JBK

# JOGINPALLY B.R. ENGINEERING COLLEGE

## UGC AUTONOMOUS

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# DEPARTMENT OF DATA SCIENCE
# COURSE OUTCOMES (COs)

### I YEAR I SEMESTER

**MA101BS - MATRICES AND CALCULUS**

| CO No. | Course Outcomes |
|---|---|
| C101.1 | Formulate the matrix representation of a set of linear equations and analyze the solutions of the system. |
| C101.2 | Compute the eigenvalues and eigenvectors, and reduce the quadratic form to its canonical form using orthogonal transformations |
| C101.3 | Analyse the nature of sequence and series |
| C101.4 | Evaluate the improper integrals using Beta and Gamma functions |
| C101.5 | Apply multivariable calculus and find the extreme values of functions of two variables with/ without constraints |

**CH102BS - CHEMISTRY**

| CO No. | Course Outcomes |
|---|---|
| C102.1 | Understand the atomic, molecular, and electronic changes, including the band theory related to conductivity, and apply molecular orbital theory to explain bonding in molecules. |
| C102.2 | Apply the principles of electrochemistry and water treatment techniques to address issues related to water hardness and its industrial treatment. |
| C102.3 | Analyze electrochemical cells, electrode potentials, and corrosion mechanisms, and evaluate methods for corrosion prevention and control. |
| C102.4 | Analyze the configurational and conformational structures of molecules, reaction mechanisms. |
| C102.5 | Apply knowledge of spectroscopy principles to analyze the structure of molecules using various spectroscopic techniques. |

## CS103ES - PROGRAMMING FOR PROBLEM SOLVING

| CO No. | Course Outcomes |
|---|---|
| C103.1 | Design algorithms and illustrate flowcharts for problem-solving in programming. |
| C103.2 | Implement C programs using arrays, pointers, strings, and structures to solve various computational problems. |
| C103.3 | Understand and effectively utilize preprocessor directives, file handling techniques in C to enhance code modularity, readability, and data management. |
| C103.4 | Decompose a problem into functions and to develop modular reusable code. |
| C103.5 | Understand and develop Searching and sorting problems. |

## EE104ES - BASIC ELECTRICAL ENGINEERING

| CO No. | Course Outcomes |
|---|---|
| C104.1 | Analyze and solve electrical circuits and theorems |
| C104.2 | Understand and analyze basic Electric and Magnetic circuits |
| C104.3 | Analyze the performance characteristics of transformers, including losses, efficiency, and equivalent circuit analysis. |
| C104.4 | Understand the working principles of Electrical Machines |
| C104.5 | Apply knowledge of low voltage electrical installation components |

## ME105ES - COMPUTER AIDED ENGINEERING GRAPHICS

| CO No. | Course Outcomes |
|---|---|
| C105.1 | Understand and apply the principles of engineering graphics to communicate ideas through drawings. |
| C105.2 | Analyze and interpret orthographic projections of points, lines, and regular geometric figures |
| C105.3 | Create and evaluate auxiliary views and sectional views of right regular solids |
| C105.4 | Determine and construct the development of surfaces for right regular solids and analyze the intersection of different solid types |
| C105.5 | Construct isometric projections of objects and demonstrate proficiency in CAD software |

## CS106ES: ELEMENTS OF COMPUTER SCIENCE AND ENGINEERING

| CO No. | Course Outcomes |
|---|---|
| CS106.1 | Know the working principles of functional units of a basic Computer |
| CS106.2 | Understand program development, the use of data structures and algorithms in problem solving. |
| CS106.3 | Know the need and types of operating system, database systems. |
| CS106.4 | Understand the significance of networks, internet, WWW and cyber security. |
| CS106.5 | Understand Autonomous systems, the application of artificial intelligence |

## CH107BS - ENGINEERING CHEMISTRY LAB

| CO No. | Course Outcomes |
|---|---|
| C107.1 | Determine the hardness and chloride content in water |
| C107.2 | Estimate the rate constant of a reaction from concentration – time relationships. |
| C107.3 | Determine the physical properties like adsorption and viscosity |
| C107.4 | Calculate of Rf values of some organic molecules by TLC technique |
| C107.5 | Conduct and analyze various laboratory experiments to draw conclusions about key parameters in chemical processes |

## CS108ES - PROGRAMMING FOR PROBLEM SOLVING LAB

| CO No. | Course Outcomes |
|---|---|
| C108.1 | Formulate the algorithms for simple problems and translate it to a working and correct program |
| C108.2 | Identify and correct logical errors encountered during execution and correct syntax errors as reported by the compilers |
| C108.3 | Represent and manipulate data with arrays, strings, structures and use pointers of different types |
| C108.4 | Create, read and write to and from simple text and binary files |
| C108.5 | Able to modularize the code with functions so that they can be reused |

## EE109ES - BASIC ELECTRICAL ENGINEERING LAB

| CO No. | Course Outcomes |
|---|---|
| C109.1 | Apply basic electrical laws to verify circuit behavior through experimentation. |
| C109.2 | Analyze the response of different types of electrical circuits to different excitations. |
| C109.3 | Understand the measurement, calculation and relation between the basic electrical parameters |
| C109.4 | Evaluate the basic characteristics of transformers and electrical machines. |
| C109.5 | Demonstrate the relationship between voltages and currents in three-phase transformer configurations and apply this knowledge to practical scenarios. |

## MA201BS ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

| CO No. | Course Outcomes |
|---|---|
| C201.1 | Identify and classify first-order differential equations |
| C201.2 | Solve higher differential equation and apply the concept of differential equation to real world problems |
| C201.3 | Evaluate the multiple integrals and apply the concept to find areas, volumes, center of mass and Gravity for cubes, sphere and rectangular parallelopiped |
| C201.4 | Compute gradient, divergence, and curl of vector fields, and explain the significance of vector identities and the properties of solenoidal and irrotational vectors. |
| C201.5 | Demonstrate proficiency in evaluating line, surface, and volume integrals, and converting them from one to another |

## AP202BS - APPLIED PHYSICS

| CO No. | Course Outcomes |
|---|---|
| C202.1 | Understand the fundamental concepts on Quantum behaviour of matter in its micro state. |
| C202.2 | Explain the fundamentals of Semiconductor physics, Optoelectronics, Lasers and fibre optics apply knowledge of carrier dynamics to solve related problems in semiconductor devices. |
| C202.3 | Design, characterization and study of properties of material help the students to prepare new materials for various engineering applications |
| C202.4 | Describe the working principles of different types of lasers and assess their applications in various fields |
| C202.5 | Analyze the laws of electromagnetism and also to have exposure on magnetic materials and dielectric materials. |

## ME203ES - ENGINEERING WORKSHOP LAB

| CO No. | Course Outcomes |
|---|---|
| C203.1 | Understand and practice on machine tools and their operations |
| C203.1 | Construct and Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding. |
| C203.1 | Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling. |
| C203.1 | Apply basic electrical engineering knowledge for house wiring practice |
| C203.1 | Identify and apply suitable tools and techniques used in trades like plumbing, machine shop, and metal cutting |

## EN204HS – ENGLISH FOR SKILL ENHANCEMENT

| CO No. | Course Outcomes |
|---|---|
| C204.1 | Apply effective spoken and written English skills |
| C204.2 | Comprehend and evaluate the given text, demonstrating the ability to respond appropriately |
| C204.3 | Analyze texts to extract key information and communicate findings confidently, utilizing appropriate vocabulary and sentence structures in discussions and written assignments. |
| C204.4 | Develop proficiency in English including reading and listening comprehension, writing and speaking skills. |
| C204.5 | Construct technical reports that demonstrate a clear understanding of the content |

## EC205ES- ELECTRONIC DEVICES AND CIRCUITS

| CO No. | Course Outcomes |
|---|---|
| C205.1 | Acquire the knowledge of various electronic devices and their use on real life. |
| C205.2 | Know the applications of various devices. |
| C205.3 | Acquire the knowledge about the role of special purpose devices and their applications. |
| C205.4 | Understand the operation of FET in different configurations and its use as a switch with switching characteristics. |
| C205.5 | Demonstrate the operation and applications of special semiconductor devices such as Zener diodes, SCR, UJT, and optoelectronic devices. |

## CS206ES: PYTHON PROGRAMMING LABORATORY

| CO No. | Course Outcomes |
|---|---|
| C206.1 | Develop the application specific codes using python. |
| C206.2 | Understand Strings, Lists, Tuples and Dictionaries in Python |
| C206.3 | Verify programs using modular approach, file I/O, Python standard library |
| C206.4 | Implement Digital Systems using Python. |
| C206.5 | Basics of numpy |

## AP207BS - APPLIED PHYSICS LAB

| CO No. | Course Outcomes |
|---|---|
| C207.1 | Determine the energy gap of a semiconductor diode through experimental analysis and interpretation of the data obtained. |
| C207.2 | Analyze the V-I characteristics of a solar cell to evaluate its performance under different illumination conditions. |
| C207.3 | Plot and interpret the V-I and P-I characteristics of a light-emitting diode |
| C207.4 | Conduct Stewart-Gee's experiment to determine the magnetic field along the axis of a current-carrying coil and discuss the implications of the results. |
| C207.5 | Determine the Hall coefficient of a given semiconductor, interpreting the results to understand charge carrier density and mobility. |

## EN208HS - ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

| CO No. | Course Outcomes |
|---|---|
| C208.1 | Understand nuances of English language through audio- visual experience and<br>group activities |
| C208.2 | Demonstrate the ability to neutralize accents for intelligibility |
| C208.3 | Express thoughts clearly and confidently which in turn enhances their employability<br>skills |
| C208.4 | Evaluate different communication styles by engaging in group activities and situational dialogues |
| C208.5 | Conduct mock interviews and formal presentations to practice and refine public speaking skills |

## CS209ES- IT WORKSHOP LAB

| CO.No | Course Outcomes |
|---|---|
| C209.1 | Apply knowledge for computer assembling and software installation and solve trouble shooting problems |
| C209.2 | Ability how to solve the trouble shooting problems. |
| C209.3 | Ability to understand the connectivity of Internet & World Wide Web |
| C209.4 | Apply the tools for preparation of PPT, Documentation and budget sheet etc |
| C209.5 | Understand the importance of cybersecurity and practice safe internet use. |

## MC210ES - ENVIRONMENTAL SCIENCE

| CO No. | Course Outcomes |
|---|---|
| C210.1 | Evaluate the structure, function, and classification of ecosystems |
| C210.2 | Analyze the use and over-utilization of water, mineral, and energy resources |
| C210.3 | Assess the value of biodiversity and the threats it faces, proposing conservation strategies based on In-Situ and Ex-Situ methods. |
| C210.4 | Identify the sources and types of environmental pollution and evaluate pollution control technologies |
| C210.5 | Understand and evaluate the framework of environmental legislation and policies |

## DS301PC-DIGITAL ELECTRONICS

| CO No. | Course Outcomes |
|---|---|
| C301.1 | Understand the numerical information in different forms and Boolean Algebra theorems |
| C302.1 | Postulates of Boolean algebra and to minimize combinational functions |
| C303.1 | Design and analyze combinational and sequential circuits |
| C304.1 | Known about the logic families and realization of logic gates. |

## DS302PC-DATA STRUCTURES

| CO No. | Course Outcomes |
|---|---|
| C302.1 | Ability to select the data structures that efficiently model the information in a problem. |
| C302.2 | Ability to assess efficiency trade-offs among different data structure implementations or combinations. |
| C302.3 | Implement and know the application of algorithms for sorting and pattern matching. |
| C302.4 | Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees. |

## DS303PC-Computer Oriented Statistical Methods

| CO No. | Course Outcomes |
|---|---|
| C303.1 | Apply the concepts of probability and distributions to case studies. |
| C303.2 | Formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data. |
| C303.3 | Apply concept of estimation and testing of hypothesis to case studies. |
| C303.4 | Correlate the concepts of one unit to the concepts in other units |

## DS304PC- Computer Organization and Architecture

| CO No. | Course Outcomes |
|---|---|
| C304.1 | Understand the basics of instruction sets and their impact on processor design. |
| C304.2 | Demonstrate an understanding of the design of the functional units of a digital computer system. |
| C304.3 | Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory. |
| C304.4 | Design a pipeline for consistent execution of instructions with minimum hazards. |
| C304.5 | Recognize and manipulate representations of numbers stored in digital computers |

## DS305PC Object Oriented Programming through Java

| CO No. | Course Outcomes |
|---|---|
| C305.1 | Demonstrate the behavior of programs involving the basic programming constructs like control structures, constructors, string handling and garbage collection. |
| C305.2 | Demonstrate the implementation of inheritance (multilevel, hierarchical and multiple) by using extend and implement keywords |
| C305.3 | Use multithreading concepts to develop inter process communication. |
| C305.4 | Understand the process of graphical user interface design and implementation using AWT or swings |
| C305.5 | Develop applets that interact abundantly with the client environment and deploy on the server. |

## DS306PC-DATA STRUCTURES LAB

| Co No | Course Outcomes |
|---|---|
| C306.1 | Ability to develop C programs for computing and real-life applications using basic elements like control statements, arrays, functions, pointers and strings, and data structures like stacks, queues and linked lists. |
| C306.2 | Ability to develop C programs using data structures like stacks, queues, and linked lists. |
| C306.3 | Ability to implement searching algorithms. |
| C306.4 | Ability to implement sorting algorithms. |
| C306.5 | Ability to develop programs for tree and graph traversal methods. |

## DS307PC- Object Oriented Programming through Java Lab

| CO No. | Course Outcomes |
|---|---|
| C307.1 | Able to design GUI based applications |
| C307.2 | Able to solve real world problems using OOP techniques. |
| C307.3 | Able to develop multithreaded applications with synchronization. |
| C307.4 | Able to solve problems using java collection framework and I/O classes. |
| C307.5 | Able to develop applets for web applications. |

## DS308PC-Data visualization- R Programming/ Power BI

| CO No. | Course Outcomes |
|---|---|
| C308.1 | Understand How to import data into Tableau. |
| C308.2 | Understand Tableau concepts of Dimensions and Measures. |
| C308.3 | Develop Programs and understand how to map Visual Layouts and Graphical Properties. |
| C308.4 | Create a Dashboard that links multiple visualizations. |
| C308.5 | Use graphical user interfaces to create Frames for providing solutions to real world problems. |

**MC309-GENDER SENSITIZATION LAB**

| CO No. | Course Outcomes |
|---|---|
| C309. | Students will be able to define and articulate basic gender concepts and terminology and the processes of socialization that shape gender roles. |
| C309. | Students will attain a finer grasp of how gender discrimination works in our society and how to counter it. |
| C309. | Students will acquire insight into the gendered division of labour and its relation to politics andeconomics. |
| C309. | Students will develop an understanding of the various types of gender-based violence, and will learn strategies for addressing and preventing such violence from a human rights perspective. |
| C309. | Students will critically assess gender representation in media and literature, and advocate for gender-sensitive language and equal relationships. |

**II YEAR II SEMESTER**

**DS401PC-DISCRETE MATHEMATICS**

| CO No. | Course Outcomes |
|---|---|
| C401.1 | Ability to understand and construct precise mathematical proofs |
| C401.2 | Ability to use logic and set theory to formulate precise statements |
| C401.3 | Ability to develop and analyze algorithms, and to apply principles of induction and recursion |
| C401.4 | Ability to analyze and solve counting problems on finite and discrete structures |
| C401.5 | Ability to apply graph theory in solving computing problems |

**SM402MS- BUSINESS ECONOMICS & FINANCIAL ANALYSIS**

| CO No. | Course Outcomes |
|---|---|
| C402.1 | Students will understand the various forms of business entities, the sources of capital, and the significance of key economic variables, including national income, inflation, and the business cycle. |
| C402.2 | Students will grasp micro and macroeconomic concepts, national income, inflation, money supply, and business cycles. |
| C402.3 | Analyze demand and supply elasticity, factors influencing them, and methods of demand forecasting. |
| C402.4 | Evaluate production functions, cost types, market structures, and pricing strategies. |
| C402.5 | Students will master financial accounting basics, prepare financial statements, and perform financial ratio analysis. |

## DS403PC-OPERATING SYSTEMS

| CO No. | Course Outcomes |
|---|---|
| C403.1 | Will be able to control access to a computer and the files that may be shared |
| C403.2 | Demonstrate the knowledge of the components of computer and their respective roles in computing. |
| C403.3 | Ability to recognize and resolve user problems with standard operating environments. |
| C403.4 | Gain practical knowledge of how programming languages, operating systems, and architectures interact and how to use each effectively |
| C403.5 | Identify which technique can be applied to File system management done by Operating Systems |

## DS404PC-DATABASE MANAGEMENT SYSTEMS

| CO No. | Course Outcomes |
|---|---|
| C404.1 | Gain knowledge of fundamentals of DBMS, database design and ER diagrams. |
| C404.2 | Understand the relational model, integrity constraints, relational algebra, and query languages. |
| C404.3 | Master the basics of Structured Query Language (SQL) for retrieval and management of data. |
| C404.4 | Be acquainted with the basics of transaction processing and concurrency control. |
| C404.5 | Familiarity with database storage structures and access techniques |

## DS405PC- SOFTWARE ENGINEERING

| CO No. | Course Outcomes |
|---|---|
| C405.1 | Ability to translate end-user requirements into system and software requirements, using e.g. UML, and structure the requirements in a Software Requirements Document (SRD). |
| C405.2 | Identify and apply appropriate software architectures and patterns to carry out high level designof a system and be able to critically compare alternative choices. |
| C405.3 | Ability to create an architectural design using UML and other design methodologies. |
| C405.4 | Will have experience and/or awareness of testing problems and will be able to develop a simpletesting report |
| C405.5 | Ability to understand software measurement and metrics for both process and product |

**DS406PC-OPERATING SYSTEMS LAB**

| CO No. | Course Outcomes |
|---|---|
| C406.1 | Able to implement CPU Scheduling algorithms such as FCFS, SJF, Round Robin, and priority scheduling. |
| C406.2 | Able to implement C programs using Unix system calls for I/O operations. |
| C406.3 | Able to implement the Banker's Algorithm for Deadlock Avoidance and Prevention in C. |
| C406.4 | Able to implement the Producer-Consumer problem using semaphores and Unix system calls. |
| C406.5 | Able to implement Inter-Process Communication (IPC) mechanisms using C programs: Pipes, FIFOs, Message Queues, Shared Memory andmemory management techniques in C. |

**DS407PC-DATABASE MANAGEMENT SYSTEMS LAB**

| CO No. | Course Outcomes |
|---|---|
| C407.1 | Design database schema for a given application and apply normalization |
| C407.2 | Acquire skills in using SQL commands for data definition and data manipulation |
| C407.3 | Develop solutions for database applications using SQL queries |
| C407.4 | Develop solutions for database applications using procedures and triggers |
| C407.5 | Develop solutions for database applications using cursors |

**DS409PC-Node JS/ React JS/ Django**

| CO No. | Course Outcomes |
|---|---|
| C409.1 | Build a custom website with HTML, CSS, and Bootstrap and little JavaScript. |
| C409.2 | Demonstrate Advanced features of JavaScript and learn about JDB |
| C409.3 | Develop Server – side implementation using Java technologies |
| C409.4 | Develop the server – side implementation using Node JS. |
| C409.5 | Design a Single Page Application using React. |

**MC410-CONSTITUTION OF INDIA**

| CO No. | Course Outcomes |
|---|---|
| C410.1 | Gain an understanding of the meaning of constitutional law and constitutionalism, and its significance in the legal framework |
| C410.2 | Explore the historical evolution of the Constitution of India, understanding its context and development over time |
| C410.3 | Identify and analyze the salient features and characteristics of the Constitution of India |
| C410.4 | Understand the scheme of fundamental rights enshrined in the Constitution of India, including their significance, scope, and enforcement. |
| C410.5 | Analyze the scheme of the Fundamental Duties as outlined in the Constitution of India |

**III YEAR I SEMESTER**

**DS501PC-DESIGN AND ANALYSIS OF ALGORITHMS**

| CO No. | Course Outcomes |
|---|---|
| C501.1 | Ability to analyze the performance of algorithms |
| C501.2 | Ability to choose appropriate data structures and algorithm design methods for a specified application |
| C501.3 | Ability to understand how the choice of data structures and the algorithm design methods impact the performance of programs |
| C501.4 | Ability to understand the principles of the greedy method and its applications. |
| C501.5 | Ability to comprehend the concepts of NP-Hard and NP-Complete problems and their implications on algorithm design and analysis. |

**DS502PC-Introduction to Data Science**

| CO No. | Course Outcomes |
|---|---|
| C502.1 | Understand basic terms of statistical modeling and data science |
| C502.2 | Implementation of R programming concepts |
| C502.3 | Utilize R elements for data visualization and prediction |

**DS503PC-COMPUTER NETWORKS**

| CO No. | Course Outcomes |
|---|---|
| C503.1 | Gain the knowledge of the basic computer network technology |
| C503.2 | Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model. |
| C503.3 | Obtain the skills of subnetting and routing mechanisms. |
| C503.4 | Familiarity with the essential protocols of computer networks, and how they can be applied innetwork design and implementation. |
| C503.5 | Understanding of key application layer protocols such as DNS, SNMP, SMTP, HTTP, and streaming audio and video. |

**DS511PE-Professional Elective – I**
**DATA WAREHOUSING AND BUSINESS INTELLIGENCE**

| CO No. | Course Outcomes |
|---|---|
| C511.1 | Understand architecture of data warehouse and OLAP operations. |
| C511.2 | Understand Fundamental concepts of BI |
| C511.3 | Application of BI Key Performance indicators |
| C511.4 | Understand Utilization of Advanced BI Tools and their Implementation. |
| C511.5 | Implementation of BI Techniques and BI Ethics. |

**DS512PE-Professional Elective – I ARTIFICIAL INTELLIGENCE**

| CO No. | Course Outcomes |
|---|---|
| C512.1 | Ability to formulate an efficient problem space for a problem expressed in natural language. |
| C512.2 | Select a search algorithm for a problem and estimate its time and space complexities. |
| C512.3 | Possess the skill for representing knowledge using the appropriate technique for a given problem. |
| C512.4 | Possess the ability to apply AI techniques to solve problems of game playing, and machine learning |
| C512.5 | Apply Instance based learning and reinforcement learning. |

**DS513PE-Professional Elective – I Web Programming**

| CO No. | Course Outcomes |
|---|---|
| C513.1 | Design web pages. |
| C513.2 | Use technologies of Web Programming. |
| C513.3 | Apply object-oriented aspects to Scripting. |
| C513.4 | Create databases with connectivity using JDBC. |
| C513.5 | Build web-based application using sockets. |

**DS514PE- Professional Elective – I IMAGE PROCESSING**

| CO No. | Course Outcomes |
|---|---|
| C514.1 | Demonstrate the knowledge of the basic concepts of two-dimensional signal acquisition,sampling, and quantization |
| C514.2 | Demonstrate the knowledge of filtering techniques. |
| C514.3 | Demonstrate the knowledge of 2D transformation techniques. |
| C514.4 | Demonstrate the knowledge of image enhancement, segmentation, restoration and compression techniques. |

**DS515PE-Professional Elective – I COMPUTER GRAPHICS**

| CO No. | Course Outcomes |
|---|---|
| C515.1 | Explore applications of computer graphics |
| C515.2 | Understand 2D, 3D geometric transformations and clipping algorithms |
| C515.3 | Understand 3D object representations, curves, surfaces, polygon rendering methods, colour models |
| C515.4 | Analyse animation sequence and visible surface detection method0073 |

**DS515PE-Professional Elective – II SPATIAL AND MULTIMEDIA DATABASES**

| CO No. | Course Outcomes |
|---|---|
| C521.1 | Understand data models, storage, indexing and design of spatial databases |
| C521.2 | Evaluate multidimensional data structures |
| C521.3 | Represent image database with R-tree |
| C521.4 | Store and retrieve audio, video and multimedia data. |

**DS522PE-Professional Elective – II INFORMATION RETRIEVAL SYSTEMS**

| CO No. | Course Outcomes |
|---|---|
| C522.1 | Design an Information Retrieval System for web search tasks. |
| C522.2 | Ability to apply IR principles to locate relevant information large collections of data |
| C522.3 | Ability to design different document clustering algorithms |
| C522.4 | Implement retrieval systems for web search tasks. |
| C522.5 | Ability to apply IR principles to locate relevant information in large collections of data. |

**DS523PE-Professional Elective – II SOFTWARE PROJECT MANAGEMENT**

| CO No. | Course Outcomes |
|---|---|
| C523.1 | Understand the software economics to improve various phases of development. |
| C523.2 | Examine the life cycle phases, artifacts, workflows and checkpoints of a process. |
| C523.3 | Demonstrate the software project framework components. |
| C523.4 | Analyze the need for various software management disciplines and metrics. |

**DS524PE-Professional Elective – II DEVOPS**

| CO No. | Course Outcomes |
|---|---|
| C524.1 | Understand the various components of DevOps environment. |
| C524.2 | Identify Software development models and architectures of DevOps |
| C524.3 | Use different project management and integration tools. |
| C524.4 | Select an appropriate testing tool and deployment model for project |

**DS525PE-Professional Elective – II COMPUTER VISION AND ROBOTICS**

| CO No. | Course Outcomes |
|---|---|
| C525.1 | Implement boundary tracking techniques |
| C525.2 | Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections. |
| C525.3 | Apply 3D vision techniques and Implement motion related techniques. |
| C525.4 | Develop applications using computer vision techniques. |

**DS504PC-R PROGRAMMING LAB**

| CO No. | Course Outcomes |
|---|---|
| C504.1 | Setup R programming environment. |
| C504.2 | Understand and use R – Data types and R – Data Structures. |
| C504.3 | Develop programming logic using R – Packages. |
| C504.3 | Analyze data sets using R – programming capabilities |

**DS504PC-COMPUTER NETWORKS LAB**

| CO No. | Course Outcomes |
|---|---|
| C505.1 | Implement data link layer farming methods |
| C505.2 | Analyze error detection and error correction codes. |
| C505.3 | Implement and analyze routing and congestion issues in network design. |
| C505.4 | Implement Encoding and Decoding techniques used in presentation layer |
| C505.5 | To be able to work with different network tools |

**DS506PC-ETL-KAFKA/TALEND**

| CO No. | Course Outcomes |
|---|---|
| C506.1 | Learn to design and deploy fault-tolerant Kafka clusters, ensuring data integrity and availability in real-world scenarios. |
| C506.2 | Gain practical experience in cluster management, topic creation, and basic operations such as producing and consuming messages |

**MC510-INTELLECTUAL PROPERTY RIGHTS**

| CO No. | Course Outcomes |
|---|---|
| C510.1 | Distinguish and Explain various forms of IPRs. |
| C510.2 | Identify criteria to fit one's own intellectual work in particular form of IPRs. |
| C510.3 | Apply statutory provisions to protect particular form of IPRs. |
| C510.4 | Appraise new developments in IPR laws at national and international level |

**III YEAR II SEMESTER**

**DS601PC-AUTOMATA THEORY AND COMPILER DESIGN**

| CO No. | Course Outcomes |
|---|---|
| C601.1 | Able to employ finite state machines for modeling and solving computing problems. |
| C601.2 | Able to design context free grammars for formal languages. |
| C601.3 | Able to distinguish between decidability and undecidability. |
| C601.4 | Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis. |
| C601.5 | Acquire skills in using lex tool and design LR parsers |

**DS602PC-MACHINE LEARNING**

| CO No. | Course Outcomes |
|---|---|
| C602.1 | Distinguish between, supervised, unsupervised and semi-supervised learning |
| C602.2 | Understand algorithms for building classifiers applied on datasets of non-linearly separable classes |
| C602.3 | Understand the principles of evolutionary computing algorithms |
| C602.4 | Design an ensembler to increase the classification accuracy |

**DS603PC-BIG DATA ANALYTICS**

| CO No. | Course Outcomes |
|---|---|
| C603.1 | Understand the importance of big data analytics and its types |
| C603.2 | Perform analytics on big data |
| C603.3 | Proficiency in big data storage and processing in Hadoop |
| C603.4 | Data analytics through MongoDB |
| C603.5 | Data analytics through R |

**DS631PE-SOFTWARE TESTING METHODOLOGIES**

| CO No. | Course Outcomes |
|---|---|
| C631.1 | Understand purpose of testing and path testing |
| C631.2 | Understand strategies in data flow testing and domain testing |
| C631.3 | Develop logic-based test strategies |
| C631.4 | Understand graph matrices and its applications |
| C631.5 | Implement test cases using any testing automation tool |

**DS632PE-DATA VISUALIZATION TECHNIQUES**

| CO No. | Course Outcomes |
|---|---|
| C632.1 | Know the historical development and evolution of data visualization techniques. |
| C632.2 | Analyze and visualize high-dimensional datasets using appropriate techniques. |
| C632.3 | Visualize large multidimensional datasets using appropriate methods. |
| C632.4 | Create insightful visual representations for diverse types of data. |

**DS633PE-SCRIPTING LANGUAGES**

| CO No. | Course Outcomes |
|---|---|
| C633.1 | This course introduces the script programming paradigm |
| C633.2 | Introduces scripting languages such as Perl, Ruby and TCL. |

**DS634PE-MOBILE APPLICATION DEVELOPMENT**

| CO No. | Course Outcomes |
|---|---|
| C634.1 | Understand the working of Android OS Practically. |
| C634.2 | Develop Android user interfaces |
| C635.3 | Develop, deploy and maintain the Android Applications. |

**DS635PE-CRYPTOGRAPHY AND NETWORK SECURITY**

| CO No. | Course Outcomes |
|---|---|
| C635.1 | Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues. |
| C635.2 | Ability to identify information system requirements for both of them such as client and server. |
| C635.3 | Ability to understand the current legal issues towards information security. |

**DS611OE-FUNDAMENTALS OF DATA SCIENCE**

| CO No. | Course Outcomes |
|---|---|
| C611.1 | Understand basic terms of statistical modeling and data science |
| C611.2 | Implementation of R programming concepts |
| C611.3 | Utilize R elements for data visualization and prediction |

**DS612OE-R PROGRAMMING**

| CO No. | Course Outcomes |
|---|---|
| C612.1 | Understand to use and program in the programming language R |
| C612.2 | Understand to use R to solve statistical problems |
| C612.3 | Implement and describe Monte Carlo the technology |
| C612.4 | Implement minimize and maximize functions using R |

**DS604PC-MACHINE LEARNING LAB**

| CO No. | Course Outcomes |
|---|---|
| C604.1 | Understand modern notions in predictive data analysis |
| C604.2 | Select data, model selection, model complexity and identify the trends |
| C604.3 | Understand a range of machine learning algorithms along with their strengths and weaknesses |
| C604.4 | Build predictive models from data and analyze their performance. |

**DS605PC-BIG DATA ANALYTICS LAB**

| CO No. | Course Outcomes |
|---|---|
| C605.1 | Use Excel as an Analytical tool and visualization tool. |
| C605.2 | Ability to program using HADOOP and Map reduce |
| C605.3 | Ability to perform data analytics using ML in R. |
| C605.4 | Use MongoDB to perform data analytics |

## DS631PE- SOFTWARE TESTING METHODOLOGIES LAB

| CO No. | Course Outcomes |
|---|---|
| C631.1 | Design and develop the best test strategies in accordance with the development model. |
| C631.2 | Design and develop GUI, Bitmap and database checkpoints |
| C631.3 | Develop database checkpoints for different checks |
| C631.4 | Perform batch testing with and without parameter passing |

## DS632PE- DATA VISUALIZATION TECHNIQUES LAB

| CO No. | Course Outcomes |
|---|---|
| C632.1 | Identify the different data types, visualization types to bring out the insight. |
| C632.2 | Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset. |
| C632.3 | Demonstrate the analysis of a large dataset using various visualization techniques and tools. |
| C632.4 | Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data. |
| C632.5 | Ability to create and interpret plots using R/Python. |

## DS633PE - SCRIPTING LANGUAGES LAB

| CO No. | Course Outcomes |
|---|---|
| C633.1 | Ability to understand the differences between Scripting languages and programming languages |
| C633.2 | Gain some fluency programming in Ruby, Perl, TCL |

## DS634PE- MOBILE APPLICATION DEVELOPMENT LAB

| CO No. | Course Outcomes |
|---|---|
| C634.1 | Understand the working of Android OS Practically. |
| C634.2 | Develop user interfaces. |
| C634.3 | Develop, deploy and maintain the Android Applications. |

## DS635PE- Cryptography and Network Security Lab

| CO No. | Course Outcomes |
|---|---|
| C635.1 | Understand basic cryptographic algorithms, message and web authentication and security issues. |
| C635.2 | Identify information system requirements for both of them such as client and server. |
| C635.3 | Understand the current legal issues towards information security |

**DS606PC- Industrial Oriented Mini Project/ Summer Internship/ Skill Development Course (UI design- Flutter)**

| CO No. | Course Outcomes |
|---|---|
| C606.1 | Implements Flutter Widgets and Layouts |
| C606.2 | Responsive UI Design and with Navigation in Flutter |
| C606.3 | Create custom widgets for specific UI elements and also apply styling using themes and custom styles. |
| C606.4 | Design a form with various input fields, along with validation and error handling |
| C606.5 | Fetches data and write code for unit Test for UI components and also animation |

***MC609- Environmental Science**

| CO No. | Course Outcomes |
|---|---|
| C609.1 | Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development |