggered JK Flip-flop, JK Master-slave Flip-flop, Registers, Shift Registers, Counters, Ripple Counters, Synchronous Counters.

Unit-V Introduction to Memory: Memory Decoding, Error Detection and Correction, Sequential (or simple) programmable logic device (SPLD), Complex programmable logic device (CPLD), Field-programmable gate array (FPGA), Digital Logic Design: RTL and DTL Circuits, TTL, ECL, MOS, CMOS, Application Specific Integrated Circuits.

Suggested List of Experiments:

1. Study and verify the operation of AND, OR, NOT, NOR and NAND logic gates.
2. Design all basic logic gates using NOR universal gate.
3. Design all basic logic gates using NAND universal gate.
4. Design a simple combinational circuit with four variables and obtain minimal expression and verify the truth table.
5. Verification of Demorgan's theorem.
6. Construction and verification of half adder and full adder circuits.
7. Construction and verification of half subtractor and full subtractor circuits.
8. Verification of functional table of 3 to 8-line Decoder /De-multiplexer.
9. Verification of 4-variable logic function using 8 to1 multiplexer.
10. Design a four-bit ring counter using D Flip–Flops/JK Flip Flop and verify output.
11. Design of Binary to Grey & Grey to Binary code Converters.
12. Design of BCD to excess-3 code converter.

Text Books:

1. M. Morris Mono, "Digital logic design", Pearson Education Pvt. Ltd.
2. A Anand Kumar, "Fundamentals of digital circuits", PHI Learning Pvt Ltd.

Reference Books:

1. A K Maini, "Digital Electronics Principles and Integrated Circuits, Wiley India Pvt Ltd.
2. R P Jain, "Modern Digital Electronics", Tata McGraw-Hill publishing company Ltd.
3. D P Kothari and J S Dhillon, "Digital Circuits and Design", Pearson Education Pvt. Ltd.

Course Outcomes:

After the completion of this course, the students will be able to:

CO1: Perform number base conversions.
CO2: Use Boolean logic to create digital circuits and reduce the Boolean functions to mitigate hardware complexity issues.
CO3: Learn design of combinational circuits.
CO4: Learn sequential circuits and use them in digital systems such as computers and communication systems.
CO5: Compare and differentiate various memories used in Computers.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus II Semester

CD204 (Object Oriented Programming)

Unit I Introduction: Object oriented programming, Introduction, Application, characteristics, difference between object oriented and procedure programming, Comparison of C and C++, Cout, Cin, Data Type, Type Conversion, Control Statement, Loops, Arrays and string arrays fundamentals, Function, Returning values from functions, Reference arguments, Overloaded function, Inline function, Default arguments, Returning by reference.

Unit II Object and Classes: Implementation of class and object in C++, access modifiers, object as data type, constructor, destructor, Object as function arguments, default copy constructor, parameterized constructor, returning object from function, Structures and classes, Classes objects and memory, static class data, Arrays of object, Arrays as class Member Data, The standard C++ String class, Run time and Compile time polymorphism.

Unit III Operator Overloading and Inheritance: Overloading unary operators, Overloading binary operators, data conversion, pitfalls of operators overloading, Concept of inheritance, Derived class and base class, access modifiers, types of inheritance, Derived class constructors, member function, public and private inheritance.

Unit IV Pointer and Virtual Function: Addresses and pointers, the address-of operator & pointer and arrays, Pointer and Function pointer, Memory management: New and Delete, pointers to objects, debugging pointers, Virtual Function, friend function, Static function, friend class, Assignment and copy initialization, this pointer, dynamic type information.

Unit V Streams and Files: Streams classes, Stream Errors, Disk File I/O with streams, file pointers, error handling in file I/O with member function, overloading the extraction and insertion operators, memory as a stream object, command line arguments, printer output, Function templates, Class templates Exceptions, Containers, exception handling.

Suggested List of Experiments:

1. Write a program to find out the largest number using function.
2. Write a program to find the area of circle, rectangle and triangle using function overloading.
3. Write a program to implement complex numbers using operator overloading and type conversion.
4. Write a program using class and object to print bio-data of the students.
5. Write a program which defines a class with constructor and destructor which will count number of object created and destroyed.
6. Write a program to implement single and multiple inheritances taking student as the sample base class.
7. Write a program to add two private data members using friend function.
8. Write a program using dynamic memory allocation to perform 2x2 matrix addition and subtraction.

9. Write a program to create a stack using virtual function.
10. Write a program that store five student records in a file.
11. Write a program to get IP address of the system.
12. Write a program to shutdown the system on windows operating system.

Text Books:

1. E. Balaguruswami, "Object Oriented Programming in C++", TMH.
2. Robert Lafore, "Object Oriented Programming in C++", Pearson.

Reference Books:

1. M.T. Somashekare, D.S. Guru, "Object-Oriented Programming with C++", PHI.
2. Herbert Shildt, "The Complete Reference C++", Tata McGraw Hill publication.

Course Outcomes:

After the completion of this course, the students will be able to:

CO1: Understand the key features of Object Oriented Programming and Methodology.
CO2: Recognize attributes and methods for given objects.
CO3: Implement programs of inheritance and operator overloading.
CO4: Understand and use concept of pointers, memory management and virtual functions in programs.
CO5: Perform file handling in programs.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus II Semester

CD205 (Introduction to Data Analytics)

Unit-I Descriptive Statistics: Probability Distributions, Inferential Statistics, Inferential Statistics through hypothesis tests Regression & ANOVA, Regression ANOVA (Analysis of Variance).

Unit-II Knowledge Representation: Different types of Data Analysis, Key Steps in a Data Analysis Process, Understanding of Different Components of a Modern Data Ecosystem, Role of Data Engineers, Data Analysts, Data Scientists, Business Analysts, and Business Intelligence Analysts Play in this Ecosystem, Responsibilities, and Skill Sets Required to be a Data Analyst.

Unit-III Introduction To Big Data: Big Data and its Importance, Four V's of Big Data, Drivers for Big Data, Introduction to Big Data Analytics, Big Data Analytics applications.

Unit-IV Big Data Technologies: Hadoop's Parallel World, Data discovery, Open source technology for Big Data Analytics, cloud and Big Data, Predictive Analytics, Mobile Business Intelligence and Big Data, Crowd Sourcing Analytics, Inter- and Trans-Firewall Analytics, Information Management.

Unit-V Processing Big Data: Integrating Disparate Data Stores, Mapping Data to the Programming Framework, Connecting and Extracting Data from Storage, Transforming Data for Processing, Subdividing Data in Preparation for Hadoop Map Reduce.

Text Books:

1. Michael Minelli, Michehe Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Wiley.
2. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", 1st Edition, IBM Corporation.

Reference Books:

1. A. Rajaraman, J. D. Ullman, "Mining of Massive Datasets", Cambridge University Press.
2. J.J. Berman, "Principles of Big Data: Preparing, Sharing and Analyzing Complex Information", Morgan Kaufmann.
3. M. Barlow, "Real-Time Big Data Analytics: Emerging Architecture", O Reilly.
4. V.M. Schonberger, K. Kenneth Cukier, "Big Data", John Murray Publishers.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series.

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Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand inferential statistics and its applications.
CO2: Identify role of various stakeholders in data analysis.
CO3: Understand the basic concepts of Big Data.
CO4: Recognize the concepts of Hadoop in business intelligence.
CO5: Apply Big Data processing methods.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus II Semester

CD206 (Computer Programming II)

(C++)

Unit-I Introduction to OOP's: Principles of Object Oriented Programming (OOP), Software Evaluation, A Look at Procedure Oriented Programming, OOP Paradigm, Basic Concepts of OOP, Benefits of OPP, Application of OOP.

Unit-II Introduction to C++: What is C++, A simple C++ Program, More C++ statements, Structure of C++ Program, Tokens, Keywords, Identifiers and Constants, C++ data types. Variables: Declaration, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Member, dereferencing Operators, Memory Management Operators, Manipulators, Type cast operators, Expressions and Control Structures.
Functions: The main() function, Function Prototyping, Call by reference, Return by reference, Inline function, Function Overloading.

Unit-III Classes and Objects: Introduction, Specifying a Class, Defining member Functions, C++ Program with Class, Nesting of Member functions, Private member functions, Memory Allocation for Objects, Static Data members, Static Member Functions, Arrays within a Class, Arrays of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects.
Pointers: Declaration and initializing, Manipulation of pointers, pointers Expression and Pointer Arithmetic, Pointer with Arrays, Arrays of Pointers, Pointers to objects, this pointers, Arrays of Pointers to Objects.
Constructors and Destructors: Constructors, Parameterized Constructors, Multiple Constructors in a class, Copy constructor, Destructors.
Operator overloading: Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Type Conversions.

Unit-IV Inheritance and Polymorphisms:
Introduction, Defining Derived Classes, Single inheritance, Multiple inheritance, Hierarchical inheritance, Multilevel inheritance, Hybrid inheritance, Virtual Base Classes, Polymorphism, static and dynamic binding, Constructor in Derived Classes, Pointers to Derived Classes, Virtual Function, Pure Virtual Function.

Unit-V I/O Operations and Files: C++ Stream Classes, Unformatted I/O Operations, Formatted I/O operations, Classes for File Streams, Opening and Closing a File : open() and close() functions, Manipulators of File Pointers : seekg(), seekp(), tellg(), tellp() functions, Sequential Input and output Operations : put(), get(), write(), read() functions, Error handling File Operations : eof(), fail(), bad(), good().

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Suggested List of Experiments:

1. Write a C++ Program to display Names, Roll No., and grades of 3 students who have appeared in the examination. Declare the class of name, Roll No. and grade. Create an array of class objects. Read and display the contents of the array.
2. Write a C++ program to declare Struct. Initialize and display contents of member variables.
3. Write a C++ program to declare a class. Declare pointer to class. Initialize and display the contents of the class member.
4. Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.
5. Write a C++ program to read the data of N employee and compute Net salary of each employee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary).
6. Write a C++ to illustrate the concepts of console I/O operations.
7. Write a C++ program to use scope resolution operator. Display the various values of the same variables declared at different scope levels.
8. Write a C++ program to allocate memory using new operator.
9. Write a C++ program to create multilevel inheritance. (Hint: Classes A1, A2, A3)
10. Write a C++ program to create an array of pointers. Invoke functions using array objects.
11. Write a C++ program to use pointer for both base and derived classes and call the member function. (Use Virtual keyword)
12. Write a Program to overload operators like *, <<, >> using friend function. The following overloaded operators should work for a class vector.

Reference Books:

1. E. Balagurusamy “Object Oriented Programming with C++” TMH.
2. Yashavant P. Kanetkar, “Let Us C++”, BPB Publications.

Text Books:

1. Herbert Shildt, “The Complete Reference C++”, Tata McGraw Hill publication.
2. Robert Lafore “Object Oriented Programming in Microsoft C++” Galgotia.
3. Bjarne Stroustrup, “C++ Programming Language”, Pearson Education.
4. M.T. Somashekare, D.S. Guru, “Object-Oriented Programming with C++”, PHI.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Apply object-oriented features, and also differentiate between object-oriented and structure-oriented programming.
CO2: Explain arrays and strings and create programs using them.
CO3: Use functions and pointers in C++ programs.
CO4: Implement data abstraction and encapsulation and learn how to reuse code using inheritance.
CO5: Design programs that use constructors and destructors.
CO6: Manage files and use exception handling to control errors.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus III Semester

CD301 (Design Thinking)

Unit-I Introduction to Design Thinking: Definition and Scope, Historical Background, Importance and Applications in Engineering and Business, 5-step Stanford model of design thinking, other design thinking models, activities to understand design thinking.

Unit-II Empathize Phase: Understanding of empathy, Recognizing steps in empathize phase of DT, Immersion activity, the steps required to conduct an immersion activity, Personas: Definition and importance, steps to create a persona in the define phase of DT, Customer journey map.

Unit-III Ideation and Define Phase: Definition, Scope, Problem Statement – Use and importance, Steps to create problem statement in define phase of DT.
Ideate Phase: steps in the ideate phase of DT, techniques of ideate phase such as how to apply techniques of ideation, Six Thinking Hats Technique.

Unit-IV Prototype and Test Phase: Storytelling, The importance of storytelling in presenting ideas and prototypes, Doodle, Prototype Phase: Definition, Scope, Importance, types of prototypes, steps involved in creating problem statement for prototype phase. Test phase: Use the best practices for the testing phase in DT.

Unit-V Other Types of Thinking: Creative, Critical, and Analytical, Difference between all four types of thinking, How DT can help become a better coder; Agile Process, Agile, and DT complement each other to deliver customer satisfaction, Value Proposition Statement, and the importance of service value proposition.

Text Books:

1. Christian Muller Roterberg, “Handbook of Design Thinking”, Kindle Direct Publishing.
2. Pavan Soni, “Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving”, Penguin Random House India Private Limited.

Reference Books:

1. Bala Ramadurai, “Karmic Design Thinking” .
2. Roger Martin, “The Design of Business: Why Design Thinking is the Next Competitive Advantage”, Harvard Business Press.
3. Nir Eyal and Ryan Hoover, “Hooked: How to Build Habit-Forming Products”, Library of Congress.
4. Dan Senor and Saul Singer, “Start-Up Nation”, Twelfth Edition, Grand Central Publishing.
5. Rod Juokins, “The Art of Creative Thinking Hardcover, Hodder & Stoughton.
6. Simon Sinek, “Start With Why How Great Leaders Inspire Everyone To Take Action”, First Edition, Penguin Publishing India.

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Course Outcomes:

After completion of this course, the students will be able to:

CO1: Recognize the importance of DT and the phases in the DT process.
CO2: List the steps required to complete empathy and define phase in the DT process.
CO3: Recognize how DT can help in functional work.
CO4: Use doodling and storytelling in presenting ideas and prototypes.
CO5: Create value proposition statements as part of their presentations and recognize how Agile and DT complement each other to deliver customer satisfaction.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus III Semester

CD302 (Computer Organization and Architecture)

Unit-I Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.
Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.

Unit-II Microprogrammed Control: Control memory, Address sequencing, micro program example, design of control unit.
Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

Unit-III Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.
Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations, Decimal Arithmetic unit, Decimal Arithmetic operations.

Unit-IV Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

Unit-V Reduced Instruction Set Computer: CISC Characteristics, RISC Characteristics.
Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor.
Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

Text Books:

1. M. Moris Mano, “Computer System Architecture”, Third Edition, Pearson.
2. William Stallings, “Computer Organization and Architecture” Sixth Edition, PHI.

Reference Books:

1. Andrew S. Tanenbaum, “Structured Computer Organization”, 4th Edition, PHI.
2. Subrata Ghoshal, “Computer Architecture and Organization”, Pearson Education India.
3. John Hayes, “Computer Architecture and Organization”, McGraw Hill Education,

4. Car Hamacher, ZvonksVranesic, Safea Zaky, "Computer Organization", Vth Edition, McGraw Hill.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the basics of instructions sets and their impact on processor design.
CO2: Demonstrate an understanding of the design of the functional units of a digital computer system.
CO3: Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory.
CO4: Design a pipeline for consistent execution of instructions with minimum hazards.
CO5: Recognize and manipulate representations of numbers stored in digital computers.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus III Semester

CD303 (Data Structures and Algorithms)

Unit-I Introduction: Data, data type, data object, types of data structure–primitive & nonprimitive, linear & non-linear, operations on data structures–traversing, searching, sorting, inserting, deleting, complexity analysis–worst case, best case, and average case, time–space trade off, algorithm efficiency, asymptotic notations–big oh, omega, theta.

Unit-II Arrays & Structure: Introduction, declaration of arrays, operations on arrays–inserting, deleting, merging of two arrays, 1 dimensional & 2 dimensional arrays, row & column major representation, address calculation in array, storing values in arrays, evaluation of polynomial: addition & representation, searching & sorting: Introduction, sequential search, binary search, Fibonacci search, indexed sequential search, hashed search, types of sorting with general concepts–bubble, insertion, selection, quick, heap, shell, bucket, radix and merge sort.

Unit-III Linked List: Introduction, basic terminology, head pointer, head node, memory allocation & deallocation for linked list, types of linked list–linear & circular linked list, singly linked list: creation of singly linked list, insertion and deletion in singly linked list, doubly linked list: creation of doubly list, deletion of node from doubly linked list, insertion of a node in doubly linked list, traversal of doubly linked list, circular linked list: singly circular linked list, doubly circular linked list, applications of linked list: polynomial representation & garbage collection.

Unit-IV Stacks & Queues: Basic concept of stacks & queues, array representation of stacks, operation on stacks: push, pop, create, getTop, empty, linked representation of stack, multiple stack, application of stack–conversion: infix, prefix, postfix and evaluation of arithmetic expression, linked representation of queue, operations on queue–insertion & deletion, Types of queue with functions: circular, deque, and priority queue, applications of queues: job scheduling, Josephus problem.

Unit-V Trees and Graphs: Basic terminology, general tree, representation of general tree, types of trees, binary tree: realization and properties, traversal in binary trees: inorder, preorder, postorder, applications of trees, Graph: basic terminologies and representations, classification of graph, graph search and traversal algorithms, applications of graph.

Suggested List of Experiments:

1. Write a program to search an element in the array using Linear and Binary Search.
2. Write a program to perform the following operation in Matrix:
   a. Addition b. Subtraction c. Multiplication d. Transpose
3. Write a program to perform the following operation on strings using string functions:
   a. Concatenation b. Copying c. Reverse d. Length of String
4. Write program for implementing the following sorting methods to arrange a list of integers in ascending order:

a. Quick sort b. Selection sort c. Insertion sort d. Merge sort

5. Write a program that uses stack operations to convert a given infix expression into its postfix equivalent.
6. Write a program to merge two sorted array into one sorted array.
7. Write a program to implement stack using array and linked list.
8. Write a program to implement queue and circular queue using array.
9. Write a program to insert an element in the beginning and end of singly linked list.
10. Write a program to insert an element at any position in singly and doubly linked list.
11. Insert and delete a node at any position in doubly linked list.
12. Write a program of Tower of Hanoi.
13. Write a program that uses functions to perform the following:
    a. Create a binary search tree of integers.
    b. Traverse the above Binary search tree non recursively in order.

Text Books:

1. A M Tanenbaum, Y Langsam & M J Augustein, "Data structure using C and C++", Prentice Hall India.
2. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Computer Science Press
3. Alfred V. Aho, John E. Hopperoft, Jeffrey D. UIlman, "Data Structures and Algorithms", Pearson Education.

Reference Books:

1. Yashavant P. Kanetkar, "Data Structures Through C", 2nd Edition, BPB Publications.
2. Donald E. Knuth, "The Art of Computer Programming: Volume 1: Fundamental Algorithms", 3rd edition, Pearson Education.
3. Varsha H. Patil,"Data Structure Using C++", Oxford.
4. Reema Thareja, "Data Structure Using C", Oxford.
5. Kushwaha and Mishra, "Data Structure: A programming Approach with C", PHI Learning.
6. A K Sharma, "Data Structure Using C", Pearson Education.
7. Robert Kruse, Bruse Leung, "Data structures & Program Design in C", Pearson Education.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Implement searching algorithms (linear search and binary search) on given data.
CO2: Perform operations on arrays.
CO3: Implement programs using queues, stacks and link lists.
CO4: Implement sorting operation using various algorithms and compare their performance.
CO5: Implement tree, graph search and traversal algorithms.

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Syllabus III Semester

CD304 (Database Management Systems)

Unit-I Basic Concepts: Basic Concepts: Introduction to DBMS, File system vs DBMS, Advantages of database systems, Database System architecture, Data models, Schemas and instances, Data independence, Functions of DBA and designer, Entities and attributes, Entity-Relationship Model: Basic concepts, Design process, Entity types, Key attributes, Relationships, Defining the E-R diagram of database, extended E-R features –generalization, specialization and aggregation, Various other data models object oriented data Model, Network data model, and Relational data model.

Unit-II Relational Model: Relational Model: Structure of relational databases, Domains, Tuples, Keys, Attributes, Relations, Characteristics of relations, Relational database, Schemas, Integrity constraints, Referential integrity, Intension and Extension, Relational algebra and relational calculus, Relational algebra operations like select, Project ,Join, Division, outer union, Types of relational calculus i.e. tuple oriented and domain oriented relational calculus and its operations.

Unit-III Structured Query Language (SQL): DDL and DML in SQL, views in SQL: Data storage and definitions, Data retrieval queries and update statements, Complex queries, various joins, indexing, triggers, assertions, Query Processing & Query Optimization: Overview, measures of query cost, selection operation, evaluation of expressions, transformation of relational expressions, Case Study of ORACLE and DB2.

Unit-IV Relational Database design: Functional Dependency –definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization –1NF, 2NF, 3NF, Decomposition using FD-dependency preservation, lossless join, BCNF, Multi-valued dependency, 4NF, Join dependency and 5NF

Unit-V Transaction Processing: Introduction of transaction, transaction processing and recovery, testing of serializability, serializability of schedules, conflict & view serializable schedule, Concurrency control: Lock management, specialized locking techniques, concurrency control without locking, Protection and Security, Introduction to: Distributed databases, Basic concepts of object oriented data base system.

Suggested List of Experiments:

1. Solving the case studies using ER data model (design ER diagram for management information system).
2. Write SQL Commands to perform various DDL, DML, DCL.
3. Write SQL Commands such as Insertion, deletion and updation for any schema.
4. Write SQL Commands to execute Nested Queries, Join Queries, order-by, having clause and string operation.

5. Write SQL Commands to perform set operators like Union, Intersect, Minus on a set of tables.
6. Write SQL Commands to execute various commands for GROUP functions (avg, count, max, min, sum).
7. Write a PL/SQL block for transaction application using Triggers.
8. Create reports using database connectivity of Front end with back end.
9. Create database Design with normalization and implementing in any application.
10. Prepare a small database application in complete semester like financial accounting system, railway reservation system, institute time table management system, student record system, library management system, hospital management system etc.

Text Books:

1. Korth, Silbertz, Sudarshan, "Database Concepts", Mc Graw Hill.
2. Elmasri, Navathe, "Fundamentals of Database Systems", Pearson.

Reference Books:

1. Date C J, "An Introduction To DatabaseSystem", Pearson Educations.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB publications.
3. S. Sharma, J. Agrawal, S. Agrawal, "Advanced Database Management System", Dreamtech Press.
4. Leon & Leon, "Fundamental of Data Base Management System",TMH.
5. Rob, "Data Base System: Design Implementation & Management", Cengage Learninig.
6. Atul Kahate , "Introduction to Database Management System", Pearson Educations.
7. Paneerselvam,"DataBase Management System", PHI Learning.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Analyze the physical and logical database designs, database modeling, relational, hierarchical and network models.
CO2: Use DDL, DML and DCL utilities to implement the schema using a DBMS.
CO3: Formulate data retrieval queries in SQL and Relational Algebra.
CO4: Demonstrate an understanding of functional dependencies, normalization theory and apply such knowledge to the design of database.
CO5: Understand concepts of Transaction Processing, Concurrency Control, and distributed database.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus III Semester

CD305 (Introduction to Data Science)

Unit-I Introduction to Data Science: Emergence and Evolution of Data Science, Where do we see Data Science, How does Data Science relate to other fields, Information vs Data, Skills for Data Science, Issues of Ethics, Bias and Privacy in Data Science; Data Scientist roles and responsibilities, Applications of Data Science in various fields, Business Intelligence vs Data Science.

Unit-II Data Collection and Preprocessing: Type of Data: Structured, Semi Structured, Unstructured and their examples, Categorical/Nominal/Ordinal data, Data Types Conversion, Challenges with unstructured data.
Data Collection Methods: Open data, social media data, Multimodal data, Data storage and presentation.
Data Preprocessing: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Data Discretization.

Unit-III Data Analysis and Data Analytics: Descriptive Analysis, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis, Regression, Data Visualization.

Unit-IV Data Science Essentials: Data Science Project Lifecycle, Standard Data Science Tasks, Tools for Data Science, Introduction of Python, R, MySQL.

Unit-V Introduction to Machine Learning for Data Science: Supervised, Unsupervised and Reinforcement learning, Examples and techniques.

Suggested List of Experiments:

1. Develop python program for Numpy arrays.
2. Develop python program for Pandas data frames.
3. Develop python program for Basic plots using Matplotlib.
4. Develop python program for Frequency distributions.
5. Develop python program for Variability.
6. Develop python program for Averages.
7. Develop python program for Normal Curves.
8. Develop python program for Correlation and scatter plots.
9. Develop python program for Correlation coefficient.
10. Develop python program for Simple Linear Regression.
11. Reading and Writing with Text Files and Binary Files.
12. Combining and Merging Data Sets.
13. Program involving Regular Expressions.
14. Data Aggregation and GroupWise Operations.

Text Books:

1. Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT.
2. Cathy O'Neil, Rachel Schutt, "Doing Data Science", 2nd Edition, O'Reilly.

Reference Books:

1. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC.
2. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.
3. Chirag Shah, "A Hands-on Introduction to Data Science", Cambridge University Press.
4. John D Kelleher, Brendan Tierney, "Data Science", MIT Press.

Course Outcomes:

After completion of the course students would be able to:

CO1: Explain the applications of Data Science.
CO2: Understand various categories of data and the operations on data.
CO3: Analyze the data to find patterns.
CO4: Understand the life cycle of a Data Science project.
CO5: Apply machine learning techniques for learning from data.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus III Semester

CD306 (Computer Programming III)

(Python)

Unit-I Introduction to Python Language: Basic syntax, Literal Constants, Numbers, Variable and Basic data types, String, Escape Sequences, Operators and Expressions, Evaluation Order, Indentation, Input, Output, Functions, Comments.

Unit-II Data Structure: List, Tuples, Dictionary, DataFrame and Sets, constructing, indexing, slicing and content manipulation.

Unit-III Control Flow: Conditional Statements - If, If-else, Nested If-else. Iterative Statement - For, While, Nested Loops. Control statements - Break, Continue, Pass.

Unit-IV Object Oriented Programming: Class and Object, Attributes, Methods, Scopes and Namespaces, Inheritance, Overloading, Overriding, Data hiding, Exception: Exception Handling, Except clause, Try finally clause, User Defined Exceptions.

Unit-V Modules and Packages: Standard Libraries: File I/0, Sys, logging, Regular expression, Date and Time, Network programming, multi-processing and multithreading.

Suggested List of Experiments:

1. To write a Python program to find GCD of two numbers.
2. To write a Python Program to find the square root of a number by Newton's Method.
3. To write a Python program to find the exponentiation of a number.
4. To write a Python Program to find the maximum from a list of numbers.
5. To write a Python Program to perform Linear Search
6. To write a Python Program to perform binary search.
7. To write a Python Program to perform selection sort.
8. To write a Python Program to perform insertion sort.
9. To write a Python Program to perform Merge sort.
10. To write a Python program to find first n prime numbers.
11. To write a Python program to multiply matrices.
12. To write a Python program for command line arguments.
13. To write a Python program to find the most frequent words in a text read from a file.
14. To write a Python program to simulate elliptical orbits in Pygame.
15. To write a Python program to bouncing ball in Pygame.

Text Books:

1. Budd Timothy A, "Exploring python", McGraw-Hill Education.
2. R. Nageshwar Rao ,"Python Programming" ,Wiley India
3. Allen B. Downey, "Think Python" O'Reilly Media, Inc.

Reference Books:

1. A.N. Kamthane, A.A. Kamthane, "Programming and Problem Solving with Python", McGraw Hill Education.
2. Balaguruswamy E., "Introduction to Computing and Problem Solving using Python", 2nd, Edition, McGraw Hill Education.
3. S. Taneja, N. Kumar, "Python Programming- A modular Approach", Pearson Education India.
4. J. V. Guttag, "Introduction to computation and programming using Python". MIT Press.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
CO2: Express proficiency in the handling of strings and functions.
CO3: Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
CO4: Identify the commonly used operations involving file systems and regular expressions.
CO5: Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD401 (Theory of Computation)

Unit-I Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and nondeterministic finite automaton, transition diagrams and Language recognizers. Finite Automata: NFA with Î transitions - Significance, acceptance of languages. Conversions & Equivalence: Equivalence between NFA with and without Î transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.

Unit-II Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions, Pumping lemma of regular sets, closure properties of regular sets.
Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion.

Unit-III CFG and PDA: Context free grammar, derivation trees, and sentential forms, Right most and left most derivation of strings, Ambiguity in context free grammars, Minimization of Context Free Grammars, Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages, Enumeration of properties of CFL.
Push Down Automata-Definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence, interconversion and equivalence of CFG and PDA, introduction to DCFL and DPDA.

Unit-IV Turing Machine: Definition, model, design of TM, Computable functions, recursively enumerable languages, Church's hypothesis, counter machine, types of Turing machines, linear bounded automata and context sensitive language.

Unit-V Computability Theory: Chomsky hierarchy of languages, decidability of problems, Universal Turing Machine, undecidability of post correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problems.

Text Books:

1. John E. Hopcroft, Rajeev Motwani Jeffrey D. Ullman, "Introduction to Automata Theory Languages and Computation", 3rd Edition, Pearson Education.
2. K.L.P Mishra and N. Chandrashekaran, "Theory of Computer Science–Automata Languages and Computation", 2nd Edition, PHI.
3. Kamala Krithivasan, Rama R, "Introduction to Formal Languages, Automata Theory and Computation", Pearson.

Reference Books:

1. Michael Sipser, "Introduction to Theory of Computation", 2nd edition, Thomson.
2. Daniel I.A. Cohen, "Introduction to Computer Theory", John Wiley.
3. Kavi Mahesh, "Theory of Computation: A Problem–Solving Approach", Wiley India Pvt. Ltd.
4. H.P. Lewis & C.H Papadimition, "Elements of Theory of Computation", Pearson/PHI.
5. John C Martin, "Introduction to Languages and the Theory of Computation", TMH.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Explain basic concepts in formal language theory, grammars, automata theory, computability theory and complexity theory.
CO2: Demonstrate abstract models of computing, including deterministic (DFA), non-deterministic (NFA), Push Down Automata (PDA) and Turing machine (TM) models and their power to recognize the languages.
CO3: Explain the application of machine models and descriptors to compiler theory and parsing.
CO4: Relate practical problems to languages, automata, computability, and complexity.
CO5: Apply mathematical and formal techniques for solving problems in computer science.
CO6: Explain the relationship among language classes and grammars with the help of Chomsky Hierarchy.

SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD402 (Operating Systems)

Unit-I Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, resource manager view, process view and hierarchical view of an OS.

Unit-II Process: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.
Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR, Multiprocessor scheduling, Real Time scheduling: RM and EDF.

Unit-III I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

Unit-IV Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP).

Unit-V Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction.
Virtual Memory: Basics of Virtual Memory, Hardware and control structures, Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).
Case Study: UNIX/Linux OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX/Linux system calls.

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B.Tech Computer Science and Engineering (Data Science)

Suggested List of Experiments:

1. Unix/Linux commands (files directory, data manipulation, network communication etc), shell programming and vi editor.
2. Write a program to implement following CPU scheduling algorithms:
    a. FCFS(First Come First Serve)
    b. SJF(Shortest Job First)
    c. Priority(Non-preemptive)
    d. Round Robin
    e. SRTF (Shortest Remaining Time First)
    f. Priority(Preemptive)
3. Write a Program to implement Shared memory.
4. Write a Program to implement Thread and Multi Thread.
5. Write a Program to implement Inter Process Communication.
6. Write a Program to implement Deadlock Avoidance and Deadlock Detection.
7. Write a Program to implement Semaphore.
8. Write a Program to implement Memory Management.
9. Write a Program to implement Indexing and Hashing.
10. Write a Program to implement certain commands and a shell like Unix/Linux system shell, using the Unix/Linux System calls.

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne. "Operating System Concepts Essentials", 6th Edition, Wiley.
2. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Pearson.
3. Dhananjay M. Dhamdhere, "Operating Systems-A Concept Based Approach", TMH.

Reference Books:

1. Charles Patrick Crowley, "Operating System: A Design-oriented Approach", TMH.
2. Gary J. Nutt, "Operating Systems: A Modern Perspective", Pearson.
3. Maurice J. Bach, "Design of the Unix Operating Systems", PHI.
4. Daniel Pierre Bovet, Marco Cesati, "Understanding the Linux Kernel", O'Reilly.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the various OS functionalities and acquire the knowledge of various types of OS.

CO2: Design and implement CPU scheduling algorithms to meet and validate the scheduling criteria.

CO3: Implement directories and perform various operations on files/directories.

CO4: Apply the acquired knowledge of deadlocks to design and implement deadlock free computer programs as well as understand the issues in inter process communication.

CO5: Understand how memory is allocated to processes by OS and implement algorithms related to main and virtual memory techniques.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD403 (Analysis & Design of Algorithms)

Unit-I Fundamentals: Algorithms, Designing algorithms, analyzing algorithms, asymptotic notations, recurrence relation and different methods to solve recurrence relation,
Divide and Conquer: Introduction, analysis, design and comparison of various algorithms based on this technique: binary search, merge sort, quick sort, heap and heap sort, strassen's matrix multiplication.

Unit-II Greedy Strategy: Study of Greedy strategy, examples of greedy method like optimal merge patterns, Huffman coding, minimum spanning trees-Kruskal and Prims algorithm, knapsack problem, job sequencing with deadlines single source shortest path algorithm-Djikstra's.

Unit-III Dynamic Programming: Concept of dynamic programming, problems based on this approach such as knapsack and 0/1 knapsack, multistage graph, reliability design, Floyd-Warshall algorithm.

Unit-IV Backtracking: Backtracking concept and its examples like 8 queen's problem, Hamiltonian cycle, Graph coloring problem.
Branch & Bound: Introduction to branch & bound method, examples of branch and bound method like traveling salesman problem etc., meaning of lower bound theory and its use in solving algebraic problem, introduction to parallel algorithms.

Unit-V Tree & Graph: Binary search trees, height balanced trees, M-way search tree, 2-3 trees, B trees, B+ tree, B* tree, red-black tree, basic search and traversal algorithms for trees and graphs, P and NP class algorithms, Polynomial reduction, NP-completeness, NP-Hard Problems.

Suggested List of Experiments:

1. Write a program for Iterative and Recursive Binary Search.
2. Write a program for Merge Sort.
3. Write a program for Quick Sort.
4. Write a program for Strassen's Matrix Multiplication.
5. Write a program for optimal merge patterns.
6. Write a program for Huffman coding.
7. Write a program for minimum spanning trees using Kruskal's algorithm.
8. Write a program for minimum spanning trees using Prim's algorithm.
9. Write a program for single sources shortest path algorithm.
10. Write a program for Floyd-Warshall algorithm.
11. Write a program for traveling salesman problem.
12. Write a program for Hamiltonian cycle problem.

Text Books:

1. T. H. Cormen, C. E.Leiserson, R. L. Rivest, and C. Stein, "Introduction to Algorithms", 3rd Edition, PHI.
2. Ellis Horowitz, Sartaj Sahni and S. Rajasekharan, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press.
3. P. H. Dave, H. B. Dave, "Design and Analysis of Algorithms", 2nd Edition, Pearson Education.

Reference Books:

1. M. T. Goodrich and R. Tomassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley & sons.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Design and Analysis of Algorithms", Pearson Education.
3. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press.
4. R. Neapolitan and K. Naimipour, "Foundations of Algorithms", 4th edition, Jones and Bartlett.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Analyze the asymptotic performance of algorithms.
CO2: Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
CO3: Find optimal solution by applying various methods.
CO4: Choose appropriate algorithm design techniques for solving problems.
CO5: Solve 8 queen's problem and others of the kind for application in real world scenarios.
CO6: Distinguish between NP hard and NP complete problems and develop their solutions.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD404 (Software Engineering)

Unit-I Introduction to Software Engineering: Definition, Software Engineering-layered Technology, Software Process and Product Characteristics, Product Metrics, Software Development Life Cycle (SDLC), Software Process Models: Waterfall Model and its Extensions, Prototyping Model, Spiral Model, RAD Model, Evolutionary Process Models like Incremental Model, Component Assembly Model, RUP.
Agile Development: Concepts of Agile Process, SCRUM, Extreme Programming, Other Agile Process Models.

Unit-II Software Requirement Analysis: Requirement Engineering Activity, Functional and Non-functional Requirements, User and System Requirements, Requirement Elicitation Methods, Requirement Analysis Methods, Software Requirement Specification (SRS), Use case Modeling, Requirement Validation, Requirement Management.

Unit-III Software Design: Software Design Process, Design Concepts and Principles, Approaches to Software Design-Overview of SA/SD Methodology, Object-Oriented Software Development, Architectural Design, User Interface Design, Function Oriented Design, Unified Modeling Language (UML), Design Measurements, Concepts of Design Patterns, Design Metrics.

Unit-IV Software Testing: Introduction to faults and failures, Software Testing Life Cycle (STLC), Testing Levels, Test Criteria, Test Case Design, Test Oracles, Testing Frameworks, Concepts of Verification and Validation, Unit Testing, Integration Testing, System Testing, White Box Testing and Black Box Testing, Code Inspection, Boundary Value Analysis, Debugging, Other Specialized Testing, Test Plan, Test Metrics, Testing Tools.

Unit-V Software Project Management: Concepts of Project Management, Software Project Planning, Project Scheduling, Feasibility study, Project Metrics, Project Estimation Techniques, Software Cost Estimation, Software Project Control and Reporting, Version Control, Risk Assessment and Mitigation, Re-engineering, Reverse Engineering, Software Configuration Management, Software Change Management, CMM and CMMI, Software Quality Assurance (SQA).

Suggested List of Experiments:

1. Write down the problem statement for a suggested system of relevance.
2. To perform requirement analysis and list the functional and non-functional requirements for the suggested system.
3. To perform the user‘s view analysis for the suggested system: Use case diagram.
4. To draw the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
5. To draw the structural view diagram for the system: Class diagram, object diagram.

6. To draw the behavioral view diagram for the suggested system: State-chart diagram, Activity diagram.
7. To draw the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram.
8. To draw the implementation view diagram for the suggested system: Component diagram for the system.
9. To draw the environmental view diagram for the suggested system: Deployment diagram for the system.
10. To Perform Estimation of effort using FP Estimation for chosen system.

Text Books:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill.
2. Rajib Mall, "Fundamental of Software Engineering", PHI.

Reference Books:

1. K.K. Agrawal & Yogesh Singh, "Software Engineering", New Age Publication.
2. Ian Sommerville, "Software Engineering", Pearson Education.
3. Grady Booch, James Rambaugh, Ivar Jacobson, "The Unified Modeling Language User Guide" Pearson Education.
4. Carlo Ghezzi, Jazayeri Mehdi and Mandrioli Dino, "Fundamentals of Software Engineering", Pearson Education.
5. Shari Lawrence Pfleeger and Joanne M. Atlee, "Software Engineering: Theory and Practice", Pearson Education.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand software engineering process and practices.
CO2: Distinguish between various software process models and cost estimation models and choose appropriate model for project.
CO3: Understand various software quality attributes and software reliability metrics.
CO4: Develop the SRS document for project.
CO5: Apply the knowledge of testing techniques and strategies to test developed software.

SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD405 (Data Mining And Warehousing)

Unit-I Data Mining: Knowledge discovery, Types of Data and Types of Databases for data mining, Data Mining Functionalities, Major Issues in Data Mining, Data Preprocessing: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Discretization.

Unit-II Data Warehouse: Operational Database Systems Vs Data Warehouse, Multidimensional Data Model, Data warehouse Schema, Data Warehouse Architecture, Data warehouse Design and Implementation, OLAP Systems, OLAP Queries, OLAP Servers, OLAP Operations, Data Marts.

Unit-III Association Analysis: Association Rule Mining: Market Basket Analysis, The Apriori Algorithm, Generating Association Rules from Frequent Items, Improving the Efficiency of Apriori, Association Mining Algorithms – FP – growth algorithm, Eclat algorithm, Pincer Search, Partition Method.

Unit-IV Classification: Decision tree technique, Bayesian Classification, Classification Using Neural Networks, Back Propagation, Classification using Support Vector Machines, Case Study of Current Available tools for classification.

Unit-V Cluster Analysis: Partitioning and Hierarchical Clustering methods, K Means, K-Medoids, CLARA, DBSCAN, BIRCH AND CURE. Categorical Clustering, Current available tools for Clustering: Case Study.

Text Books:

1. Han and Kamber, "Data Mining: Concepts and Techniques", Publications.
2. A.K. Pujari, "Data Mining Techniques", Universities Press Pvt. Ltd.

Reference Books:

1. David J. Hand, Heikki Mannila, Padhraic Smyth, "Principles of Data Mining", PHI.
2. Dunham, "Data Mining", Pearson Education India.

Course Outcomes:

After completion of this course, the students would be able to:

CO1: Classify various databases systems and data models, design schema of data warehouse for given problem.
CO2: Understand Online Analytical Processing.
CO3: Apply pre-processing techniques.
CO4: Explain data mining for knowledge discovery & prediction.
CO5: Develop data mining methods for identification of association rules.
CO6: Develop various classification and clustering algorithms.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD405 (Cloud Computing)

Unit-I Fundamental of Cloud Computing: Definition of cloud computing, Cloud infrastructure, Cloud segments or service delivery model, Infrastructure as a service, Platform as a service, Software as a service, Types of cloud, advantage and disadvantage of cloud computing, applications of cloud computing.

Unit-II Cloud Computing Architecture: Cloud Reference Model, Cloud Interoperability & Standards, Scalability and Fault Tolerance, Cloud Solutions: Cloud Ecosystem, Cloud Business Process Management, Cloud Service Management, Cloud Offerings: Cloud Analytics, Testing Under Control, Virtual Desktop Infrastructure.

Unit-III Cloud Management & Virtualization Technology: Cloud Governance, High Availability and Disaster Recovery, Virtualization: Fundamental concepts of compute, storage, networking, desktop and application virtualization, Virtualization benefits, server virtualization, Block and file level storage virtualization, Hypervisor management software, Infrastructure Requirements, Virtual LAN(VLAN) and Virtual SAN(VSAN).

Unit-IV Cloud Security: Cloud security fundamentals, Cloud security services, Design principles, Secure Cloud Software Requirements, Understanding cloud security models, Cloud Computing Security Challenges, Virtualization security Management, Cloud Computing Security Architecture.

Unit-V Market Based Management of Clouds: Federated Clouds/Inter Cloud: Characterization & Definition, Cloud Federation Stack, Third Party Cloud Services, Case study: Google App Engine, Microsoft Azure, Hadoop, Amazon and Aneka.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing”, TMH.
2. Kumar Saurabh, “Cloud Computing”, Wiley.
3. Russell Dean Vines, Ronald L. Krutz, “Cloud Security “, Wiley.

Reference Books:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing- A Practical Approach”, TMH.
2. Barrie Sosinsky, “Cloud Computing”, Wiley.
3. Douglas Comer, “The Cloud Computing Book-The Future of Computing”, Chapman and Hall/CRC.
4. Sunil kumar Manvi, Gopal Shyam, “Cloud Computing: Concepts and Technologies”, CRC Press.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the core concepts of cloud computing.
CO2: Learn the concept of cloud infrastructure model.
CO3: Implement different types of virtualization technologies and service oriented architecture systems.
CO4: Understand the concept of cloud security.
CO5: Choose among various cloud technologies for implementing applications.
CO6: Install and use current cloud technologies.

SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus IV Semester

CD406 (Computer Programming IV)

(Java)

Unit-I Introduction: Overview of Java, Installation, First Simple Program, Compilation process, Java Keywords, Identifiers, Literals, Comments, Data Types, Variables, Dynamic initialization, type conversion and casting, Operators, Control Statements.

Unit-II Objects and Methods in Java: Declaring Objects, Introducing Methods, Constructors, this Keyword, Garbage Collection, finalize Method, Overloading Methods, Overloading Constructors, Using Objects as Parameters, Inheritance, Creating a Multilevel Hierarchy, Packages and Interfaces, Exception Handling, Multithreading.

Unit-III Applet Class: Applet Basics, The Applet Class, Applet Architecture, Applet Initialization and Termination, Simple Applet Display Methods, Simple Banner Applet, Using the Status Window, The HTML APPLET Tag, Passing Parameters to Applets, Improving the Banner Applet.

Unit-IV Abstract Window Toolkit (AWT): Introduction to AWT, Working with Windows, Graphics, and Text, AWT Classes, Window Fundamentals, Component, Container, Panel, Frame, Working with Frame Windows, Handling Events in a Frame Window, AWT Controls, Layout Managers, and Menus, Adding and Removing Controls, Grid Layout, Border Layout, introduction to swing and servlet.

Unit-V Event Handling: Event Handling Mechanisms, The Delegation Event Model, Events, Event Sources, Event Listeners, Event Classes, The Mouse Event Class and others, JDBC: JDBC ODBC bridge, the connectivity model, the driver manager, navigating the result set object contents, the JDBC exceptional classes, connecting to remote database.

Suggested List of Experiments:

1. Write a program that accepts two numbers from the user and print their sum.
2. Write a program to calculate addition of two number using prototyping of methods.
3. Write a program to demonstrate function overloading for calculation of average.
4. Write a program to demonstrating overloaded constructor for calculating box volume.
5. Write a program to show the detail of students using concept of inheritance.
6. Write a program to demonstrate package concept.
7. Write a program to demonstrate implementation of an interface which contains two methods declaration square and cube.
8. Write a program to demonstrate exception handling in case of division by zero error.
9. Write a program to demonstrate multithreading.
10. Write a program to demonstrate JDBC concept using create a GUI based application for student information.

11. Write a program to display "Hello World" in web browser using applet.
12. Write a program to add user controls to applets.
13. Write a program to create an application using concept of swing.
14. Write a program to demonstrate student registration functionality using servlets with session management.

Text Books:

1. E. Balagurusamy, "Programming with Java A Primer", Tata McGraw Hill.
2. Naughton & Schildt, "The Complete Reference Java 2", Tata McGraw Hill.
3. P. Radha Krishna, "Object Oriented Programming through Java", University Press.
4. T. Budd, "Understanding Object-Oriented Programming with Java", Pearson Education.

Reference Books:

1. Horstmann & Cornell, "Core Java 2", (Vol I & II), Pearson.
2. Y. Daniel Liang, "Introduction to Java programming", Pearson Education.
3. S. Malhotra, S. Chudhary, "Programming in Java", 2nd Edition, Oxford University Press.
4. J. Nino and F.A. Hosch, "An Introduction to programming and OO design using Java", John Wiley & sons.
5. R. A. Johnson, "Java Programming and Object-oriented Application Development", Cengage Learning.
6. Sharanam Shah, "Core Java 8 for Beginners", Shroff Publisher.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the use of abstract classes and solve real world problems using OOP techniques.
CO2: Solve problems based on different data types, decision structures, loops and functions.
CO3: Develop program using the java collection API as well as the java standard class library.
CO4: Develop multithreaded applications with synchronization.
CO5: Develop applets for web applications.
CO6: Design GUI based applications.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD501 (Computational Mathematics)

Unit-I Linear Algebra: Vector space, vector subspace, linear dependence and independence of vectors, orthogonal matrix, idempotent matrix and partition matrix, their properties, quadratic forms, basis, dimension, linear transformation.

Unit-II System of Linear Equations and Their Solutions: Matrix representation of System of linear equations, Gaussian elimination, Cayley Hamilton theorem, trace, eigenvalues, eigenvectors, determinant, rank, nullity, projections, LU decomposition, singular value decomposition.

Unit-III Laplace Transform and Fourier Transform: Laplace transform and its properties, Inverse Laplace transform, laplace transform of derivative, Fourier transform and its properties, Convolution theorem, Fibonacci Series: Recursion, Fibonacci sequence.

Unit-IV Numerical Analysis: Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson's rule, Solution of Algebraic and Transcendental Equations using Newton Raphson method, Solution of Ordinary Differential Equation using Runge Kutta method. Interpolation: Forward and Backward for Equal and Unequal intervals, Finite Differences.

Unit-V Statistics: Sampling, Testing of Hypothesis, Tests for Small and Large Samples, t, f, z and chi-square tests, Linear Regression model, Design of Experiments, Randomized block design, latin square design.

Text Books:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna publishers.
2. Gilbert Strang, "Introduction to linear algebra", Wellesley-Cambridge Press.
3. A. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", vol. I & II, World Press.
4. M.K. Jain, S.R.K. Iyengar, R.K. Jain, "Numerical methods for Scientific and Engineering Computation", New age international publishers.

Reference Books:

1. A.M. Mood, F.A. Graybill & D.C. Boes, "Introduction to the Theory of Statistics", McGraw Hill.
2. Erwin Kreyszig "Advanced Engineering Mathematics",Wiley.
3. Kenneth Hoffman, Ray Kumze, "Linear Algebra", Pearson Prentice Hall.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Demonstrate an understanding of the concepts of vector space and subspace.
CO2: Solve systems of linear equations using multiple methods and apply principles of matrix algebra to linear transformations.
CO3: Apply Fourier transforms to boundary problems.
CO4: Learn about the Laplace transforms of standard functions, and the conditions for their existence.
CO5: Analyze and evaluate the accuracy of numerical methods.
CO6: Use inferential statistics and test statistics to assess the significance of a model.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD502 (Compiler Design)

Unit-I Introduction to Compilers: Structure of a compiler, Lexical Analysis, Role of Lexical Analyzer, BOOT Strapping & Porting**,** Input Buffering, Specification of Tokens, Recognition of Tokens, LEX, Finite Automata, Regular Expressions to Automata, Minimizing DFA.

Unit-II Syntax Analysis: Role of Parser, Grammars, Error Handling , Context-free grammars, Writing a grammar, Top Down Parsing, General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0)Item Construction of SLR Parsing Table -Introduction to LALR Parser, Error Handling and Recovery in Syntax Analyzer-YACC.

Unit-III SDD and Intermediate Code Generation: Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

Unit-IV Run-Time Environment And Code Generation: Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management, Issues in Code Generation, Design of a simple Code Generator.

Unit-V Code Optimization: Introduction to Code optimization: sources of optimization of basic blocks, loops in flow graphs, dead code elimination, loop optimization, Introduction to global data flow analysis, Code Improving transformations, Data flow analysis of structure flow graph Symbolic debugging of optimized code.

Suggested List of Experiments:

1. Write a program to implement the Lexical Analyzer.
2. Implement the construction of DAG.
3. Implement Predictive Parsing Table.
4. Implement Shift Reduce Parsing.
5. Tokenizing a file using C.
6. Implement Intermediate code generation – Postfix, Prefix (Infix to Postfix).
7. Implement Intermediate code generation – Postfix, Prefix (Postfix to Prefix).
8. Implementation of LALR Parser using YACC.
9. Implement the front end of a compiler that generates the three address code (Quadruple, Triple, Indirect triple).
10. Design and develop a single code generator(back end of the compiler).

Text Books:

1. V. Aho, R. Sethi and J. D. Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education.
2. K.C. Louden, “Compiler Construction: Principles and Practice”, Cengage Learning.

3. Keith D Cooper and Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers.
4. K Muneeswaran, "Compiler Design", Oxford University Press.

Reference Books:

1. Rand Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers.
3. Charles N. Fischer, Richard. J. LeBlanc, "Crafting a Compiler with C", Pearson Education.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Design various phases of compiler.
CO2: Use the compiler tools like LEX, YACC, etc.
CO3: Examine various parsing techniques and their comparison.
CO4: Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.
CO5: Compare various code generation and code optimization techniques.
CO6: Analyze different tools and techniques for designing a compiler.

SCHOOL OF INFORMATION TECHNOLOGY, RGPV, BHOPAL

New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD503 (Cloud Computing)

Unit-I Introduction: Cloud Computing in Data Science, Vision of Cloud Computing, Characteristics of cloud computing as per NIST, Importance of Cloud computing in Data Science, Cloud services requirements, Cloud and dynamic infrastructure, Cloud Adoption and rudiments, Overview of cloud applications: ECG Analysis in the cloud, Protein structure prediction, Gene Expression Data Analysis, Satellite Image Processing, CRM and ERP, Social networking.

Unit-II Cloud Computing Architecture: Cloud Reference Architecture, cloud models(IaaS,PaaS,Saas,DaaS), Cloud Interoperability & Standards, Scalability and Fault Tolerance, Cloud Solutions: Cloud Ecosystem, Cloud Business Process Management, Cloud Service Management, Cloud Offerings: Cloud Analytics, Testing Under Control, Virtual Desktop Infrastructure.

Unit –III Cloud Management & Virtualization Technology: Resiliency, Provisioning, Asset management, Concepts of Map reduce, Cloud Governance, High Availability and Disaster Recovery, Virtualization: Fundamental concepts of compute, storage, networking, desktop and application virtualization. Virtualization benefits, server virtualization, Block and file level storage virtualization Hypervisor management software, Infrastructure Requirements, Virtual LAN(VLAN) and Virtual SAN(VSAN) and their benefits.

Unit-IV Cloud Security: Cloud Information security fundamentals, Cloud security services, Design principles, Secure Cloud Software Requirements, Policy Implementation, Cloud Computing Security Challenges, Virtualization security Management, Cloud Computing Security Architecture.

Unit-V Cloud Computing Platform for Data Science: Amazon Web Services, Google Cloud, BigQuery, Dataflow, Dataproc (Running Apache Hadoop, Apache Spark clusters), Looker - Business Intelligence Analytics, Google Data Studio-Visualization Dashboards, Data Reporting, Data Preparation, Microsoft Azure products for data analytics , Azure Synapse Analytics, Data Factory Microsoft Azure databases- Azure Cosmos DB (NoSQL database), Azure SQL Database (SQL database).

Suggested List of Experiments:

1. Working of Goggle Drive to store files and folders.
2. Working of Goggle Drive to make spreadsheet and notes.
3. Working and installation of Microsoft Azure
4. Installation and configuration of Hadoop
5. Installation and configuration of Euceliptus etc.
6. Install a C compiler in the virtual machine created using virtual box andexecute Simple Programs

7. Install Google App Engine.
8. Create hello world app and other simple web applications using python/java.
9. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of Windows 7or 8.
10. Working and installation of Google App Engine.
11. Cloud security management: Performance evaluation of services over cloud-Google App & Amazon web services.

Text Books:

1. R. Buyya, C. Vecchiola, S.T Selvi, "Mastering Cloud Computing", TMH.
2. Kumar Saurabh, "Cloud Computing", Wiley.
3. Russell Dean Vines, Ronald L. Krutz, "Cloud Security ", Wiley.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing- A Practical Approach", TMH.
5. Barrie Sosinsky, "Cloud Computing", Wiley.
6. Noah Gift, Alfredo Deza, "Computing for Data analysis", O'Reilly.

Reference Books:

1. Douglas Comer, "The Cloud Computing Book-The Future of Computing", Chapman and Hall/CRC.
2. Sunil kumar Manvi, Gopal Shyam, "Cloud Computing: Concepts and Technologies", CRC Press.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the core concepts of cloud computing.
CO2: Learn the concept of cloud infrastructure model.
CO3: Implement different types of virtualization technologies and service oriented architecture systems.
CO4: Understand the concept of cloud security.
CO5: Choose among various cloud technologies for implementing applications.
CO6: Install and use current cloud technologies.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD504 (Artificial Intelligence)

Unit-I Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, problem characteristics in AI, problem as state space search, Production System, various types of production system, problem characteristics, and characteristics of production system.

Unit-II Search Techniques: Breadth first search, Depth first search, Depth limited search, Heuristic search, Best-first search, problem reduction, A*search. AO* search, generate test, Hill climbing search, Simulated annealing search, Local beam search, Constraint Satisfaction Problems, Constraint propagation, Means and Analysis.

Unit-III Propositional and Predicate Logic: Knowledge representation issues, Propositional logic , predicate logic, first order logic, syntax and semantics, inferences in first-order logic, resolution, refutation, deduction, theorem proving, inferencing, monotonic and non monotonic reasoning, procedural and declarative knowledge, forward and backward reasoning.

Unit-IV Probability: Bayes theorem, Bayesian networks, semantic networks, scripts, schemas, frames, conceptual dependency, introduction to learning, techniques used in learning, neural network introduction, common sense, reasoning, examples of expert system.

Unit-V Game Playing: Minimax procedure, alpha-beta pruning, monte-carlo tree search, stochastic games, partially observable games, block word problem in robotics, Introduction to understanding and NLP.

Text Books:

1. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill.
2. Stuart Russell and Peter Norvig, “Artificial Intelligence –A Modern Approach”, Pearson.
3. Nelsson N.J., “Principles of Artificial Intelligence”, Springer Verlag, Berlin.

Reference Books:

1. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education.
2. Patrick H. Winston, "Artificial Intelligence", Pearson Education.
3. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education.
4. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Apply Knowledge and search techniques
CO2: Apply problem solving techniques
CO3: Apply game playing and CSP techniques
CO4: Perform logical reasoning.
CO5: Perform probabilistic reasoning under uncertainty and expert system.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD505(A) (Advanced Web Technology)

Unit-I Introduction to Web and HTML: Web Browsers, Web Servers, Web essentials, W3C, Clients-Servers, Communication, architecture, Markup Languages –HTML, Tags, Tables, Forms, Frames etc .XHTML, HTML5.

Unit-II CSS And Java Script: CSS: Inline, Internal and External Style Sheet, Bootstrap-CSS Text, CSS forms, CSS components drop down, Introduction of CSS3, Bootstrap.
Client side programming: Java script language, Java Script Objects, JS Alert, JS Button, JS popover, Host Objects Browsers and the DOM.
Server side programming: Java servlets, Basics, Simple Program, Separating Programming And Presentation.

Unit-III ASP/JSP: ASP/JSP, JSP Basics, ASP/JSP Objects, Simple ASP/JSP Pages, Representing Web data, Data Base Connectivity, JDBC, Dynamic Web Pages, XML, DTD, XML Schema, DOM, SAX, Xquery, JSON, WEB 3.0, Building Web Applications, Cookies, Sessions, Open Source Environment.

Unit-IV PHP And Mysql: Basic PHP Programs, Form & PHP: Creating Form Controls, Using Values Returned From, Forms Using PHP.
PHP Database Connectivity: Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection. Manipulating Data in MySQL Using PHP: Inserting, Viewing, Updating and Deleting Records, Manipulating joined tables. User Authentication: Creating Session, Authorization Level.

Unit-V Web Hosting: Uploading Web pages - Using FTP and using Web Page Editors Web hosting - Shared hosting, running a Local Web server.

Suggested List of Experiments:

1. Create a HTML page with frames, links, tables and other tags for highlighting the facilities in the Department in your College. State the assumptions you make (business logic you are taking into consideration).
2. Create a web page with the following using HTML:
    a. To embed a map in a web page.
    b. To fix the hot spots in that map.
    c. Show all the related information when the hot spots are clicked.
    d. Embed an image map picture (India map) on a Web page that provides different links to other Web pages (different states) and show the all the related information depending on where a user clicks on the image.
    e. Create a webpage to embed a human body image, identify and display all the related information about the human body parts (head, eye, nose, finger etc.) based on the user clicks on the human body image map.

3. Create a web page with the following:
    a. Cascading style sheets.
    b. Embedded style sheets.
    c. Inline style sheets.
    d. Use your college information for the web pages.
4. Write a DTD for an XML document that declares an address book containing contacts. Each contact has a name and address. An address should contain attributes for street name, state and phone number. Write an XML document and validate it against this DTD.
5. Write programs in PHP to create three-tier applications:
    a. For conducting on-line examination.
    b. For displaying student mark list. Assume that student information is available in a database which has been stored in a database server
6. Session tracking using hidden form fields and Session tracking for a hit count.
7. Write a PHP program for Employee Details which includes EmpID, Name, Designation, Salary, DOJ, etc.,to connect with the database and execute queries to retrieve and update data. Prepare the report for single and group of employees based on the end user needs.
8. Uploading websites on FTP and Local Server.

Text Books:

1. Deitel P. J., Deitel H. M. and Deitel A., "Internet and World Wide Web: How to Program", Fifth Edition, Pearson Prentice Hall.
2. Jon Duckett, "HTML & CSS: Design and Build Websites", John Wiley & Sons.
3. Naramore E., Gerner J., Scouarnec Y.L., "Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer", John Wiley & Sons Inc.

Reference Books:

1. Sebesta R. W.,"Programming the World Wide Web", Eight Edition, Pearson.
2. Pressman R. and Lowe D., "Web Engineering: a practitioner's approach", First Edition, McGrawHill,.
3. Kappel G., "Web Engineering: The Discipline of systematic Development of Web Applications", First Edition, John Wiley & Sons.
4. Suh W., "Web Engineering: Principles and Techniques", Idea Group Inc.
5. Ullman L, "PHP for the Web: Visual Quick Start Guide", Fifth Edition, Peach pit Press.
6. Chris Bates, "Web Programming – Building Internet Applications, "Wiley India.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Construct a basic website using HTML and Cascading Style Sheets.
CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3: Construct simple web pages in PHP and to represent data in XML format.
CO4: Design and implement server side programs using PHP.
CO5: Do database manipulation using MySQL and authenticate data.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD505(B) (Introduction to Toolkits for Data Science)

Unit-I Python for Data Science: Review of Numpy, Pandas and Scikit-learn, Supervised Learning Techniques packages/toolkit for regression and classification: -Decision Trees, Naive Bayes, Classification, Support vector machines, Random Forest, Neural network, Ensemble Methods, Ordinary Least Squares Regression, Logistic Regression, etc. Unsupervised Learning, Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture, Optimization Using Evolutionary Techniques etc.

Unit-II R for Data Science: Basic of R and RStudio: R data structures: vectors, factors, lists, arrays, matrices, and data frames. Working with data: Import data into R and visualize data. Data Analytics Software: Weka, Orange, Rapidminer, Minitab, PowerBI, GitHub, Google Colab.

Unit-III Introduction to Deep Learning: Basics of TensorFlow and keras, Basics of PyTorch, style transfer of one image to another, text generation, and sentiment analysis with PyTorch. Neural networks that recognize objects, improve the accuracy of object recognition using CNN, use pre-trained models to build state-of-the-art classifiers, Saving and Loading models, Time series forecasting with RNNs, and LSTMs,

Unit-IV Introduction to Time Series Analysis: Time series regression and exploratory data analysis toolkits: ARMA/ARIMA models, model identification/estimation/linear operators, Fourier analysis, spectral estimation, and state-space models.

Unit-V Cloud Computing for Data Science: Implementation of Machine Learning and Deep learning through AWS/Azure platform, Version controlling tools for data science projects, Case studies of data science projects.

Suggested list of Experiments:

1. Write programs to create numpy arrays of different shapes and from different sources, reshape and slice arrays, add array indexes, and apply arithmetic, logic, and aggregation functions to some or all array elements.
2. Write programs to use the pandas data structures: Frames and series as storage containers and for a variety of data-wrangling operations.
3. Write programs to parse text files, CSV documents and extract relevant data. After retrieving data check any anomalies in the data, missing values etc.
4. Write programs for searching, splitting, and replacing strings based on pattern matching using regular expressions.
5. Write a Python/R program to implement your own version of the K-means algorithm.
6. Write a Python/R program to classify text as spam or not spam using the Naïve Bayes Classifier.
7. Design a perceptron classifier to classify handwritten numerical digits (0-9). Implement using scikit or Weka.

8. Write a program using Scikit-learn to split the any dataset into 70% train data and 30% test data. Apply training and print both datasets.
9. Binary Classification Task: Build a network to classify movie reviews as positive or negative, based on the text content of the reviews.
10. Implement sentimental analysis or text classification using PyTorch.

Text Books:

1. Jonathan D. Cryer, Kung-Sik Chan, "Time-Series Analysis with Applications in R", Springer.
2. Giovanni Petris, Sonia Petrone Patrizia Campagnoli, "Dynamic Linear Models with R", Springer.
3. Hadley Wickham, Garrett Grolemund, "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data", O'reilly.

Reference Books:

1. Peter J. Brockwell, Richard A. Davis, "Introduction to Time Series and Forecasting", Springer.
2. Raquel Prado, Marco A. R. Ferreira, Mike West, "Time Series: Modeling, Computation, and Inference" Chapman & Hall/CRC.
3. David Ruppert, David S. Matteson, "Statistics and Data Analysis for Financial Engineering with R examples", Springer.

Course Outcomes:

After completion of this course, students will be able to:

CO1: Implement python libraries and packages used for data science.
CO2: Run and interpret data analytics tools using R-programming.
CO3: Implement various neural networks of deep learning using Tensorflow, PyTorch.
CO4: Analyze and estimate time series models.
CO5: Apply machine learning and deep learning through cloud platforms.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus V Semester

CD505(C) (Computational Intelligence)

Unit-I Introduction to Computational Intelligence: Definition and Scope, Historical Background Importance and Applications in Engineering, types of Computational Intelligence, components of Computational Intelligence. Concepts of adaptation and self-organization,
Artificial Intelligence (AI): Overview of AI, Symbolic AI vs. Sub symbolic, AI Problem-solving and Search Strategies, Concept of Learning/Training model: Parametric Models, Nonparametric Models.

Unit-II Fuzzy Systems: Concepts and Paradigms, Concepts of Fuzzy Sets and Fuzzy Logic Operators, Concept of Fuzzy relations and their composition, Membership Functions, Fuzzy Inference Systems, Approximate Reasoning, Differences between Fuzzy Logic and Probability, Approaches to the Design and Analysis of Fuzzy Systems.
Fuzzy Inference Systems: Mamdani and Sugeno Models, Fuzzification and Defuzzification
Design of Fuzzy Systems: Rule-based System Design, Applications in Control Systems and Decision-Making, and factors to consider when implementing fuzzy systems. Implementation examples include a traditional fuzzy rule system and an evolutionary fuzzy rule system.

Unit-III Introduction to Evolutionary Algorithms: Genetic Algorithms (GA), Genetic Programming (GP), Evolution Strategies (ES) and Differential Evolution (DE), Genetic Algorithms: Basic Genetics, Concepts, Working Principle, Creation of Offspring, Encoding, Representation, Selection, Crossover, Mutation, Fitness Functions, Applications of GA in Optimization Problems.

Unit-IV Neural Networks: Biological Neurons vs. Artificial Neurons, Basic Concepts: Perceptron, Activation Functions, Layers.
Rough Set Theory: Introduction, Fundamental Concepts, Set approximation, Rough membership, Attributes, Optimization, Hidden Markov Models, Decision tree model.

Unit-V Introduction to Swarm Intelligence: Basics of Swarm Intelligence, Swarm Intelligence Techniques: Ant Colony Optimization, Particle Swarm Optimization, Bee Colony Optimization, etc. Recent Trends in Evolutionary Computation: Real-world applications. Ethical and Societal Impacts: Ethical Considerations in AI and CI, Societal Impacts and Future Directions.

Suggested List of Experiments:

1. Familiarize with popular machine learning libraries (e.g., Scikit-learn, TensorFlow, Keras) and tools (e.g., Jupyter Notebook).
2. Create a comparison table highlighting the differences between symbolic AI and subsymbolic AI.
3. Implement a basic self-organizing map (SOM) in Python to visualize how data points are organized into clusters based on similarity.

4. Implement a simple linear regression model (parametric) and k-nearest neighbors model (nonparametric) using Scikit-learn. Use a sample dataset to train and evaluate both models.
5. Implementation of Basic Genetic Algorithm: Develop a simple genetic algorithm to solve a given optimization problem and analyze the effects of different parameters (e.g., population size, mutation rate).
6. Design a fuzzy logic controller for a temperature control system, including fuzzification, rule base creation, and defuzzification.
7. Implement a decision tree classifier for the Iris dataset, using optimized attributes from rough set theory.
8. Implement PSO to optimize a multi-dimensional function and compare its performance with other optimization algorithms.
9. Hybrid Neuro-Fuzzy System: Develop a hybrid neuro-fuzzy system for a pattern recognition task, combining the strengths of neural networks and fuzzy logic.
10. Real-World Application Project: Work on a mini-project that applies computational intelligence techniques to a real-world problem (e.g., predicting stock prices, medical diagnosis, or autonomous navigation), presenting the methodology and results.

Text Books:

1. Russell C. Eberhart and Yuhui Shi, "Computational Intelligence: Concepts to Implementations", Morgan Kaufmann Publishers.
2. Andries P. Engelbrecht, Computational Intelligence: An Introduction", Wiley Publishing.

Reference Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson.
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall.
3. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning", Pearson Education.
4. Jagdish Chand Bansal, Pramod Kumar Singh, Nikhil R. Pal, "Evolutionary and Swarm Intelligence Algorithms", Springer Publishing.
5. S. Rajeskaran, G.A. VijaylakshmiPai, "Neural Networks, Fuzzy Logic, Genetic Algorithms Synthesis and Applications", PHI Publication.
6. J.S. Roger Jang, C.T.Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning & Machine Intelligence", PHI Publication.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Explain the basic concepts and techniques of computational intelligence, including artificial intelligence, machine learning, neural networks, and fuzzy logic.
CO2: Construct fuzzy inference systems and apply fuzzy logic techniques to decision-making and control systems.
CO3: Utilize genetic algorithms, particle swarm optimization, and other evolutionary techniques to solve complex optimization problems.
CO4: Design, implement, and analyze neural networks for various applications.
CO5: Apply computational intelligence techniques to real-world problems.

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New Scheme Based on AICTE Flexible Curricula

B.Tech Computer Science and Engineering (Data Science)

Syllabus VI Semester

CD601 (Computer Networks)

Unit-I Introduction & Physical Layer: Computer Network Definitions, goals, components, Architecture, Classifications & Types, Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, Connection Oriented & Connectionless Services, Service primitives, Design issues & its functionality. ISO OSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations.

Unit-II Data Link Layer: Data link layer design issues, framing, flow & error control, physical addressing, Stop & Wait protocol, Go back N ARQ, selective repeat ARQ, piggybacking and pipelining, HDLC LAN Protocol stack-Logical link control and Media Access Control sublayer, IEEE 802.2 LLC Frame format; MAC layer Protocols- static and dynamic allocation, Pure and slotted ALOHA, Carrier sense multiple access, Persistent and non persistent CSMA, IEEE standard 802.3, 802.4, 802.5, FDDI.

Unit-III Network Layer: logical addressing, classful & classless addressing, packet delivery & forwarding. unicast routing protocols , multicast routing protocols, Routing algorithm- Least Cost, Dijkstra's, Bellman-ford, Introduction to Internet protocol, IPv4 header, IPv4 Datagrams, Encapsulation, Fragmentation and Reassembly, IP routing, Subnet addressing, Subnet mask, Super netting- special case of IP addresses, Ipv6-Motivation, frame format and addressing. ICMP: Introduction, ICMP Header, ICMP message types.

Unit-IV Transport Layer: TCP: Introduction ,Transport services , Process to process delivery, TCP ,congestion control algorithms, quality of service, headers, connection establishment and termination, timeout of connection establishment, maximum segment size, port no. and socket addresses, TCP timers, UDP: Introduction, UDP header, UDP checksum, UDP operations, encapsulation & decapsulation, queuing, SCTP-Services, transmission sequence number, stream identifier, stream sequence number, packet format.

Unit-V Application Layer: BOOTP:-operation, packet format, DHCP:-Address allocation, configuration & packet Format, DNS: Distribution of name spaces, DNS in the internet, FTP:-Connection, Communication, command processing, TFTP, E-Mail: SMTP, POP, IMAP, SNMP, study of internetworking devices and their configuration– switches, hubs, Bridges, routers and Gateways.

Text Books:

1. Andrew S Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education.
2. Behrouz A. Forouzan, “Data Communications and Networking”, 5th Edition TMH.

Reference Books:

1. S. Keshav, "An Engineering Approach to Computer Networks", 2nd Edition, Pearson Education.
2. W. A. Shay, "Understanding communications and Networks", 3rd Edition, Cengage Learning.
3. James F. Kurose, K. W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 3rd Edition, Pearson Education.

Course Outcomes:

After completion of this course, the students 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.
CO2: Apply channel allocation, framing, error and flow control techniques.
CO3: Describe the functions of network layer i.e. logical addressing, subnetting & routing mechanism.
CO4: Explain the different transport layer function i.e. port addressing, connection management, error control and flow control mechanism.
CO5: Understand the functions offered by session and presentation layer and their Implementation.
CO6: Explore different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus VI Semester

CD602 (Machine Learning for Data Science)

Unit-I Introduction to Machine Learning: Basics of ML, Types of Learning: Supervised, Unsupervised, Semi-supervised learning and Reinforcement learning with applications, Guidelines for ML experiments, working with real data: Data preparation, training and testing the model, machine learning challenges.

Unit-II Supervised Learning: Linear and Logistic Regression, Linear models for classification, Sigmoid, Logistic regressions with single and multiple variables, Polynomial regression. Cross validation, Model evaluation (precision, recall, F1-mesure, accuracy, area under curve), Statistical decision theory including discriminant function and decision surfaces, Naive Bayes classification, Bayesian networks, Decision Tree and Random Forests, k- Nearest neighbor classification, least squares regression.

Unit-III Unsupervised Learning: Clustering, Common distance measures, Hierarchical algorithms, agglomerative and divisive, partitioning algorithms, k-means and derivatives, using clustering for image segmentation, DBSCAN, other clustering algorithms, Applications of Unsupervised Learning.

Unit-IV Ensemble Learning: Boosting, Adaboost, Stumping, Gradient Boosting Machines And Xgboost , Bagging, Subagging, Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis , Covariance's, limitations of PCA, Computing PCA.

Unit-V Reinforcement Learning: Basics of RL, RL Framework, Markov Decision Process, Exploration Vs Exploitation, Polices, Value Functions and Bellman Equations, Solution Methods, Q-learning. Contemporary Issues.

Suggested List of Experiments:

1. Familiarizing with Anaconda and Jupyter for importing modules and dependencies for ML.
2. Demonstrate various data pre-processing techniques for a given dataset.
3. Implement Simple and Multiple Linear Regression Models.
4. Develop Logistic Regression Model for a given dataset.
5. Implement Dimensionality reduction using Principle Component Analysis (PCA) method.
6. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
7. Implement Naive Bayes Classification.
8. Write a program to implement K-Means clustering Algorithm.
9. Implement Random forest ensemble method on a given dataset.
10. Implement anomaly detection and recommendation.

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press.
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer.
4. E. Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI.

Reference Books:

1. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Taylor & Francis
2. Peter Flash, "Machine Learning: The Art and Science of Algorithms That Make Sense of Data", Cambridge University Press.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the basic concepts of machine learning.
CO2: Apply various supervised learning approaches.
CO3: Demonstrate unsupervised learning approaches.
CO4: Examine the performance of model on applying dimensionality reduction and ensemble techniques.
CO5: Identify suitable Reinforcement learning algorithms for solving real world problems.

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B.Tech Computer Science and Engineering (Data Science)

Syllabus VI Semester

CD603 (Data Handling and Visualization)

Unit-I Introduction To Data Visualization: History of Data Visualization ,Role of Data Visualization in Analysis and Decision Making, Data Visualization Fundamentals: Principles, visualization types, Introduction to Data Handling, steps of Data Handling.

Unit-II Visualization Plot Types - Bar charts, Scatter Plots, Maps, Bullet Graphs, Pie Charts, Donut Charts, Heat Maps, and Tables, show modifications of the various plots according to the data-ink maximization and erasing principals in order to increase the data-ink ratio. Identify the proper chart and preattentive attributes for different visualization scenarios

Unit-III Visualizing Data Process - Identify and recognize the different types of data attributes, transform data from raw formats to visualization-suitable formats, applying suitable techniques for the different data attributes, normalization and standardization techniques for data preprocessing.

Unit-IV Data Visualization Tools- Introduction of Various Data Visualization tools like Tableau, Looker, Zohoanalytics, IBM cogno analytics, Qlik sense, Domo, Microsoft Power BI, SAP analytics cloud, Wahagraph

Unit-V Security Data Visualization - Port scan visualization -Vulnerability assessment and exploitation -Firewall log visualization -Intrusion detection log visualization -Attacking and defending visualization systems –Creating security visualization system.

Suggested List of Experiments:

1. Introduction to various Data Visualization tools.
2. Introduction to Tableau and Installation.
3. Creating common visualizations (bar charts, line charts etc.)
4. Connecting to Data and preparing data for visualization in Tableau.
5. Case Study on Security in Data Visualization.
6. Case Study on Power BI.
7. Create Stories using Tableau.
8. Case study on time series data visualization.
9. Study of Hierarchical data and topographical data visualization in Tableau.
10. Study of basic dashboard in Tableau.

Text Books:

1. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization, And Statistics", Wiley & Sons.
2. Edward R. Tufte, "The Visual Display of Quantitative Information", 2nd edition Graphics Press.

Reference Books:

1. Stephen Few, "Information Dashboard Design: Displaying Data for At-a-glance Monitoring", Analytic Press.
2. Andy Kirk, Data Visualization A Handbook for Data Driven Design", Sage Publications.
3. Kieran Healy, "Data Visualization: A Practical Introduction", Princeton University Press.
4. Alberto Cairo, "The Functional Art of Data Visualization", New Riders.
5. Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, "The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios", Wiley.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Develop a deep understanding of history, principles and concepts of data visualization, including the perception of visual information, effective use of visual elements.
CO2: Develop a deep understanding of different Visualization Plot types.
CO3: Understand the Data and its transformation for processing.
CO4: Acquire proficiency in utilizing a wide range of data visualization tools to create impactful visual representations of data for analysis and communication purposes.
CO5: Understand the Security process in Data Visualization.

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Syllabus VI Semester

CD604 (Cyber and Information Security)

Unit-I Information and Network Security Concepts: The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptography, Network Security, Trust and Trustworthiness, Standards.

Introduction to Building Blocks of Information Security: Basic Principles, Security-Related Basic Terms and Definitions, The Three Pillars of Information Security: CIA, Information Classification, Criteria for Classification of Data and Information, Data Obfuscation.

Unit-II Cryptography: Classical Encryption Techniques - Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.
Introduction to Block Ciphers and the Data Encryption Standard**,** Principles of Public-Key Cryptosystems, The RSA Algorithm**a**nd Other Public-Key Cryptosystems: Diffie–Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography**,** Symmetric Key Distribution Using Symmetric Encryption and Asymmetric Encryption.

Unit-III Cryptographic Hash Functions: Applications, Requirements and Security, Secure Hash Algorithm (SHA).
Message Authentication Codes: Requirements, Functions, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC Authenticated Encryption: CCM and GCM, Key Wrapping, Pseudorandom Number Generation Using Hash Functions and MACs.
User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption and Asymmetric Encryption.

Unit V: Transport-Level Security: Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH).
Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, DNS-Based Authentication of Named Entities, Sender Policy Framework, Domain Keys Identified Mail, Domain-Based Message Authentication, Reporting, and Conformance.

Unit-V IP Security: Overview, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.
Network Endpoint Security: Firewalls, Intrusion Detection Systems, Malicious Software, Distributed Denial of Service Attacks.
Cloud Security: Concepts, Risks and Countermeasures, Cloud Security as a Service
Internet of Things (IoT) Security: Privacy Issues in IoT, Security Threats, Best Practices for Intelligent Buildings, Smart Cities: Privacy and Security.

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 4th edition, Prentice Hall.
2. Nina Godbole, "Information System Security", Wiley.
3. V.K. Jain, "Cryptography and Network Security", Khanna Book Publishing Company, Delhi.
4. Gupta & Gupta, "Information Security and Cyber Laws", Khanna Book Publishing Company, Delhi.

Reference Books:

1. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi.
2. Yuri Diogenes, Erdal Ozkaya, "Cybersecurity - Attack and Defense Strategies: Infrastructure security with Red Team and Blue Team tactics", Packt Publishing.
3. Atul Kahate, "Cryptography and Network Security", McGraw Hill.
4. V.K. Pachghare, "Cryptography and Information Security", PHI Learning.
5. Bothra Harsh, "Hacking", Khanna Publishing House, Delhi.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand and explain with examples the concepts of confidentiality, integrity and availability.
CO2: Analyse symmetric and asymmetric key cryptography.
CO3: Design and implement appropriate security technologies and policies to protect computers and digital information.
CO4: Identify information security threats and vulnerabilities in information systems.
CO5: Apply security measures to real time scenarios and in new age systems such as cloud computing and IoT.

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Syllabus VI Semester

CD605(A) (Introduction to IoT)

Unit-I Introduction: Overview, Definition, features & it's components, IoT Principles, Challenges & Applications Conceptual Framework & IoT Architecture, IoT reference model.
IoT development Tools: Arduino, Types, Fundamentals and Configuration, Raspberry Pi: Introduction, configuration, board setting.

Unit-II Sensors, Actuator & Protocols: IoT Sensors: Introduction, sensor types, features, basic components, working principles of different sensors, Actuator and it's types, Microcontroller for IoT.
IoT protocols: MQTT, COAP, SOAP, REST, HTTP, XMPP, WEBSOCKET.

Unit-III Technologies & Models: IoT Enabled Technologies Overview: RFID, NFC, 6LOWPAN, ZIGBEE, WIFI, WIMAX, Bluetooth, IPv4 & IPv6, IoT Communication Models (Publisher Subscriber, Request Response, Push-Pull, Exclusive pair), IoT Gateways , Privacy & security issues in IoT.

Unit-IV Compare Machine To Machine With IoT: M2M Overview, M2M value chains, IoT Value Chain, M2M Vs IoT.
Industry 4.0 standard Overview: Introduction, Software Defined network (SDN), Network Function Virtualization (NFV), Setup working environment for available IoT cloud platform (AWS/AZURE/ThingSpeak).

Unit-V IoT Levels And Deployment: IoT cloud-data Collection, IoT data analytics, IoT data life Cycle, Different IoT levels for real-time application deployment (level 1: Home Automation, Level-2: Smart Irrigation, Level-3: Package Tracking, Level-4: Noise Monitoring, Level-5: Forest Fire Detection, Level-6: Weather Monitoring System).

Suggested List of Experiments:

1. Installing Arduino IDE, Perform running Sketches (blinking LED, blink without delay).
2. Demonstration of Raspberry Pi.
3. Perform interfacing of sensors with Arduino/ Raspberry Pi.
4. Perform interfacing of actuators with Arduino/ Raspberry Pi.
5. Perform interfacing of servomotor with Arduino/ Raspberry Pi.
6. Perform experiment using Arduino with latest IoT Technologies for Smoke detector.
7. Perform experiment using Arduino with latest IoT Technologies Temperature Monitoring.
8. Perform experiment using Arduino with latest IoT Technologies Garbage Collector.
9. Setup IoT cloud environment for IoT analytics platform to aggregate, visualize, and analyze live data streams.
10. Develop small IoT realtime application based on cloud service.

Text Books:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill.
2. Donald Norris, "Internet of Things: Do it yourself projects with Arduino, RaspberryPi and BeagleBone Book", McGraw-Hill.
3. Arshdeep Bahga, Vijay K. Madisetti, "Internet of things: A hands on approach Book", Orient Blackswan Private Limited-New Delhi.

Reference Books:

1. Adrian McEwen & Hakim Cassimality, "Designing the Internet of Things", Wiley India.
2. Simon Monk, "Raspberry Pi Cookbook, Software and Hardware Problems and solutions", O'Reilly.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things-Key Applications and Protocols", Wiley Publication.
4. Michael Mille, "The Internet of Things", Pearson.

Course Outcomes:

After completion of this course, the students would be able to:

CO1: Make use of IoT Development tools.
CO2: Construct IoT applications using IoT Components and protocols.
CO3: Apply different IoT technologies for designing simple IoT applications.
CO4: Construct Cloud services, cloud platform & its applications for IoT.
CO5: Apply Cloud computing data services for IoT to develop real time application.

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Syllabus VI Semester

CD605(B) (Robotics and Embedded Systems)

Unit I Introduction to Robotics: Overview of Robotics, Types of Robots, Components Needed for Robot, Pattern recognition and robots, Closed and open loop control system, Robots and Computer Vision.

Unit-II Introduction to Embedded Systems: Overview of Embedded Systems, Features, Requirements and Applications of Embedded Systems, Recent Trends in the Embedded System Design, Use of Embedded Systems in Robotics Architecture and integration with sensors, actuators, components, Programming for Robot Applications.

Unit-III Association Analysis: Sensors and Vision System: Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc., Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations, Vision applications in robotics.

Unit-IV Robot Control and Robot Actuation Systems: Basics of control: Transfer functions, Control laws: P, PD, PID Non-linear and advanced controls, Actuators: Electric, Hydraulic and Pneumatic, Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Unit-V Game Playing: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing.

Suggested List of Experiments:

1. Study components of a real robot and its DH parameters.
2. Inverse kinematics of the real robot and validation using any software.
3. Use of open-source computer vision programming tool OpenCV.
4. Image Processing using OpenCV.
5. Image Processing for color/shape detection.
6. Positioning and orientation of robot arm.
7. Prepare a Case study on different types of Sensors
8. Robot programming and simulation for pick and place.
9. Robot programming and simulation for color identification.
10. Robot programming and simulation for shape identification.

Text Books:

1. S.K Saha, “Introduction to Robotics, 2nd Edition, McGraw-Hill.
2. B. Niku Saeed, “Introduction to Robotics: Analysis, Systems, Applications”, PHI.
3. S. Mukherjee, “Robotics and Automation”, Khanna Publishing House, Delhi.

Reference Books:

1. Peter McKinnon, "Robotics: Everything You Need to Know About Robotics from Beginner to Expert", Create Space Independent Publishing Platform.
2. Robin R. Murphy, "Introduction to AI Robotics", 2nd Edition, MIT press.
3. Francis X. Govers, "Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques", Packt Publishing.

Course Outcomes:

After completion of this course, the students would be able to:

CO1: Understand the basics concept of robotics and embedded systems.
CO2: Apply their knowledge of embedded systems and robotics to solve real life problems.
CO3: Demonstrate their potential in various robotics and embedded systems.
CO4: Understand the use of sensors and vision systems.
CO5: Design control laws for a robot and integrate mechanical and electrical hardware for a real prototype of robotic device.
CO6: Analyze and co-relate robotics with AI and use in real-world applications like Gaming.

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Syllabus VI Semester

CD605(C) (Computer Graphics & Multimedia)

Unit-I Introduction: Raster Scan displays, Pixels, Frame buffer, Vector & Character generation, Random Scan systems, Display devices, Scan Conversion techniques, Line Drawing algorithms: simple DDA, Bresenham's Algorithm, Circle Drawing Algorithms: Midpoint Circle drawing and Bresenham's Algorithm, Polygon fill algorithm: Boundary-fill and Flood-fill algorithms.

Unit-II 2-D Transformation: Translation, Rotation, Scaling, Shearing, Reflection, Inverse Transformation, Homogeneous coordinate system, Matrices Transformation, Composite Transformation. Windowing & Clipping: World Coordinate System, Screen Coordinate System, Viewing Transformation, Line Clipping & Polygon Clipping Algorithms.

Unit-III 3-D Transformations: Translation, Rotation and Scaling. Parallel & Perspective Projection: Types of Parallel & Perspective Projection, Hidden Surface elimination: Depth comparison, Back face detection algorithm, Painter's Algorithm, Z-Buffer Algorithm.

Unit-IV Curve Generation and Color Models: Curve generation, Bezier and B-spline methods. Basic Illumination Model: Diffuse reflection, Specular reflection, Phong Shading, Gouraud shading, Ray Tracing, Color models like RGB, YIQ, CMY, HSV.

Unit-V Multimedia: Basic of multimedia, Multimedia architecture, Text-Types, Unicode Standard ,text Compression, Text file formats, Audio Components, Digital Audio, Digital Audio processing, Sound cards, Audio file formats ,Audio Processing software ,Video-Video color spaces, Digital Video, Digital Video processing, Video file formats. Animation: Principles of Animation, Animation techniques- traditional, key framing , Animation file formats, Animation software, Special Effects in animation, Storyboarding for Animation.

Suggested List of Experiments:

1. Write a program to implement DDA line drawing algorithm.
2. Write a program to implement Bresenham's line drawing algorithm.
3. Write a program to implement Bresenham's circle drawing algorithm.
4. Write a program to implement mid point circle algorithm.
5. Write a program to fill area using flood fill algorithm.
6. Write a program to fill area using boundary fill algorithm.
7. Write a program to perform 2D transformation operations (rotation, scaling, and translation).
8. Write a program to perform line clipping algorithm.
9. Write a program to perform polygon clipping algorithm.
10. Write a program to create Bezier curves using.

Text Books:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics C version" Second Edition, Pearson Education.
2. Foley James D., Vandam Andries and Hughes Johnν F., "Computer Graphics: Principles and Practice", Pearson Education.
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill
4. Ranjan Parekh, "Principles of Multimedia", Tata McGraw Hill Publications.

Reference Books:

1. David F. Rogers, "Mathematical Elements for Computer Graphics", McGraw-Hill.
2. Harrington, "Computer graphics", McGraw-Hill.
3. Pakhira, "Computer Graphics, Multimedia & Animation", PHI learning.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Understand the core concepts of computer graphics, display devices.
CO2: Implement various shapes drawing algorithms.
CO3: Apply geometric transformations on graphic objects and also implement clipping, shading.
CO4: Understand multimedia systems architecture, multimedia components and use various multimedia tools.
CO5: Perform activities involved in design, development of shading and animation, illumination models.
CO6: Perform 3D graphics and animation.