R. V. R. & J. C. COLLEGE OF ENGINEERING *(Autonomous)*

Chowdavaram, Guntur-19.

Computer Science & Engineering (Data Science)

II B.Tech – I Semester

Sl. No.	Course code	Course Name
1	CD 211	Mathematics-II (Linear Algebra)
2	CD 212	Discrete Mathematics
3	CD 213	Computer Organization
4	CD 214	Data Visualization
5	CD 215	Object Oriented Programming
6	CD 251	Business Communication and Value Science Lab
7	CD 252	Data Visualization Lab
8	CD 253	Object Oriented Programming Lab
9	CD SL01	Web Development (Skill Oriented Course)
10	CD MC03	Design Thinking & Product Innovation

CD 211	**Mathematics-II**	**L**	**P**	**C**
		3	**0**	**3**

Course Objectives:
- To learn maximum and minimum value of a given function
- To learn improper integrals using Beta and Gamma functions
- To learn methods of solving first order differential equations and learn about its applications to basic engineering problems

Course Outcomes:
The students will be able to:
1. Optimize functions of several variables essential in many engineering problems'.
2. Evaluate double and triple integrals to find areas and volumes.
3. Concepts like divergence, curl in integration of vector functions.
4. Solve differential equations which model physical processes.

Course Content:
UNIT I
Multivariable Calculus: Limit, continuity and partial derivatives, total derivative maxima, minima and saddle points of two variables, method of Lagrange multipliers.

UNIT II
Multiple Integrals: Double integrals (Cartesian and polar), change of order of integration, change of variables (Cartesian to polar), area by double integration, triple integrals, volume by triple integrals.

UNIT III
Introduction: Scalar and vector point functions, Gradient, directional derivative, divergence and curl, del applied twice to point and product of point functions (without proofs)
Vector integration: Line integral, surface and volume integrals, Green's theorem (without proof), Stokes' theorem (without proof), Gauss divergence theorem (without proof)

UNIT IV
First order ordinary differential equations: Linear, Bernoulli and exact equations
Second order ordinary linear equations: Solution by method of variation of parameters, Cauchy's equation, Power series solutions, Legendre polynomials, Bessel functions of the first kind and their properties

Learning Resources:
Text Book:
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd edition.

Reference Books:
1. N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

CD 212   **Discrete Mathematics**   **L   P   C**

                                                                          2   0   3

Course Objectives:

At the end of the course, the student will

- Introduction to the concepts of mathematical logic.
- Understand the combinatorial problems using counting principles.
- Create generating functions and solve recurrence relations.
- Use Directed & Un-Directed Graphs concepts and its applications.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply formal methods of proof; propositional & First order logic to validate the propositional statements.
2. Apply techniques for counting the occurrences of discrete events including permutations, combinations with or without repetitions.
3. Solve generating function and recurrence relations.
4. Solve the real-world problems using directed and undirected graphs.

Course Content

UNIT I

Foundations: Sets, Relations and Functions, Fundamentals of Logic, Logical Inferences, Methods of Proof of an implication, First order Logic & Other methods of proof, Rules of Inference for Quantified propositions, Mathematical Induction.

UNIT II

Elementary Combinatorics: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with repetitions, Enumerating Combinations and Permutations with Constrained Repetitions.

UNIT III

Recurrence Relations: Generating functions of sequences, calculating coefficients of generating functions, solving recurrence relations by substitution and generating functions, The methods of characteristic roots, solutions of inhomogeneous recurrence relations.

UNIT IV

Relations & Digraphs: Properties & equivalence relations, operations on relation, directed graphs and adjacency matrices, ordering relations, lattices and enumerations.

Graphs: Isomorphism and subgraphs, planar graphs, Euler's formula, multi-graphs and Euler circuits, Hamiltonian graphs, chromatic numbers, The four color problem.

Learning Resources:

Text Book:
1. Joe L. Mott, Abraham Kandel& Theodore P.Baker, Discrete Mathematics for Computer Scientists & Mathematicians, PHI 2nd edition.

Reference Books:
1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, 3rd Edition, Tata McGraw – Hill.
2. Discrete and Combinational Mathematics- An Applied Introduction-5thEdition– Ralph. P. Grimaldi, Pearson Education
3. Discrete Mathematical Structures with applications to computer science, Trembly J.P. & Manohar. P, Tata McGraw – Hill.
4. Discrete Mathematics and its Applications, Kenneth H. Rosen, 5th Edition, Tata McGraw – Hill.

CD 213   **Computer Organization**   L   P   C
                                                                     3   0   3

Course Objectives:
- To introduce the functional units of computer systems, architecture and its operations.
- To discuss the basic processing unit and I/O devices.
- To impart knowledge on the memory system.
- To demonstrate the arithmetic operations in a computer system.
- To instruct the instruction level parallelism

Course Outcomes:
At the end of the course the students will be able to:
1. Describe components, architecture of a computer system and its working.
2. Analyze instruction execution and control system.
3. Develop a pipeline system for the execution of instruction.
4. Explain various I/O handling mechanisms and its interfaces.
5. Analyze computer arithmetic algorithms.
6. Construct various memory systems.

Course Content:
UNIT I
Basic structure of computers: Computer types, Functional Units, Basic Operational Concepts, Number Representation and Arithmetic, Character Representation, Performance.
Instruction Set Architecture: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Stacks, Subroutines, Additional Instructions, Encoding of Machine Instructions.

UNIT II
Basic Processing Unit: Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control.
Pipelining: Basic Concept-The Ideal Case, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Resource limitations.

UNIT III
Basic Input/ Output: Accessing I/O Devices, I/O Device Interface, Program-Controlled I/O, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling I/O Device Behavior, Processor Control Registers.
Input/output Organization: Bus Structure, Bus Operation: Synchronous Bus, Asynchronous Bus, Arbitration, Interface Circuits, PCI Bus, SCSI Bus.

UNIT IV

The Memory System: Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Cache Memories, Performance Considerations.

Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Unsigned Numbers, Multiplication of Signed Numbers, Fast Multiplication-Bit-Pair recoding of Multipliers, Integer Division, Floating-Point Numbers and Operations.

Learning Resources:

Text Book(s):

1. Computer Organization and Embedded Systems, 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Reference Books:

1. Computer Architecture and Organization, 3rd Edition by John P. Hayes, WCB/McGraw-Hill.
2. Computer Organization and Architecture: Designing for Performance, 10th Edition by William Stallings, Pearson Education.

CD 214   **Data Visualization**   **L P C**
                                                                       3 0 3

Course Objectives:
- This course introduces the visualization techniques of data.
- To enable students to make more effective use of data.
- To utilize various levels and types of summarization of data
- Give an insight into the statistical methods of data analysis and prediction.

Course Outcomes:
At the end of the course the students will be able to:
1. Understand the basic data types and preprocessing the data according to needs.
2. Understand the visualization of data.
3. Understand the visual distribution of data.
4. Understand the multiple visual distribution of data.

UNIT I
Introduction to Data:
The basic data types – nominal, ordinal, interval, ratio scaled.
Data Pre-processing:
Why pre-process the data? Descriptive data summarization-measuring the central tendency, measuring the dispersion of data-range, quartiles, outliers, and box plots, variance and standard deviation, graphic displays of basic descriptive data summaries, data cleaning - missing values, noisy data-outlier detection, correction and removal, data cleaning as a process, data imputation techniques, data integration and transformation - data integration, data transformation, data reduction -attribute subset selection, numerosity reduction.

UNIT-II
Visualizing Data:
Mapping data onto aesthetics, aesthetics and types of data, scales map data values onto aesthetics, visualizing amounts: bar plots, grouped and stacked bars, dot plots and heat maps, exploration of visualization tools.

UNIT-III
Visualizing Distributions:
Histograms and density plots - visualizing a single distribution, visualizing multiple distributions at the same time.
Empirical cumulative distribution functions and q-q plots - empirical cumulative distribution functions, highly skewed distributions, quantile-quantile plots.

UNIT-IV:
Visualizing Multiple Distributions:
Visualizing distributions along the vertical axis, visualizing distributions along the horizontal axis.

Visualizing associations among two or more quantitative variables - scatter plots, scatter plot matrix, ggplots, correlograms, dimension reduction, paired data

Learning Resources:
Text books:
1. Claus O. Wilke, Fundamentals of Data Visualization, Oreilly publication, 1stEdition.
2. Charu C Aggarwal, Data Mining, Springer International Publishing Switzerland, 2015.
3. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.

Reference books:
1. Arun K Pujari, Data Mining Techniques, 3rdEdition, Universities Press.
2. Kieran Healy, Data Visualization: A Practical Introduction 1stEdition, Princeton university press.

CD 215   **Object Oriented Programming**   **L   P   C**
                                                                          3   0   3

Course Objectives:
The learning objectives of this course are:
- To make the students understand Java fundamental concepts
- To elucidate the fundamentals of object-oriented programming in Java
- To create awareness on exception handling and multithreading
- To familiarize students with the concepts of Event Handling, Generics and Collections

Course Outcomes:
By the end of the course, the students will be able to
1. Comprehend the concepts of OOP and fundamentals of Java Programming.
2. Develop reusable and efficient programs using Inheritance & Polymorphism.
3. Demonstrate the importance of packages and interfaces.
4. Use the concept of exception handling to create error free codes and avoid abnormal program terminations.
5. Design multi-tasking applications using Multithreading.
6. Develop Event Driven applications and generic programs

Course Content:
UNIT I
Introduction: The history and evolution of Java, Java buzz words, object-oriented programming, data types, variables and arrays, operators, control statements.
Classes and Objects: Concepts, methods, constructors, types of constructors, constructor overloading, usage of static, access control, this keyword, garbage collection, finalize() method, overloading, parameter passing mechanisms, final keyword, nested classes and inner classes.
Utility Classes: Date, Calendar, Scanner, Random

UNIT II
Inheritance: Basic concepts, access specifiers, usage of super key word, method overriding, using final with Inheritance, abstract classes, dynamic method dispatch, Object class.
Interfaces: Differences between classes and interfaces, defining an interface, implementing interface, variables in interface and extending interfaces.
Packages: Creating a package, setting CLASSPATH, Access control protection, importing packages.
Strings: Exploring the string class, string buffer class, command-line arguments

UNIT III

Exception Handling: Concepts of exception handling, types of exceptions, usage of try, catch, throw, throws and finally keywords, multiple catch clauses, nested try, built-in exceptions, creating own exception subclasses.

Multithreading: The Java thread model, thread life cycle, thread class, Runnable interface, creating multiple threads, synchronization, inter thread communication, deadlock.

Applets: Concepts of applets, life cycle of an applet, creating applets

Event Handling: Events, event sources, event classes, event listeners, delegation event model, handling events.

UNIT IV

AWT: AWT components, file dialog boxes, layout managers, event handling model of AWT, adapter classes, menu, menu bar.

GUI with Swing– Swings introduction, JApplet, JFrame and JComponent, icons and labels, text fields, buttons – The JButton class, check boxes, radio buttons. combo boxes, tabbed Panes, scroll panes, trees, and tables

Generics: Basics of generic methods, generic classes

Collections: Collection interfaces, collection classes**,** accessing a collection via an iterator.

Learning Resources:

Text Book:

1. Java The Complete Reference - Herbert Schildt 11[th]Edition, Mc Graw Hill Education.

Reference Books:

1. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
2. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
3. Cay.S.Horstmann and Gary Cornell, Core Java 2, Vol 1, Fundamentals 7[th]Edition, Pearson Education.
4. H.M.Dietel and P.J.Dietel, Java How to Program, 6[th]Edition, Pearson Education/PHI.
5. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001.
6. Cay Horstmann, John Wiley and Sons, Big Java 2[nd]Edition, Pearson Education.

CD 251　　　Business Communication &Value Science-1 Lab　　L　T　P　C
**　　　　　　　　　　　　　　　　　　　　　　　　　　　　-　-　3　1.5**

Course Prerequisites: Basic Knowledge of high school English
Course Objectives:
- ▪ Understand what life skills are and their importance in leading a happy and well-adjusted life.
- ▪ Motivate students to look within and create a better version of self.
- ▪ Introduce them to key concepts of values, life skills and business communication.

Course Outcomes:
1. Recognize the need for life skills and values.
2. Recognize your own strengths and opportunities.
3. Apply life skills to different situations.
4. Understand the basic tenets of communication.
5. Apply the basic communication practices in different types of communication.

UNIT-I
Introducing Self: Activity On Self - introduction, introducing others, SWOT analysis
Overview of Business Communication: Newspaper report, celebrity conversations, quiz
Self-awareness: Identity, body awareness, stress management

UNIT-II
Essential Grammar-I: Refresher on parts of speech, tenses, functional grammar, sentence formation, common errors.
Communication Skills: Overview of communication skills, barriers of communication, effective communication, types of communication - verbal and non–verbal.
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.

UNIT-III
Verbal Communication: Pronunciation, clarity of speech
Email Writing: Formal and Informal Emails
Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related the field of technology, phrases, idioms, significant abbreviations formal business vocabulary – Read Economic Times, Reader's Digest, National Geographic, 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
Life Skill: Stress management, working with rhythm and balance, colours, and teamwork

UNIT-IV
Understanding Life Skills: Movie based learning
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, join a trek.
Values to be learnt: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation

Learning Resources:
Text Books:
There are no prescribed textbooks for Semester1.

Reference Books:

1. English Vocabulary In Use – Alan Mc'carthy and O'dell
2. APAART: SpeakWell1 (English Language And Communication)
3. APAART: SpeakWell 2 (Soft Skills)
4. Business Communication– Dr.Saroj Hiremath

Web References:

1. Train your mind to perform under pressure – Simonsinek
   https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under pressure-capture-your-flag/
2. Brilliant way one CEO rallied his team in the middle olayoffs
   https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before numbers.html
3. Will Smith's Top Ten rules for success
   https://www.youtube.com/watch?v=bBsT9omTeh0

Online Resources:

1. https://www.coursera.org/learn/learning-how-to-learn

2. https://www.coursera.org/specializations/effective-business-communication

CD 252   **Data Visualization Laboratory**   L   T   P   C
                                                                          -   -   3 1.5

Course Objectives:
This course enables the students:
- To interpret data plots and understand core data visualization concepts such as correlation, linear relationships, and log scales.
- To explore the relationship between two continuous variables using scatter plots and line plots.
- To translate and present data and data correlations in a simple way.

Course Outcomes:
Upon successful completion of this course, Students will be able to:
1. Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer.
2. Find and select appropriate data that can be used in order to create a visualization that answers a particular research question.
3. Properly document and organize data and visualizations in order to prepare them for reuse.

Lab Exercises:
1. Loading and Distinguishing Dependent and Independent parameters
2. Exploring Data Visualization tools
3. Drawing Charts
4. Drawing Graphs
5. Data mapping
6. Creating Scatter Plot maps
7. Using BNF Notations
8. Working with REGEX
9. Visualize Network Data
10. Understanding Data Visualization frameworks

CD 253   **Object Oriented Programming Lab**   **L   P   C**
                                                                   0   3   1.5

Course Objectives:
- To introduce java compiler, interpreter.
- To make the students learn an object oriented way of solving problems using java.
- To make the students write programs using multithreading concepts and exception handling.
- To make the students understand the usage of event handling, generics, collections.

Course Outcomes:
By the end of this course the students will be able to
1. Write simple java programs using java fundamentals and basic OOP concepts.
2. Design programs using inheritance and polymorphism.
3. Demonstrate inter process communication using multithreading.
4. Demonstrate the user defined exceptions by exception handling keywords (try, catch, throw, throws and finally).
5. Develop event driven applications and generic programs.

List of Experiments:
The programming concepts to be implemented in the Lab are
    Week 1: Fundamentals of classes and objects
    Week 2: static keyword, this keyword, variable length arguments
    Week 3: inner classes, constructor overloading
    Week 4: Types of inheritances
    Week 5: Method overloading, Method Overriding, usage of final and super
    Week 6: Abstract classes, interfaces, Dynamic method dispatch.
    Week 7: String class and its methods
    Week 8: Packages
    Week 9: Exception Handling Techniques
    Week 10: Multithreading concepts
    Week 11: Applets and event handling
    Week 12: Awt components and delegation event model
    Week 13: MVC architecture in Swing
    Week 14: Generics and collections

CD SL01	Web Development	L	P	C
		0	3	1.5

Course Objectives:
- To build web applications using HTML, CSS with client side validations.
- To learn the image and image types with html.
- To develop the web application with various CSS layout.
- To develop a web application with various form layout.
- To learn the basic things of website and domain names.

Course Outcomes: After completion of the course, students will be able to
1. Design web pages with CSS attributes.
2. Design and import various type of images with html tags.
3. Design and develop web applications with the support of client side validations.
4. Develop the web applications with various form layout.
5. Design and develop the basic things of website and domain names.

UNIT-I:
Introduction: HTML AND HTML5 getting started with tags, how to save web pages, viewing your web pages, basic HTML tags, basic HTML template, heading tags, paragraph and break tags, bold and italics, HTML lists. getting started with CSS, introduction to CSS, CSS rules, where to put your styles, using CSS selectors, inline and embedded styles, CSS and fonts, font colours, font sizes, styling fonts

UNIT II:
Dealing with images: Types of images, inserting images part 1, inserting images part 2, image attributes, images and CSS, text wrapping with CSS, CSS and image borders, background images, adding captions to images, linking to other pages, hyperlinks, linking to other pages, other types of hyperlinks, CSS and hyperlinks, external style-sheets, HTML lists and navigation bars.

UNIT III:
CSS layouts: The box model, CSS comments, CSS positioning, CSS floats, one column CSS layout, styling the one column layout, styling HTML 5 tags, two column CSS layout. HTML 4 and HTML 5 tables, row and col span, table alignment, colours, images.text boxes, submit, reset, formatting text boxes with CSS, labels, text areas, option buttons and check boxes, passwords, hidden fields, HTML 5 forms, place holders, required, email, URL, search, spinners and sliders, dates, color pickers, data list, HTML form layout, HTML 5 video and audio, HTML 5 canvas tags details, mask.

UNIT-VI

Web essentials: Clients, servers and communication – the internet – basic internet protocols – World Wide Web – HTTP request message – HTTP response message – web clients – web servers. getting your site on the internet: websites and domain names, what to look for when buying web space, search engine optimization, pay per click advertising, Sitemaps.

Text Books:
1. Web Technologies, Uttam K Roy, Oxford University Press.
2. Deitel, Deitel, Goldberg, "Internet & World Wide Web How to Program", 3rd Edition, Pearson Education, 2006.
3. HTML & CSS:The Complete Reference, Thomas.A Powel,5th Edition,2017.

Reference Books:
1. Robert. W. Sebesta, "Programming the World Wide Web", 4th Edition, Pearson Education, 2007.
2. Marty Hall and Larry Brown, "Core Web Programming" 2nd Edition, Volume I andII, Pearson Education, 2001.
3. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

CD MC03	Design Thinking	L	P	C
		2	-	-

Course Objectives:
- To create awareness on design thinking among students of engineering.
- To teach a systematic approach for identifying and applying design thinking processes.
- To enable the use of doodling and storytelling the same as of presenting ideas and prototypes.
- To motivate students to create value proposition statements for identified problems.

Course Outcomes:
After completion of the course the student should be able to
1. Identify design thinking phases from an engineering perspective.
2. Validate problem statements through user empathization with societal and environmental consciousness.
3. Devise visual design and documentation to communicate more effectively.
4. Develop prototypes catering to the needs of users.

UNIT – I:

Design Thinking Overview and Motivation: Design thinking for business–stories, examples and case studies, design thinking for students, introduction to design thinking–Stanford's 5-step model
*Activities to understand design thinking and its applications

UNIT – II:

Doing Design: Empathize Phase: empathy; importance of empathy, empathy tools, introduction to immersion activity, personal, importance of personal creation, data collection and inferences
*Activities For Empathize Phase

UNIT – III:

Doing Design: Define Phase: Problem statements– introduction, definition, and validation
Need analysis: Types of users, types of needs, addressable needs and touch points, structuring need statements

*Activities for define phase
Doing Design: Ideate Phase
Ideation Tools: Six thinking hats, ideate to generate solutions, brainstorming, doodling and storytelling top recent ideas; ideation by SCAMPER, ideation by reconstruct and deconstruct.
*Activities for ideate phase

UNIT – IV:
Doing Design: Prototype phase
Introduction to prototype, methods of prototyping, value proposition for the solution *activities for prototype phase.
Doing Design: Test Phase
Importance of testing, Feedback Collection, Documentation of Feedback, Inference from Feedback, Looping of Design Thinking, Agile and Design Thinking to deliver customer satisfaction
*Activities for Test Phase

Learning Resources
Text Books:
1. There are no prescribed texts for Semester 5–there will be handouts and reference links shared.

References:
1. Nir Eval, Hooked. How to Build Habit – Forming Products, Penguin Publishing Group
2. Rod Judkins, The Art of Creative Thinking, Hodder & Stoughton
3. Dan Senor and Saul Singer, Start-up Nation. The Story of Israel's Economic Miracle, Grand Central Publishing
4. Simon Sinek, Start with Why. How Great Leaders Inspire Everyone to Take Action, Penguin Books Limited