Academic Council Meeting No. and Date : 11 / June 27, 2025

Agenda Number : 02 Resolution Number : 50, 51 / 2.3, 2.9

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme Code : BUCS

Programme :Bachelor of Science

Specific Programme : Computer Science

[T.Y.B.Sc. (Computer Science)]

Level 5.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2025 - 2026

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Preamble

The aim of the BSc Computer Science Syllabus is to lay the theoretical foundations of software and hardware equally supplemented by the practical techniques. With this foundation of computer science along with core subjects like Mathematics, Statistics etc, the computer science students are expected to contribute efficient solutions for the various problems that are given to them.

Over this period of time, computer science students have proved this fact and have done well in Industries (mainly software) which have offered plenty of opportunities to them. With the advancement in software industry and technological innovations, the industry demands from graduate and postgraduate students are changing. The syllabus is been designed to meet the industry expectations, to inspire the students to take-up higher education as well as research, to attract student over other courses and finally to fulfill the expectations of Credit system.

The syllabus will be designed keeping these challenges in mind. The syllabus aims to cover core concepts of Computer Science and also to cover the latest technologies which can be accommodated at BSc level. One such step is that we would like to promote Open Source Technologies as much as possible.

Abhijeet A. Kale
Chairman
Board of Studies in Computer Science

PROGRAMME OUTCOMES (PO)

The Undergraduate Programmesof Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

- **BACHELOR OF SCIENCE (B.Sc.)**

PO1 - Disciplinary Knowledge
Lay strong foundation of conceptual learning in science. Instil ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude
Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learner to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy
Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning process.

PO4 - Sensitization towards Environment
Build cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Team work
Encourage learner to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness
Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build attitude of unbiased, truthful actions and avoid unethical behaviour in all aspects of life.

Program Specific Outcomes

- Prepare the students ready for industry usage by providing required training in cutting edge technologies. (Level 4)
- Design and develop optimized computing mechanisms by integrating core computing concepts and advanced optimization techniques. (Level 6)
- Evaluate ethical, social, and professional challenges and justify appropriate communication and entrepreneurial decisions. (Level 5)
- Demonstrate basic knowledge of computer applications and apply standard practices in software project development. (Level 3)
- Understand Analyze and Develop computer programs for efficient design of computer-based systems of varying complexity. (Level 2)
- Understand various concepts of Computing, Statistics, Mathematics and Electronics appropriately to the discipline. (Level 2).

VPM's B.N.Bandodkar College of Science (Autonomous), Thane
T.Y.B.Sc. (Computer Science) Revised under NEP
Structure of Programme
Semester V

	Course Code	Course Title	No. of lectures	Credits
Major	25BUCS5T01	Soft Computing Techniques	**30**	**2**
	25BUCS5T02	Data Mining and Data Warehousing	**30**	**2**
	25BUCS5T03	Web Technology	**30**	**2**
	25BUCS5P01	Practical Based on 25BUCS5T01	**60**	**2**
	25BUCS5P02	Practical Based on 25BUCS5T02	**60**	**2**
	25BUCS5P03	Practical Based on 25BUCS5T03	**60**	**2**
Minor	25BUCS5TMN	Game Programming	**30**	**2**
Elective	25BUCS5TE1	Embedded Systems	**30**	**2**
	25BUCS5PE1	Practical Based on 25BUCS5TE1	**60**	**2**
	25BUCS5TE2	Advance Databases	**30**	**2**
	25BUCS5PE2	Practical Based on 25BUCS5TE2	**60**	**2**
VSC	25BUCS5VSC	Ethical Hacking	**30**	**2**
OJT	25BUCS5OJT	OJT / FP	**60**	**2**
OR				
FP	25BUCS5FPR	Field Project in CS - I		
Total				**22**

Semester VI

	Course Code	Course Title	No. of lectures	Credits
Major	25BUCS6T01	Introduction to Data Science	**30**	**2**
	25BUCS6T02	Machine Learning and AI	**30**	**2**
	25BUCS6T03	Cryptography and Network Security	**30**	**2**
	25BUCS6P01	Data Science Practical	**60**	**2**
	25BUCS6P02	Machine Learning and AI Practical	**60**	**2**
	25BUCS6P03	Data and Information Security Practical	**60**	**2**
Elective	25BUCS6TE1	Next Generation Databases	**30**	**2**
	25BUCS6PE1	Next Generation Databases Practical	**60**	**2**
	25BUCS6TE2	Information Retrieval	**30**	**2**
	25BUCS6PE2	Information Retrieval Practical	**60**	**2**
IKS	25BUCS6IKS	Indian Knowledge and Technology	**30**	**2**
VSC	25BUCS6VSC	Internet of Things	**30**	**2**
OJT	25BUCS6OJT	OJT / FP	**60**	**2**
OR				
FP	25BUCS6FPR	Field Project in CS - II		
Total				**22**

Semester V

Course Code	Course Title	Credits	No. of lectures
25BUCS5T01	Soft Computing Techniques	02	30

CO1	Understand the fundamental concepts of soft computing, including fuzzy logic, neural networks, genetic algorithms, probabilistic reasoning, and their applications.	L2
CO2	Apply supervised, unsupervised, and associative neural network models such as perceptron, backpropagation, Kohonen maps, ART networks, and Hopfield networks to solve classification and clustering problems.	L3
CO3	Analyze learning mechanisms, architectures, and performance characteristics of neural and fuzzy systems, including spiking neural networks and fuzzy relations, for different problem domains.	L4
CO4	Evaluate soft computing techniques—neural networks, fuzzy logic models, and probabilistic approaches—to select appropriate methods for real-world applications under uncertainty and imprecision.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	3	2	1	2	1
CO3	3	3	2	1	2	1
CO4	3	3	2	1	2	2

Unit I	Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing. Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.	**15** **[CO1, CO2]**
Unit II	UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. Neural Networks: Spiking Neural networks Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets	**15** **[CO1, CO3, CO4]**

References:

1. Artificial Intelligence and Soft Computing, Anandita Das Battacharya, SPD, 3rd Edition, 2018
2. Principles of Soft computing, S.N.Sivanandam, S.N.Deepa, Wiley, 3rd Edition, 2019
3. Neuro-Fuzzy Computing and Soft J.S.R.Jang, C.T.SunE.Mizutani, Prentice Hall of India, 2004
4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A., Vijayalakshami, Prentice Hall of India, 2004
5. Fuzzy Logic with Engineering Applications, Timothy J.Ross, McGrawHill, 1997

Course Code	Course Title	Credits	No. of lectures
25BUCS5T02	**Data Mining and Data Warehousing**	02	30

CO1	Understand fundamental concepts of Big Data, characteristics, sources, challenges, storage, processing techniques, and key Big Data technologies.	L2
CO2	Evaluate Big Data processing and data warehousing solutions, including distributed file systems, MapReduce algorithms, and OLAP systems, with respect to scalability, efficiency, and analytical requirements.	L5
CO3	Explain data warehousing concepts, frameworks, dimensional modeling principles, and OLAP architectures for supporting analytical and decision-making processes.	L2
CO4	Apply dimensional modeling, data warehousing design considerations, and basic MapReduce concepts to design solutions for real-world data analysis problems	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	1	1
CO2	3	3	3	1	2	2
CO3	3	2	2	1	1	1
CO4	3	3	3	1	2	2

Unit I	Big Data: Getting Started, Big Data, Facts About Big Data, Big Data Sources, Three Vs of Big Data, Volume, Variety, Velocity, Usage of Big Data, Visibility, Discover and Analyze Information, Segmentation and Customizations, Aiding Decision Making, Innovation, Big Data Challenges, Policies and Procedures, Access to Data, Technology and Techniques, Legacy Systems and Big Data, Structure of Big Data, Data Storage, Data Processing, Big Data Technologies · Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques	**15** **[CO1, CO2]**
Unit II	Introduction to Data Warehousing: Introduction, Necessity, Framework of the data warehouse, options, developing data warehouses, end points. Data Warehousing Design Consideration and Dimensional Modeling: Defining Dimensional Model, Granularity of Facts, Additivity of Facts, Functional dependency of the Data, Helper Tables, Implementation manyto-many relationships between fact and dimensional modelling. Data warehousing and OLAP: Defining OLAP, The Value of Multidimensional data, OLAP terminologies, Multidimensional architectures, Multidimensional views of relational data, Physical Multidimensional databases, Data Explosion, Integrated relational OLAP, Data sparsity and data explosion.	**15** **[CO3, CO4]**

References:

1. DW2.0 by W.H.Inmon, Derek Strauss Morgan Kaufmann Publication
2. Data Mining: Introductory and Advanced Topics by M. H. Dunham Pearson Education 2010
3. Data Mining A Knowledge Discovery Approach" by Krzysztof J. Cios, W. Pedrycz,R. W. Swiniarski, L.A. Kurgan Springer
4. Data Mining: Concepts and Techniques by J. Han and M. Kamber, Elsevier 2nd 2008
5. Principles of Data Mining D. Hand, H. Mannila and P. Smyth Prentice-Hall 2001
6. Data Mining with SQL Server 2005 Z.Tang and J MacLennan, Wiley

Course Code	Course Title	Credits	No. of lectures
25BUCS5T03	**Web Technology**	02	30

CO1	Explain advanced client-side scripting concepts including jQuery fundamentals, AJAX interactions, feature detection techniques, and the role of Modernizer in cross-browser compatibility.	L2
CO2	Apply AngularJS concepts such as controllers, directives, services, forms, and single-page application architecture to develop interactive web user interfaces.	L3
CO3	Develop server-side web applications using Node.js by creating HTTP servers, handling events, managing modules, performing file operations, and connecting to databases.	L3
CO4	Analyze search engine behavior and optimization techniques for individual web pages and entire websites, identifying effective practices and common pitfalls affecting visibility and ranking.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	1	1
CO2	3	2	3	1	2	1
CO3	3	3	3	1	2	2
CO4	2	3	2	1	1	2

Unit I	Advanced Client side programming: Fundamentals of jQuery, Element Selector, Document ready function, Events, jQuery UI, Unobtrusive client validation, working with AJAX and jQuery. Feature detection: Browser detection, Feature detection, Modernizer. Introduction to AngularJS: Controllers, Models, Directives and Services, Single Page Applications, Angular User Interfaces: Angular Forms, Using Angular with Angular UI and Angular Bootstrap, Angular Services, Developing Custom Directives, Enhanced End-to End Testing.	**15** **[CO1, CO2]**
Unit II	Introduction to Node JS: Node JS process model, Advantages, Traditional web server model. Setup Install Node.js on windows, REPL, Node JS console, Node JS modules, Events: Event Emitter class, inheriting events, Node Package Manager, Creating web server: handling http requests, sending requests, File System, Debugging Node JS application, Database Connectivity. Search engines: Searching techniques used by search engines, keywords, advertisements, Search engine optimization for individual web pages: header entries, tags, selection of URL, alt tags, Search engine optimization for entire website: Hyperlinks and link structure, page rank of Google, click rate, residence time of website, frames, scripts, content management system, cookies, robots, Pitfalls in Optimization: optimization and testing, keyword density, doorway pages, duplicate contents, quick change of topics, broken links, poor readability, rigid layouts, navigation styles.	**15** **[CO3, CO4]**

References:

1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book
2. Web Development with Node and Express

Course Code 25BUCS5P01	Course Title Practicals based upon 25BUCS5T01	Credits 02	No. of lectures 60

CO1	Understand fundamental programming constructs and data structures in Python by implementing basic algorithms such as Breadth First Search, Depth First Search, and simple game logic.	L2
CO2	Apply Python programming and standard libraries (Math, NumPy, SciPy, Pandas, Matplotlib) to perform numerical computations, data manipulation, visualization, and machine learning–oriented tasks.	L3
CO3	Analyze datasets by computing statistical measures such as mean, median, mode, variance, and standard deviation, and interpret the results for decision-making and problem solving.	L4
CO4	Design and develop Python-based applications, including dataset creation/loading and interactive programs such as games, to solve computational and data-driven problems effectively.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	-
CO2	3	3	3	1	2	-
CO3	2	3	2	1	1	1
CO4	3	3	2	1	3	1

Practical 1	Write a Program to Implement Breadth First Search.
Practical 2	Write a Program to Implement Depth First Search
Practical 3	Write a program to implement Tic-Tac-Toe game
Practical 4	Implementation of Python basic Libraries such as Math, Numpy and Scipy
Practical 5	Implementation of Python Libraries for ML application such as Pandas and Matplotlib
Practical 6	Creation AND Loading different datasets in Python.
Practical 7	Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets
Practical 8	Write a Program to Implement Breadth First Search.
Practical 9	Write a Program to Implement Depth First Search
Practical 10	Write a program to implement Tic-Tac-Toe game
Practical 11	Implementation of Python basic Libraries such as Math, Numpy and Scipy
Practical 12	Implementation of Python Libraries for ML application such as Pandas and Matplotlib

Course Code 25BUCS5P02	Course Title Practicals based upon 25BUCS5T02	Credits 02	No. of lectures 60

CO1	Recall and explain fundamental concepts of data mining, including data mining model structures, types of data, preprocessing steps, and basic terminology used in classification, clustering, association, and prediction tasks.	L1
CO2	Apply data mining tools and programming environments such as R, Weka, and Python to build basic data mining models and implement algorithms including Decision Tree, Clustering, Apriori, Naïve Bayes, Association Rules, and Linear Regression.	L2
CO3	Analyze datasets obtained from real-world sources such as social networking sites and text corpora by performing data exploration, pattern discovery, clustering, and text mining, and interpret the analytical results.	L3
CO4	Evaluate and compare the performance of different data mining algorithms and models based on accuracy, efficiency, and suitability for specific problem domains, and justify the selection of appropriate techniques.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	-
CO2	3	3	3	1	2	-
CO3	2	3	2	1	2	1
CO4	2	3	2	-	1	2

Practical 1	Build the Data Mining Model Structure and built the Decision Tree with Proper Decision Nodes.(Using R Tools/ Weka/ Python)
Practical 2	Build the Data Mining Model Structure and Implement the Clustering Algorithm.(Using R Tools/ Weka/ Python)
Practical 3	Build the Data Mining Model Structure. Implement the Apriori Algorithm.(Using R Tools/ Weka/ Python)
Practical 4	Build the Basic Data Mining Model and Implement the Association Algorithm.(Using R Tools/ Weka/ Python)
Practical 5	Build the Data Mining Model Structure. Implement the Naïve Bayes Algorithm.(Using R Tools/ Weka/ Python)
Practical 6	Build the Basic Data Mining Model and Show the Analysis of Social Networking Sites.(Using R Tools/ Weka/ Python)
Practical 7	Build the Data Mining Model Structure. Show the Implementation of Text mining.(Using R Tools/ Weka/ Python)
Practical 8	Build the Basic Data Mining Model and Show the Implementation of Data Exploration Algorithm. (Using R Tools/ Weka/ Python)
Practical 9	Build the Basic Data Mining Model and Show the Implement the Linear Regression Algorithm.(Using R Tools/ Weka/ Python)

Course Code 25BUCS5P03	Course Title Practicals based upon 25BUCS5T03	Credits 02	No. of lectures 60

CO1	Recall and describe the fundamental concepts, syntax, and features of client-side and server-side web technologies including jQuery, AJAX, events, AngularJS, NodeJS, and database connectivity.	L1
CO2	Analyze user interaction requirements and application workflows to implement appropriate event handling, form validation, asynchronous communication (AJAX), and dynamic UI components using jQuery and AngularJS.	L3
CO3	Evaluate different web development frameworks and techniques such as jQuery UI, AngularJS, and NodeJS for performance, scalability, and usability in web applications.	L4
CO4	Design and develop interactive, data-driven web applications by integrating front-end technologies, server-side logic, and database connectivity to meet real-world application requirements.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	1	-
CO2	2	3	2	-	2	1
CO3	2	3	2	-	1	2
CO4	3	3	3	1	3	1

Practical 1	Practical Based on JQuery.
Practical 2	Practical Based on JQuery.
Practical 3	Practical Based on AJAX.
Practical 4	Practical Based on Events.
Practical 5	Practical Based on Events.
Practical 6	Practical Based on AngularJS.
Practical 7	Practical Based on AngularJS.
Practical 8	Practical Based on NodeJS.
Practical 9	Practical Based on NodeJS.
Practical 10	Practical Based on Validation.
Practical 11	Practical Based on JQuery UI.
Practical 12	Practical Based on Database Connection.

Course Code	Course Title	Credits	No. of lectures
25BUCS5TMN	Game Programming	02	30

CO1	Recall and define the fundamental mathematical concepts for computer graphics, including Cartesian coordinates, vectors, matrices, transformations, projections, and basic GPU and DirectX terminology.	L1
CO2	Apply vector algebra, matrix transformations, and projection techniques to perform geometric transformations, lighting calculations, and back-face detection in 2D and 3D graphics.	L3
CO3	Explain the architecture and working of modern graphics systems, including GPU vs CPU architectures, DirectX 11 pipeline stages, rendering engines, and Unity engine components.	L2
CO4	Evaluate graphics pipelines, rendering engines, and XR technologies (VR, AR, MR) to justify appropriate tools, SDKs, and platforms for real-time graphics and immersive applications.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	1
CO2	3	2	2	1	2	1
CO3	3	2	3	1	1	1
CO4	3	3	3	1	2	2

Unit I	**Mathematics for Computer Graphics, DirectX Kick start:** **Cartesian Coordinate system:** The Cartesian XY-plane, Function Graphs, Geometric Shapes, Polygonal Shapes, Areas of Shapes, Theorem of Pythagoras in 2D, Coordinates, Theorem of Pythagoras in 3D, 3D Polygons. **Vectors:** Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule, deriving a Unit Normal Vector for a Triangle Areas, Calculating 2D Areas **Transformations:** 2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors, Determinants, Perspective Projection, Interpolation **DirectX:** Understanding GPU and GPU architectures. How they are different from CPU Architectures? Understanding how to solve by GPU?	**15** **[CO1, CO2, CO3]**
Unit II	**DirectX Pipeline and Programming:** **Introduction To DirectX 11:** COM, Textures and Resources Formats, The swap chain and Page flipping, Depth Buffering, Texture Resource Views, Multisampling Theory and MS in Direct3D, Feature Levels **Direct3D 11 Rendering Pipeline:** Overview, Input Assembler Stage (IA), Vertex Shader Stage (VS), The Tessellation Stage (TS), Geometry Shader Stage(GS), Pixel Shader Stage (PS), Output merger Stage (OM) Understanding Meshes or Objects, Texturing, Lighting, Blending. **Introduction to Rendering Engines:** Understanding the current market Rendering Engines. Understanding AR, VR and MR. Depth Mappers, Mobile Phones, Smart Glasses, HMD's	**15** **[CO2, CO3, CO4]**

	Unity Engine: Multi-platform publishing, VR + AR: Introduction and working in Unity, 2D, Graphics, Physics, Scripting, Animation, Timeline, Multiplayer and Networking, UI, Navigation and Path finding, XR, Publishing. **XR:** VR, AR, MR, Conceptual Differences. SDK, Devices	

References:

1. Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition,2017
2. Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar Cengage Learning, Delmar Cengage Learning,2011
3. Introduction To 3D Game Programming With Directx® 11,Frank D Luna, Mercury Learning And Information,2012.
4. https://docs.unity3d.com/Manual/index.html - Free

Course Code	Course Title	Credits	No. of lectures
25BUCS5TE1	Embedded Systems	02	30

CO1	Explain the fundamentals of embedded systems, including their classification, applications, core components, architectures, characteristics, and quality attributes.	L2
CO2	Analyze embedded hardware architectures, memory organization, interrupts, peripherals, and processor selection criteria to design application-specific embedded systems.	L4
CO3	Apply 8051 microcontroller concepts and C programming techniques to develop basic embedded applications involving I/O operations, data conversion, and timing control.	L3
CO4	Design and develop a complete embedded system solution using appropriate development tools, programming structures, debugging techniques, and following the embedded product development life cycle.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	1
CO2	3	3	2	1	2	1
CO3	3	2	3	1	2	1
CO4	3	3	3	1	3	2

Unit I	**Introduction:** Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems **Core of embedded systems:** microprocessors and micro controllers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components. **Characteristics and quality attributes of embedded systems:** Characteristics, operational and non-operational quality attributes. **Embedded Systems – Application and Domain Specific:** Application specific – washing machine, domain specific – automotive **Embedded Hardware:** Memory map, i/o map, interrupt map, processor family, external peripherals, memory – RAM , ROM, types of RAM and ROM, memory testing, CRC ,Flash memory.	**15** **[CO1, CO2, CO3]**
Unit II	**8051 Programming in C:** Data Types and time delay in 8051 C, I/O Programming, Logic operations, Data conversion Programs. Designing **Embedded System with 8051 Microcontroller:** Factors to be considered in selecting a controller, why 8051 Microcontroller, Designing with 8051 **Programming embedded systems:** structure of embedded program, infinite loop, compiling, linking and debugging. **Design and Development:** Embedded system development Environment IDE, types of file generated on cross compilation, disassembler/ de-compiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.	**15** **[CO2, CO3, CO4]**

References:

1. Programming Embedded Systems in C and C++, Michael Barr, O'Reilly, Edition First, 1999
2. Introduction to embedded systems, Shibu K V, TataMcgraw-Hill, First Edition 2012
3. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson, Second Edition, 2011
4. Embedded Systems Rajkamal Tata Mcgraw-Hill

Course Code 25BUCS5PE1	Course Title Practicals based upon 25BUCS5TE1	Credits 02	No. of lectures 60

CO1	Understand the architecture, internal blocks, and programming model of the 8051 microcontroller for embedded system applications.	L2
CO2	Demonstrate the use of general-purpose I/O ports for input/output operations, including LED interfacing and data transfer between microcontrollers.	L3
CO3	Develop and execute embedded programs to implement binary counters, LED patterns, and blinking operations using both software and hardware timers	L6
CO4	Analyze and debug embedded programs using simulation tools and hardware debugging techniques.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	-
CO2	3	2	2	1	2	-
CO3	3	3	2	1	3	-
CO4	2	3	3	-	2	1

Practical 1	Design and develop a reprogrammable embedded computer using 8051 microcontrollers and to show the following aspects. a. Programming b. Execution c. Debugging
Practical 2	Configure timer control registers of 8051 and develop a program to generategiven time delay
Practical 3	To demonstrate use of general purpose port i.e. Input/ output port of two controllers for data transfer between them.
Practical 4	Port I / O: Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's
Practical 5	To interface 8 LEDs at Input-output port and create different patterns.
Practical 6	To demonstrate timer working in timer mode and blink LED without using anyloop delay routine.
Practical 7	Serial I / O: Configure 8051 serial port for asynchronous serial communication with serial port of PC exchange text messages to PC and display on PC screen. Signify end of message by carriage return
Practical 8	To demonstrate interfacing of seven-segment LED display and generate counting from 0 to 99 with fixed time delay
Practical 9	Interface 8051 with D/A converter and generate square wave of given frequencyon oscilloscope.
Practical 10	Interface 8051 with D/A converter and generate triangular wave of given frequency on oscilloscope.
Practical 11	Using D/A converter generate sine wave on oscilloscope with the help of lookup table stored in data area of 8051.
Practical 12	Interface stepper motor with 8051 and write a program to move the motorthrough a given angle in clock wise or counter clock wise direction

Course Code	Course Title	Credits	No. of lectures
25BUCS5PE2	**Advance Databases**	02	30

CO1	Identify and define the core concepts of Object-Oriented Databases, including object models, inheritance, polymorphism, and key features of object databases	L1
CO2	Explain and differentiate between RDBMS, OORDBMS, parallel databases, distributed databases, and their architectures, advantages, and limitations	L2
CO3	Apply database design concepts such as data partitioning, fragmentation, replication, and allocation to model parallel and distributed database systems.	L3
CO4	Evaluate and justify the selection of appropriate database systems and indexing techniques for multimedia and spatial database applications based on performance, scalability, and data complexity.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	1
CO2	3	2	2	1	1	1
CO3	3	3	2	1	2	1
CO4	3	3	3	1	2	2

Unit I	Concepts of Object-Oriented Databases, Key Features of Object Databases, Drawbacks of Object Databases, Object Model, Inheritance, Polymorphism Object-Oriented Relational Database Management System (OORDBMS), RDBMS and OORDBMS Parallel Database: Introduction, Three architectures shared memory, shared disk, shared nothing, Partitioning the data	**15 [CO1, CO2]**
Unit II	Distributed Database: Introduction, Data Fragmentation, Data Replication and Allocation. Multimedia Database: Requirement of Multimedia Database, Challenges of Multimedia Database, Application of Multimedia Database. Spatial Database: Spatial Database Concept, Spatial DBMS Data Models, Different Indexing Techniques	**15 [CO3, CO4]**

References:

1. Principles of Distributed Database Systems. Author: M. Tamer Özsu
2. Distributed System: Concepts, Design, and Applications Publisher: O, Reilly, Author: S.K.Singh
3. Multimedia Database Management Systems, Author: Prabhakaran, Publisher: Springer
4. Multimedia Database Management Systems, Author: Guojun Li
5. Spatial Databases: With Application to GIS, by Michel O. Scholl
6. Spatial Data Management by Nikos Mamoulis

Course Code 25BUCS5PE2	Course Title Practicals based upon 25BUCS5TE2	Credits 02	No. of lectures 60

CO1	Implement various database fragmentation techniques such as horizontal and vertical fragmentation, and create replicated databases to improve performance and reliability.	L3
CO2	Develop and manage specialized databases including temporal databases, active databases using triggers, OODBMS, and ORDBMS applications to handle complex data and operations.	L6
CO3	Retrieve and analyze spatial data from spatial databases and evaluate database designs for efficiency and accuracy.	L4
CO4	Design and implement XML-based applications to store, manipulate, and exchange structured data effectively across database systems.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	1
CO2	3	3	3	1	2	2
CO3	3	3	2	1	1	2
CO4	3	2	3	1	2	1

Practical 1	Horizontal fragmentation of database.
Practical 2	Vertical fragmentation of database
Practical 3	Creating Replica of database.
Practical 4	Create Temporal Database.
Practical 5	Implement Active database using Triggers
Practical 6	Create OODBMS Application
Practical 7	Create ORDBMS Application
Practical 8	Implement and retrieve records from a Spatial Database
Practical 9	XML Application

Course Code	Course Title	Credits	No. of lectures
25BUCS5VSC	**Ethical Hacking**	02	30

CO1	Recall fundamental information security concepts including assets, CIA triad, access control, authentication, authorization, threats, vulnerabilities, malware, and attack surfaces.	L1
CO2	Identify common types of malware, vulnerabilities and cyberattacks affecting web, mobile, IoT, and networked systems.	L1
CO3	Explain ethical hacking principles, legal and compliance considerations, vulnerability assessment, penetration testing methodologies, and pre-attack planning processes.	L2
CO4	Apply threat modeling and vulnerability assessment techniques using manual and automated tools to analyze security weaknesses and prepare a basic penetration testing report.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	2
CO2	3	2	2	1	1	2
CO3	3	3	2	1	2	3
CO4	3	3	3	1	2	3

Unit I	**Information Security : Attacks and Vulnerabilities** **Introduction to information security :** Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle **Types of malware :**Worms, viruses, Trojans, Spyware, Rootkits **Types of vulnerabilities :** OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation, broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database **Types of attacks and their common prevention mechanisms:** Keystroke Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs	**15** **[CO1, CO2]**
Unit II	**Ethical Hacking – I (Introduction and pre-attack)** **Introduction:** Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why isEthical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?, Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing. **Approach : Planning -** Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report	**15** **[CO1, CO3, CO4]**

References:
1. Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
2) CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007
3) Certified Ethical Hacker: Michael Gregg, Pearson Education,1st Edition, 2013
4) Certified Ethical Hacker: Matt Walker, TMH,2011
1) http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
2) https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project
3) https://www.owasp.org/index.php/Mobile_Top_10_2016-Top_10
4) https://www.owasp.org/index.php/OWASP_Testing_Guide_v4_Table_of_Contents
5) https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_Guide
6) https://cve.mitre.org/
7) https://access.redhat.com/blogs/766093/posts/2914051
8) http://resources.infosecinstitute.com/applications-threat-modeling/#gref
9)http://www.vulnerabilityassessment.co.uk/Penetration%20Test.html

Course Code 25BUCS5OJT	Course Title **ON-JOB TRAINING / FIELD PROJECT IN Computer Science**	Credits **02**	No. of hours **120**

CO1	Apply theoretical knowledge in real workplace situations	L3
CO2	Demonstrate professional workplace skills and ethics	L3
CO3	Use industry tools, technologies, and procedures competently	L3
CO4	Evaluate work performance and identify areas for improvement	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	1
CO2	2	1	1	1	3	3
CO3	2	2	3	1	2	1
CO4	2	3	2	1	2	2

General Guidelines:

- The OJT/FP topic may be undertaken from any topic relevant to course
- Each of the learners must undertake an OJT/FP individually based on field-work/field-survey/laboratory work.
- Learners must remain presented at the time of review meeting scheduled by research guide.
- Structure of report should contain the following chapter: Title; Abstract; Aim, Objectives, and Rationale; Introduction and Review of Literature; Materials and Methodology; Observation and Result; Discussion and Conclusion; References.
- Learners should prepare a PowerPoint presentation (PPT) of research project and it should be presented in front of external examiner.
- Duly signed hard copy of report and PPT should be submitted to the Department
- In case of OJT, detail report of attendance, record and acknowledgement /certificate issued from the organization to be submitted in college.

Semester VI

Course Code	Course Title	Credits	No. of lectures
25BUCS6T01	Introduction to Data Science	02	30

CO1	Explain the fundamental concepts of Data Science, including types of data, data sources, exploratory data analysis, data visualization, and data management processes.	L2
CO2	Apply data collection, cleaning, transformation, and modeling techniques using programming tools, IDEs, and large-scale data systems to prepare datasets for analysis.	L3
CO3	Analyze statistical and machine learning models by examining model selection techniques, bias–variance tradeoff, regularization methods, and performance evaluation strategies.	L4
CO4	Design and develop end-to-end data science solutions by integrating supervised and unsupervised learning methods, feature engineering, and ensemble techniques to solve real-world problems.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	3	3	1	2	1
CO3	3	3	2	1	1	2
CO4	3	3	3	1	2	2

Unit I	Introduction to Data Science: Meaning of Data, Different kinds of data, Introduction to high level programming language, Integrated Development Environment (IDE), Exploratory Data Analysis (EDA), Data Visualization, Different types of data sources Data Management: Data Collection, Data cleaning / extraction, Data analysis & Modeling Data Curation: Query languages and Operations to specify and transform data, Structured / schema-based systems as users and acquirers of data, Semi-structured systems as users and acquirers of data, Unstructured systems in the acquisition and structuring of data, Security and ethical considerations in relation to authenticating and authorizing access to data on remote systems, Software development tools, Large scale data systems, Amazon Web Services (AWS)	**15 [CO1, CO2]**
Unit II	Statistical Modeling and Machine Learning: Introduction to model selection: Regularization, bias/variance tradeoff e.g. parsimony, AIC, BIC, Cross validation, Ridge regressions and penalized regression e.g. LASSO Data transformations: Dimension reduction, Feature extraction, Smoothing and aggregating Supervised Learning: Regression, linear models, Regression trees, Time- series Analysis, Forecasting, Classification: classification trees, Logistic regression, separating hyper planes, k-NN Unsupervised Learning: Principal Components Analysis (PCA), k-means clustering, Hierarchical clustering, Ensemble methods	**15 [CO2, CO3, CO4]**

References:

1. Doing Data Science, Rachel Schutt and Cathy O'Neil, O'Reilly,2013
2. Mastering Machine Learning with R, Cory Lesmeister, PACKT Publication,2015
3. Hands-On Programming with R, Garrett Grolemund,1st Edition, 2014
4. An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., Tibshirani, R.,Springer,2015

Course Code	Course Title	Credits	No. of lectures
25BUCS6T02	Machine Learning and AI	02	30

CO1	Explain concepts of intelligent agents, machine learning, agent architectures, single, multi-agent systems, learning paradigms, machine learning models.	L2
CO2	Apply machine learning paradigms and techniques such as supervised and unsupervised learning, feature selection, clustering, and support vector machines to analyze and solve real-world problems.	L2
CO3	Explain fundamentals of Artificial Intelligence, its history, foundations, applications, and the architecture and functioning of expert systems.	L2
CO4	Apply expert system concepts such as rule-based systems, blackboard systems, truth maintenance systems, and expert system shells to model and solve domain-specific problems.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	-	1	1
CO2	3	3	2	1	2	1
CO3	3	2	1	-	1	2
CO4	3	3	2	1	2	2

Unit I	**Introduction to Machine Learning:** Examples of Machine Learning Problems, Structure of Learning, learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, and Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection. **Machine Learning Paradigms:** Machine Learning systems, supervised and un-supervised learning, inductive learning, deductive learning, clustering, support vector machines, cased based reasoning and learning.	**15 [CO1, CO2]**
Unit II	**Introduction to Artificial Intelligence:** History, foundation and Applications Expert System and Applications: Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth Maintenance System, Application of Expert Systems, Shells and Tools **Intelligent Agents:** Agents vs. software programs, classification of agents, working of an agent, single agent and multi-agent systems, performance evaluation, architecture, agent communication language, applications	**15 [CO3, CO4]**

References:

Machine Learning:

1. The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge University Press, 2015
2. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman, Springer 2nd Edition, 2015
3. Introduction to Machine Learning, Ethem Alpaydin, PHI, 2nd Edition, 2013

Artificial Intelligence:

1. A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, Pearson, 2010.
2. Artificial Intelligence: Foundations of Computational Agents, David L Poole, Alan K. Mackworth, 2nd Edition, Cambridge University Press ,2017.
3. Artificial Intelligence, Kevin Knight and Elaine Rich, 3rd Edition, 2017
4. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman

Course Code	Course Title	Credits	No. of lectures
25BUCS6T03	Cryptography and Network Security	02	30

CO1	Understand the fundamentals of security and basic categories of threats to computers and networks	L2
CO2	Understand basic cryptographic algorithms, message and web authentication and security issues	L2
CO3	Understand theory of fundamental cryptography encryption and decryption algorithms	L2
CO4	Understand various network security applications, IPSec, Firewall, IDS, Web Security, Email Security and Malicious software	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	2
CO2	3	2	2	1	1	2
CO3	3	2	1	1	1	2
CO4	3	2	3	1	2	3

Unit I	**Introduction to Security Concepts**, The need for Security, Security Approaches, Principles of Security, Types of Attacks **Cryptographic Techniques**, Plain text and Cipher Text, Substitution techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric key cryptography, Stenography, Key Range and Key Size, Possible types of attacks DES Algorithm, IDEA, RC4, RC5, Blowfish, RSA Algorithm, Digital Signatures	**15 [CO1, CO2]**
Unit II	Internet Security Protocols, SSL, TLS, SHTTP, SET, Email Security User Authentication Mechanism, Passwords, Biometric Authentication, Kerberos Network Security, TCP/IP Protocol, Firewalls, IP Security, VPN, Intrusion	**15 [CO3, CO4]**

References:

1. Cryptography and Network Security by Atul Kahate, 3rd Edition, McGraw Hill Education
2. Cryptography and Network Security by Behrouz Forouzan, Debdeep Mukhopadhyay, 2nd edition, McGraw Hill Education
3. Network Security, A Beginner's Guide by Eric Maiwald, 2nd Edition
4. Cryptography and Network Security by William Stallings, 5th Edition, Pearson

Course Code 25BUCS6P01	Course Title Practicals Based upon 25BUCS6T01	Credits 02	No. of lectures 60

CO1	Recall and describe fundamental concepts related to data formats (CSV, XML, JSON, JPEG), data preprocessing techniques, graph structures, and basic neural network models.	L1
CO2	Analyze datasets by performing data preprocessing operations such as format conversion to HORUS, data binning, averaging, outlier detection, attribute retrieval, error handling, and pattern identification using Python/R tools.	L4
CO3	Evaluate data quality, preprocessing results, and neural network outputs by comparing binary and bipolar sigmoidal activation functions and assessing their suitability for different data scenarios.	L5
CO4	Design and implement data processing pipelines and computational models, including acyclic graphs and simple linear neural network architectures, to solve real-world data-driven problems.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	-	-	-
CO2	2	3	3	1	1	-
CO3	2	3	2	-	1	2
CO4	3	3	2	1	3	1

Practical 1	Write the programs for the following: Text Delimited CSV to HORUS format
Practical 2	XML to HORUS format
Practical 3	JSON to HORUS format
Practical 4	Picture(JPEG) to HORUS format
Practical 5	Data Binning or Bucketing
Practical 6	Averaging of data
Practical 7	Outlier Detection
Practical 8	Perform following data processing using R
Practical 9	Program retrieve different attributes of data
Practical 10	Data pattern
Practical 11	Loading IP_DATA_ALL
Practical 12	Perform error management on the given data using pandas package
Practical 13	Write a python/R program to build acyclic graph

Course Code 25BUCS6P02	Course Title Practicals Based upon 25BUCS6T02	Credits 02	No. of lectures 60

CO1	Recall and describe fundamental concepts of search algorithms, machine learning paradigms, hypothesis learning, regression models, dataset types, and basic Python libraries used in artificial intelligence and machine learning.	L1
CO2	Apply uninformed and informed search techniques such as Breadth First Search, Depth First Search, Hill Climbing, and A algorithms, and implement basic machine learning algorithms including Find-S, Candidate Elimination, and simple linear regression using Python	L2
CO3	Apply Python libraries such as NumPy, SciPy, Pandas, Matplotlib, and Seaborn to create, load, preprocess datasets, handle missing values and outliers, compute statistical measures, and visualize data through univariate and bivariate plots.	L3
CO4	Analyze datasets and machine learning models by interpreting regression coefficients, evaluating model performance using metrics such as R-squared and MSE, exploring feature relationships, and addressing issues such as feature selection and multicollinearity.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	-	-	-
CO2	3	3	2	-	2	-
CO3	2	3	3	1	1	-
CO4	2	3	2	-	1	2

Practical 1	Write a Program to Implement Breadth First Search.
Practical 2	Write a Program to Implement Depth First Search
Practical 3	Write a program to implement Hill Climbing Algorithm
Practical 4	Write a program to implement A* Algorithm
Practical 5	Write a program to implement Tic-Tac-Toe game
Practical 6	Implementation of Python basic Libraries such as Math, Numpy and Scipy
Practical 7	Implementation of Python Libraries for ML application such as Pandas andMatplotlib
Practical 8	Creation AND Loading different datasets in Python.
Practical 9	Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets
Practical 10	Implementation of Find S Algorithm
Practical 11	Implementation of Candidate elimination Algorithm
Practical 12	Write a program to implement simple Linear Regression and Plot the graph
Practical 13	Load a CSV dataset. Handle missing values, inconsistent formatting, and outliers
Practical 14	Load a dataset, calculate descriptive summary statistics, create visualizations using different graphs, and identify potential features and target variables Note: ExploreUnivariate and Bivariate graphs (Matplotlib) and Seaborn for visualization.
Practical 15	Create or Explore datasets to use all pre-processing routines like label encoding, scaling, and binarization.
Practical 16	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from CSV file and generate the final specific hypothesis. (Create your dataset)
Practical 17	Fit a linear regression model on a dataset. Interpret coefficients, make predictions, and evaluate performance using metrics like R-squared and MSE
Practical 18	Extend linear regression to multiple features. Handle feature selection and potential Multicollinearity

Course Code 25BUCS6P03	Course Title Practicals based upon 25BUCS6T03	Credits 02	No. of lectures 60

CO1	Recall and describe fundamental concepts of cryptography and network security, including substitution and transposition ciphers, symmetric and asymmetric encryption, hashing algorithms, key management, and firewall basics.	L3
CO2	Apply classical and modern cryptographic algorithms such as Caesar, Monoalphabetic, Vernam, Playfair, Rail Fence, Columnar Transposition, DES, AES, Diffie–Hellman, and MD5 to encrypt, decrypt, and secure data.	L6
CO3	Analyze the security strength, limitations, and use cases of different cryptographic techniques and key exchange mechanisms by comparing algorithm behavior, key sizes, and resistance to attacks.	L4
CO4	Evaluate and implement appropriate security mechanisms, including encryption algorithms and firewall configurations, to protect systems, applications, and network resources against security threats.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	-	-	2
CO2	3	2	2	-	2	2
CO3	2	3	1	-	1	3
CO4	2	3	2	-	2	3

Practical 1	Write programs to implement the following Substitution Cipher Techniques: Caesar Cipher
Practical 2	Write programs to implement the following Substitution Cipher Techniques: Monoalphabetic Cipher
Practical 3	Write programs to implement the following Substitution Cipher Techniques: Vernam Cipher
Practical 4	Write programs to implement the following Substitution Cipher Techniques: Playfair Cipher
Practical 5	Write programs to implement the following Transposition Cipher Techniques: Rail Fence Cipher
Practical 6	Write programs to implement the following Transposition Cipher Techniques: Simple Columnar Technique
Practical 7	Write program to encrypt and decrypt strings using: DES Algorithm
Practical 8	Write program to encrypt and decrypt strings using: AES Algorithm
Practical 9	Write a program to implement the Diffie-Hellman Key Agreement algorithm to generate symmetric keys.
Practical 10	Write a program to implement the MD5 algorithm compute the message digest.
Practical 11	Configure Windows Firewall to block: A port, A program, A website

Course Code	Course Title	Credits	No. of lectures
25BUCS6TE1	**Next Generation Databases**	02	30

CO1	Understand the fundamentals of NoSQL databases, including ACID vs. BASE properties, CAP theorem, categories of NoSQL databases, and differences between SQL and NoSQL systems.	L2
CO2	Explain MongoDB concepts such as design philosophy, data model, BSON/JSON structures, schema evolution, storage engines, indexing mechanisms, and architectural components.	L2
CO3	Apply MongoDB operations to create, query, update, delete, index, and aggregate data using the MongoDB shell, and design appropriate document-based data models for real-world applications.	L3
CO4	Evaluate MongoDB architectures, deployment strategies, sharding approaches, and storage engines to determine their suitability, performance trade-offs, limitations, and security implications for different application use cases.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	1	1
CO2	3	2	2	1	1	1
CO3	3	3	3	1	2	1
CO4	3	3	3	1	2	2

Unit I	**NoSQL:** SQL, NoSQL, Definition, A Brief History of NoSQL, ACID vs. BASE, CAP Theorem (Brewer‟s Theorem), The BASE, NoSQL Advantages and Disadvantages, Advantages of NoSQL, Disadvantages of NoSQL, SQL vs. NoSQL Databases, Categories of NoSQL Databases **Introducing MongoDB:** History, MongoDB Design Philosophy, Speed, Scalability, and Agility, Non-Relational Approach, JSON-Based Document Store, Performance vs. Features, Running the Database Anywhere, SQL Comparison **The MongoDB Data Model:** The Data Model, JSON and BSON, The Identifier (_id), Capped Collection, Polymorphic Schemas, Object- Oriented Programming, Schema Evolution **Using MongoDB Shell:** Basic Querying, Create and Insert, Explicitly Creating Collections, Inserting Documents Using Loop, Inserting by Explicitly Specifying _id, Update, Delete, Read, Using Indexes, Stepping Beyond the Basics, Using Conditional Operators, Regular Expressions, MapReduce, aggregate(), Designing an Application‟s Data Model, Relational Data Modeling and Normalization, MongoDB Document Data Model Approach **MongoDB Architecture:** Core Processes, mongod, mongo, mongos, MongoDB Tools, Standalone Deployment, Replication, Master/Slave Replication, Replica Set, Implementing Advanced Clustering with Replica Sets, Sharding, Sharding Components, Data Distribution Process, Data Balancing Process, Operations, Implementing Sharding, Controlling Collection Distribution	**15** **[CO1, CO2]**
Unit II	**MongoDB Storage Engine:** Data Storage Engine, Data File (Relevantfor MMAPv1), Namespace (.ns File), Data File (Relevant for WiredTiger), Reads and Writes, How Data Is Written Using Journaling, GridFS – The MongoDB File System, The Rationale of GridFS, GridFSunder the Hood, Using GridFS, Indexing, Types of Indexes, Behaviors and Limitations **MongoDB Use Cases:** Use Case 1 -Performance Monitoring, Schema Design, Operations, Sharding, Managing the Data, Use Case 2 – Social Networking,	**15** **[CO1, CO3, CO4]**

	Schema Design, Operations, Sharding **MongoDB Limitations:** MongoDB Space Is Too Large (Applicable for MMAPv1), Memory Issues (Applicable for Storage Engine MMAPv1), 32-bit vs. 64-bit, BSON Documents, Namespaces Limits, Indexes Limit, Capped Collections Limit - Maximum Number of Documents in a Capped Collection, Sharding Limitations, Shard Early to Avoid Any Issues, Shard Key Can‟t Be Updated, Shard Collection Limit, Select the Correct Shard Key, Security Limitations, No Authentication by Default, Traffi c to and from MongoDB Isn‟t Encrypted, Write and Read Limitations, Case-Sensitive Queries, Type-Sensitive Fields, No JOIN, Transactions, MongoDB Not Applicable Range	

References:

1. Practical MongoDB Shakuntala Gupta Edward Navin Sabharwal Apress
2. Beginning jQuery Jack Franklin, Russ Ferguson Apress Second
3. Next Generation Databases Guy Harrison Apress
4. Beginning JSON Ben Smith Apress

Course Code 25BUCS6PE1	Course Title Practicals based upon 25BUCS6TE1	Credits 02	No. of lectures 60

CO1	Recall and describe fundamental concepts of NoSQL databases, MongoDB architecture, document-oriented data models, CRUD operations, aggregation expressions, and client-side scripting concepts using jQuery.	L1
CO2	Apply MongoDB queries and jQuery techniques to perform database creation, collection management, document manipulation, aggregation operations, Python–MongoDB integration, and dynamic web page interactions.	L2
CO3	Evaluate the effectiveness of MongoDB aggregation functions and jQuery effects in terms of performance, usability, and suitability for specific application requirements.	L5
CO4	Design and develop interactive, data-driven web applications by integrating MongoDB with Python back-end services and jQuery-based front-end components.	L6

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	-	-
CO2	3	2	3	-	2	-
CO3	2	3	2	-	1	1
CO4	3	3	3	1	3	1

Practical 1	Write a MongoDB query to create and drop database.
Practical 2	Write a MongoDB query to create, display and drop collection
Practical 3	Write a MongoDB query to insert, query, update and delete a document.
Practical 4	Simple Queries with MongoDB
Practical 5	Write a MongoDB query to use sum, avg, min and max expression.
Practical 6	Write a MongoDB query to use push and addToSetexpression.
Practical 7	Write a MongoDB query to use first and last expression.
Practical 8	Connecting Python with MongoDB and inserting, retrieving, updating and deleting.
Practical 9	jQuery Basic, jQuery Events
Practical 10	jQuery Selectors, jQuery Hide and Show effects
Practical 11	jQuery fading effects, jQuery Sliding effects
Practical 12	jQuery Animation effects, jQuery Chaining
Practical 13	jQuery Callback, jQuery Get and Set Contents
Practical 14	jQuery Insert Content, jQuery Remove Elements and Attribute

Course Code	Course Title	Credits	No. of lectures
25BUCS6TE2	**Information Retrieval**	02	30

CO1	Recall the fundamental concepts of Information Retrieval, including its history, components, Boolean retrieval model, and issues related to IR systems.	L1
CO2	Explain link analysis techniques and web search concepts such as PageRank, HITS, web structure, search engine architecture, and evaluation measures.	L2
CO3	Interpret recommendation and personalization approaches, including collaborative filtering, content-based recommendation, cross-lingual retrieval, summarization, and handling the invisible web.	L2
CO4	Apply Information Retrieval and XML retrieval models, including vector space models, Hadoop–MapReduce processing, and XML retrieval techniques to solve real-world search and retrieval problems.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	1
CO2	3	3	2	1	1	2
CO3	3	3	2	1	1	2
CO4	3	3	3	1	2	2

Unit I	**Introduction to Information Retrieval:** Introduction, History of IR, Componentsof IR, and Issues related to IR, Boolean retrieval, Dictionaries and tolerant retrieval. **Link Analysis and Specialized Search:** Link Analysis, hubs and authorities, Page Rank and HITS algorithms, Similarity, Hadoop & Map Reduce, Evaluation, Personalized search, Collaborative filtering and content-based recommendation of documents and products, handling ―invisible‖ Web, Snippet generation, Summarization, Cross- Lingual Retrieval.	**15** **[CO1, CO2]**
Unit II	**Web Search Engine:** Web search overview, web structure, the user, paid placement, search engine optimization/spam, Web size measurement, search engine optimization/spam, Web Search Architectures. **XML retrieval:** Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval,Text-centric versus data-centric XML retrieval.	**15** **[CO1, CO3, CO4]**

References:

1. Introduction to Information Retrieval, C. Manning, P. Raghavan, and H. Schütze, Cambridge University Press, 2008
2. Modern Information Retrieval: The Concepts and Technology behind Search, Ricardo Baeza-Yates and Berthier Ribeiro – Neto, 2nd Edition, ACM Press Books 2011.
3. Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler andTrevor Strohman, 1st Edition, Pearson, 2009
4. Information Retrieval Implementing and Evaluating Search Engines, Stefan Büttcher, Charles L. A. Clarke and Gordon V. Cormack, The MIT Press; Reprint edition (February 12,2016)

Course Code 25BUCS6PE2	Course Title Practicals based upon 25BUCS6TE2	Credits 02	No. of lectures 60

CO1	Recall and describe fundamental concepts of information retrieval, text processing, similarity measures, web mining, ranking algorithms, and distributed computing paradigms such as MapReduce.	L1
CO2	Apply algorithms and programming techniques including bitwise operations, PageRank, edit distance, text similarity, MapReduce, and web crawling to process, retrieve, and analyze textual and web-based data.	L2
CO3	Analyze textual and web datasets by performing preprocessing, indexing, similarity computation, trend detection, and graph-based ranking to extract meaningful information.	L3
CO4	Evaluate the effectiveness of information retrieval and web mining techniques such as Lucene-based IR systems, PageRank variants, and Twitter mining approaches for relevance, accuracy, and scalability.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	-	-	-
CO2	3	3	2	-	2	-
CO3	2	3	2	1	1	1
CO4	2	3	2	-	1	2

Practical 1	Write a program to demonstrate bitwise operation.
Practical 2	Implement Page Rank Algorithm.
Practical 3	Implement Dynamic programming algorithm for computing the edit distance between strings s1 and s2.
Practical 4	Write a program to Compute Similarity between two text documents.
Practical 5	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
Practical 6	Implement a basic IR system using Lucene.
Practical 7	Write a program for Pre-processing of a Text Document: stop word removal.
Practical 8	Write a program for mining Twitter to identify tweets for a specific period and identify trends and named entities.
Practical 9	Write a program to implement simple web crawler.
Practical 10	Write a program to parse XML text, generate Web graph and compute topic specific page rank.

Course Code	Course Title	Credits	No. of lectures
25BUCS6IKS	Indian Knowledge and Technology	02	30

CO1	Recall and list the key concepts of Indian Knowledge Systems (IKS), including ancient mathematical systems, logic traditions, early computational devices, and their relationship with modern Information Technology.	L1
CO2	Explain the relevance of ancient Indian mathematical foundations, such as the decimal system, zero, binary concepts, Sulba Sutras, and classical algorithms, in the development of modern computing and algorithmic thinking.	L2
CO3	Describe the principles of Indian logic and reasoning systems, including Nyaya logic, Arthashastra strategies, and syllogistic reasoning, and explain their influence on programming paradigms, artificial intelligence, and decision systems.	L2
CO4	Explain the contribution of Indian Knowledge Systems to emerging technologies, including AI, machine learning, cryptography, combinatorics, and knowledge preservation through digitization and cloud computing.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	2
CO2	3	3	1	1	1	2
CO3	3	3	2	1	1	3
CO4	3	3	3	2	1	3

Unit I	**Introduction**: Overview of Indian Knowledge Systems (IKS), Relation Between Indian Knowledge Systems and Information Technology **Mathematical foundations in ancient India and its relevance to IT**: Evolution of Decimal System, Binary systems and Zero, Sulba Sutras and early algorithmic geometry, Aryabhata's Algorithm for Square Roots and algorithmic thinking **Indian Logic and Its Application in IT**: Basic principles of Nyaya logic and Inference systems, Kautilya's Arthashastra: Algorithmic Thinking and Strategy, Influence of Indian syllogism and deductive reasoning on modern programming languages and AI decision systems	**15** **[CO1, CO2]**
Unit II	**AI and ML in ancient India:** Automata and Artificial Entities in Indian Mythology, Cognitive Models and Simulated Learning in Vedanta and Yoga, Aryabhata's and Madhava's Prediction and Data-Driven Models, Pattern Recognition and Classification in Ancient India **Mechanical Devices and early computing applications:** The Antikythera Mechanism, Indian Astronomy and Early Computational Models, Early Forms of Cryptography and Logic, Chaturanga, Abacus, Combinatorics and recursion **Present, Innovations and Future Directions:** Role of digitization, cloud computing, and knowledge management systems in preserving traditional knowledge, Bridging the Gap: Ancient Knowledge and Modern IT, Integration of IKS with emerging technologies	**15** **[CO1, CO3, CO4]**

References:

1. A Modern Introduction to Ancient Indian Mathematics**,** T. S. Bhanu Murthy, New Age International (P), Limited. First Edition, 1992
2. https://www.researchgate.net/publication/383541219_Sanskrit's_Role_in_Advancing_AI_A_Comprehensive_Study
3. Computing Science in Ancient India, T.R.N Rao and Subhash Kak, Center for Advanced Computer Studies, University of Southwestern Louisiana, First Edition, 1998

Course Code	Course Title	Credits	No. of lectures
25BUCS6VSC	Internet of Things	02	30

CO1	Explain IoT concepts including architecture, physical and logical design, enabling technologies, IoT stack, and major application domains.	L2
CO2	Apply sensor, actuator, and networking fundamentals to interface IoT hardware with network devices using TCP/IP, IPv6, and socket-based communication.	L3
CO3	Implement wireless communication and IoT protocols such as MQTT, CoAP, and HTTP/HTTPS to enable data exchange in IoT systems.	L3
CO4	Evaluate IoT cloud platforms and communication technologies with respect to scalability, security, data management, and suitability for real-world IoT applications.	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	3	3	1	2	1
CO3	3	3	3	1	2	1
CO4	3	3	3	2	2	2

Unit I	IoT Introduction and Concepts: IoT Architecture, Physical &Logical IoT design Basics, IoT Enabling Technologies, IoT Stack, IoT Applications Sensors & Actuators: Sensor working, Sensor Characteristics, Types of sensors and working principle, Sensors used in IoT Networking Fundamentals: TCP/IP Basics, IPV6, Network devices and configurations, Web servers and Socket programming	**15** **[CO1, CO2, CO3]**
Unit II	Wirelessfor IoT: Overview of Wireless Sensor Networks, IEEE standards for IoT, Overview of Wireless Modems(RF, GSM/GPRS, Bluetooth, RFID, Wi-Fi etc.) IoT Protocols: IoT Protocol overview, MQTT, COAP, HTTP/HTTPS Cloud platforms for IoT: IoT dashboards, Introduction to various cloud platforms, Device and data management from Cloud Platforms, Uploading data from hardware platforms to cloud	**15** **[CO2, CO3, CO4]**

References:

1. Internet of Things – A hands on Approach, ArshdeepBahga, Vijay Madisetti, University Press 2015
2. Designing the Internet of Things by Adrian McEwen, Hakim Cassimally, John Wiley

Course Code 25BUCS6OJT	Course Title **ON-JOB TRAINING / FIELD PROJECT IN Computer Science**	Credits 02	No. of hours 120

CO1	Apply theoretical knowledge in real workplace situations	L3
CO2	Demonstrate professional workplace skills and ethics	L3
CO3	Use industry tools, technologies, and procedures competently	L3
CO4	Evaluate work performance and identify areas for improvement	L5

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	1
CO2	2	1	1	1	3	3
CO3	2	2	3	1	2	1
CO4	2	3	2	1	2	2

General Guidelines:

- The OJT/FP topic may be undertaken from any topic relevant to course
- Each of the learners must undertake an OJT/FP individually based on field-work/field-survey/laboratory work.
- Learners must remain presented at the time of review meeting scheduled by research guide.
- Structure of report should contain the following chapter: Title; Abstract; Aim, Objectives, and Rationale; Introduction and Review of Literature; Materials and Methodology; Observation and Result; Discussion and Conclusion; References.
- Learners should prepare a PowerPoint presentation (PPT) of research project and it should be presented in front of external examiner.
- Duly signed hard copy of report and PPT should be submitted to the Department
- In case of OJT, detail report of attendance, record and acknowledgement /certificate issued from the organization to be submitted in college.

Evaluation and Examination Scheme

Evaluation Scheme 30:20
Internals Based on Unit 1 / Unit 2 / Unit 3/ Unit 4

Assignments/ Tutorials/Class Test	Seminar or any other activities	Active Participation & Leadership qualities	Total
10	05	05	20

Suggested Format for Mandatory Question paper

Duration:1.30Hours **Total Marks:30**

N. B.: 1. All the questions are compulsory
2. Figures to the right indicate full marks.
3. Answer to the same question must be written together.
4.Use of non-programmable calculator is allowed.

Q.1 **Attempt any Two** **8**
(A)
(B)
(C)
(D)

Q.2 **(A)** **Attempt any One** **4**
i)
ii)
(B) **Attempt any One** **3**
i)
ii)

Q.3 **Attempt any Two** **8**
(A)
(B)
(C)
(D)

Q.4 **(A)** **Attempt any One** **4**
i)
ii)
(B) **Attempt any One** **3**
i)
ii)

Semester End Practical Examination:
Practical examination of each paper for 50 marks will be held for 2 or 3 hours.

VPM's B. N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme T.Y.B.Sc. Computer Science

	Course Code	SEMESTER – V	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
		Course Title	EM	EN	SD	PE	GE	HV	ES
Major	25BUCS5T01	Soft Computing Techniques	√	√	√				
	25BUCS5T02	Data Mining and Data Warehousing	√	√	√				
	25BUCS5T03	Web Technology	√	√	√				
	25BUCS5P01	Practical Based on 25BUCS5T01	√	√	√				
	25BUCS5P02	Practical Based on 25BUCS5T02	√	√	√				
	25BUCS5P03	Practical Based on 25BUCS5T03	√	√	√				
MN	25BUCS5T04	Game Programming	√	√	√				
DSE_E1	25BUCS5TE1	Embedded Systems	√	√	√				
	25BUCS5PE1	Practical Based on 25BUCS5TE1	√	√	√				
DSE_E2	25BUCS5TE2	Advance Databases	√	√	√				
	25BUCS5PE2	Practical Based on 25BUCS5TE2	√	√	√				
VSC	25BUCS5VSC	Ethical Hacking	√	√	√				
OJT	25BUCS5OJT	OJT in CS – I	√	√	√		√	√	
FP	25BUCS5FPR	Field Project in CS - I	√	√	√		√	√	

	Course Code	SEMESTER – VI	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
		Course Title	EM	EN	SD	PE	GE	HV	ES
Major	25BUCS6T01	Introduction to Data Science	√	√	√				
	25BUCS6T02	Machine Learning and AI	√	√	√				
	25BUCS6T03	Cryptography and Network Security	√	√	√				
	25BUCS6P01	Practical Based on 25BUCS6T01	√	√	√				
	25BUCS6P02	Practical Based on 25BUCS6T02	√	√	√				
	25BUCS6P03	Practical Based on 25BUCS6T03	√	√	√				
DSE_E1	25BUCS6TE1	Next Generation DB	√	√	√				
	25BUCS6PE1	Practical Based on 25BUCS6TE1	√	√	√				
DSE_E2	25BUCS6TE2	Information Retrieval	√	√	√				
	25BUCS6PE2	Practical Based on 25BUCS6TE2	√	√	√				
IKS	25BUCS6IKS	Indian Knowledge and Technology	√	√	√	√	√		
VSC	25BUCS6VSC	Internet of Things	√	√	√				
OJT	25BUCS6OJT	OJT in CS - II	√	√	√		√		
FP	25BUCS6FPR	Field Project in CS - II	√	√	√		√		

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