JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech. in COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
COURSE STRUCTURE & SYLLABUS (R22 Regulations)

Applicable from AY 2022-23 Batch

I Year I Semester

S. No.	Course Code	Course	L	T	P	Credits
1.	MA101BS	Matrices and Calculus	3	1	0	4
2.	CH102BS	Engineering Chemistry	3	1	0	4
3.	CS103ES	Programming for Problem Solving	3	0	0	3
4.	EE104ES	Basic Electrical Engineering	2	0	0	2
5.	ME105ES	Computer Aided Engineering Graphics	1	0	4	3
6.	CS106ES	Elements of Computer Science & Engineering	0	0	2	1
7.	CH107BS	Engineering Chemistry Laboratory	0	0	2	1
8.	CS108ES	Programming for Problem Solving Laboratory	0	0	2	1
9.	EE109ES	Basic Electrical Engineering Laboratory	0	0	2	1
		Induction Program				
		Total	**12**	**2**	**12**	**20**

I Year II Semester

S. No.	Course Code	Course	L	T	P	Credits
1.	MA201BS	Ordinary Differential Equations and Vector Calculus	3	1	0	4
2.	PH202BS	Applied Physics	3	1	0	4
3.	ME203ES	Engineering Workshop	0	1	3	2.5
4.	EN204HS	English for Skill Enhancement	2	0	0	2
5.	EC205ES	Electronic Devices and Circuits	2	0	0	2
6.	CS206ES	Python Programming Laboratory	0	1	2	2
7.	PH207BS	Applied Physics Laboratory	0	0	3	1.5
8.	EN208HS	English Language and Communication Skills Laboratory	0	0	2	1
9.	CS209ES	IT Workshop	0	0	2	1
10.	*MC210	Environmental Science	3	0	0	0
		Total	**13**	**4**	**12**	**20**

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS301PC	Digital Electronics	3	0	0	3
2	DS302PC	Data Structures	3	0	0	3
3	DS303PC	Computer Oriented Statistical Methods	3	1	0	4
4	DS304PC	Computer Organization and Architecture	3	0	0	3
5	DS305PC	Object Oriented Programming through Java	3	0	0	3
6	DS306PC	Data Structures Lab	0	0	3	1.5
7	DS307PC	Object Oriented Programming through Java Lab	0	0	3	1.5
8	DS308PC	Data visualization- R Programming/ Power BI	0	0	2	1
9	*MC309	Gender Sensitization Lab	0	0	2	0
		Total	**15**	**1**	**10**	**20**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS401PC	Discrete Mathematics	3	0	0	3
2	SM402MS	Business Economics & Financial Analysis	3	0	0	3
3	DS403PC	Operating Systems	3	0	0	3
4	DS404PC	Database Management Systems	3	0	0	3
5	DS405PC	Software Engineering	3	0	0	3
6	DS406PC	Operating Systems Lab	0	0	2	1
7	DS407PC	Database Management Systems Lab	0	0	2	1
8	DS408PC	Real-time Research Project/ Societal Related Project	0	0	4	2
9	DS409PC	Node JS/ React JS/ Django	0	0	2	1
10	*MC410	Constitution of India	3	0	0	0
		Total	**18**	**0**	**10**	**20**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS501PC	Algorithms Design and Analysis	3	0	0	3
2	DS502PC	Introduction to Data Science	3	1	0	4
3	DS503PC	Computer Networks	3	0	0	3
4		Professional Elective - I	3	0	0	3
5		Professional Elective - II	3	0	0	3
6	DS504PC	R Programming Lab	0	0	2	1
7	DS505PC	Computer Networks Lab	0	0	2	1
8	EN508HS	Advanced English Communication Skills Lab	0	0	2	1
9	DS506PC	ETL-Kafka/Talend	0	0	2	1
10	*MC510	Intellectual Property Rights	3	0	0	0
		Total	**18**	**1**	**08**	**20**

III YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS601PC	Automata Theory and Compiler Design	3	0	0	3
2	DS602PC	Machine Learning	3	0	0	3
3	DS603PC	Big Data Analytics	3	0	0	3
4		Professional Elective – III	3	0	0	3
5		Open Elective - I	3	0	0	3
6	DS604PC	Machine Learning Lab	0	0	2	1
7	DS605PC	Big Data Analytics Lab	0	0	2	1
8		Professional Elective - III Lab	0	0	2	1
9	DS606PC	Industrial Oriented Mini Project/ Summer Internship/ Skill Development Course (UI design- Flutter)	0	0	4	2
10	*MC609	Environmental Science	3	0	0	0
		Total	**18**	**0**	**10**	**20**

Environmental Science in III Yr II Sem Should be Registered by Lateral Entry Students Only.

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS701PC	Predictive Analytics	3	0	0	3
2	DS702PC	Web and Social Media Analytics	3	0	0	3
3		Professional Elective – IV	3	0	0	3
4		Professional Elective – V	3	0	0	3
5		Open Elective – II	3	0	0	3
6	DS703PC	Predictive Analytics Lab	0	0	2	1
7	DS704PC	Web and Social Media Analytics Lab	0	0	2	1
8	DS705PC	Project Stage – I	0	0	6	3
		Total Credits	**15**	**0**	**10**	**20**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	DS801PC	Organizational Behavior	3	0	0	3
2		Professional Elective – VI	3	0	0	3
3		Open Elective – III	3	0	0	3
4	DS802PC	Project Stage – II including Seminar	0	0	22	11
		Total Credits	**9**	**0**	**22**	**20**

***MC – Satisfactory/Unsatisfactory**

Professional Elective - I

DS511PE	Data Warehousing and Business Intelligence
DS512PE	Artificial Intelligence
DS513PE	Web Programming
DS514PE	Image Processing
DS515PE	Computer Graphics

Professional Elective - II

DS521PE	Spatial and Multimedia Databases
DS522PE	Information Retrieval Systems
DS523PE	Software Project Management
DS524PE	DevOps
DS525PE	Computer Vision and Robotics

Professional Elective - III

DS631PE	Software Testing Methodologies
DS632PE	Data Visualization Techniques
DS633PE	Scripting Languages
DS634PE	Mobile Application Development
DS635PE	Cryptography and Network Security

 # Courses in PE - III and PE - III Lab must be in 1-1 correspondence.

Professional Elective - IV

DS741PE	Quantum Computing
DS742PE	Database Security
DS743PE	Natural Language Processing
DS744PE	Information Storage Management
DS745PE	Internet of Things

Professional Elective - V

DS751PE	Privacy Preserving Data Publishing
DS752PE	Cloud Computing
DS753PE	Data Science Applications
DS754PE	Mining Massive Datasets
DS755PE	Exploratory Data Analysis

Professional Elective - VI

DS861PE	Data Stream Mining
DS862PE	Web Security
DS863PE	Video Analytics
DS864PE	Blockchain Technology
DS865PE	Parallel and Distributed Computing

Open Elective - I

1. DS611OE: Fundamentals of Data Science
2. DS612OE: R Programming

Open Elective - II

1. DS721OE: Data Mining
2. DS722OE: Data Analytics

Open Elective - III

1. DS831OE: Introduction to social media mining
2. DS832OE: Data Visualization using Python

DS862PE: WEB SECURITY (Professional Elective –VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

1. Give an Overview of information security
2. Give an overview of Access control of relational databases

Course Outcomes: Students should be able to

1. Understand the Web architecture and applications
2. Understand client side and service side programming
3. Understand how common mistakes can be bypassed and exploit the application
4. Identify common application vulnerabilities

UNIT - I

The Web Security, The Web Security Problem, Risk Analysis and Best Practices Cryptography and the Web: Cryptography and Web Security, Working Cryptographic Systems and Protocols, Legal Restrictions on Cryptography, Digital Identification

UNIT - II

The Web's War on Your Privacy, Privacy-Protecting Techniques, Backups and Antitheft, Web Server Security, Physical Security for Servers, Host Security for Servers, Securing Web Applications

UNIT - III

Database Security: Recent Advances in Access Control, Access Control Models for XML, Database Issues in Trust Management and Trust Negotiation, Security in Data Warehouses and OLAP Systems

UNIT - IV

Security Re-engineering for Databases: Concepts and Techniques, Database Watermarking for Copyright Protection, Trustworthy Records Retention, Damage Quarantine and Recovery in Data Processing Systems, Hippocratic Databases: Current Capabilities

UNIT - V

Future Trends Privacy in Database Publishing: A Bayesian Perspective, Privacy-enhanced Location Based Access Control, Efficiently Enforcing the Security and Privacy Policies in a Mobile Environment

TEXT BOOKS:

1. Web Security, Privacy and Commerce Simson G Arfinkel, Gene Spafford, O'Reilly.
2. Handbook on Database security applications and trends Michael Gertz, Sushil Jajodia

DS863PE: VIDEO ANALYTICS (Professional Elective –VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To know the fundamental concepts of big data and analytics
- To learn various techniques for mining data streams
- To acquire the knowledge of extracting information from surveillance videos.
- To learn Event Modelling for different applications.
- To understand the models used for recognition of objects in videos.

Course Outcomes:

- Understand the basics of video- signals and systems.
- Estimate motion in a video
- Detect the objects and track them
- Recognize activity and analyze behavior
- Evaluate face recognition technologies

UNIT - I

Introduction

Multi-dimensional signals and systems: signals, transforms, systems, sampling theorem. Digital Images and Video: human visual system and color, digital video, 3D video, digital-video applications, image and video quality.

UNIT - II

Motion Estimation

Image formation, motion models, 2D apparent motion estimation, differential methods, matching methods, non-linear optimization methods, transform domain methods, 3D motion and structure estimation.

UNIT - III

Video Analytics

Introduction- Video Basics - Fundamentals for Video Surveillance- Scene Artifacts- Object Detection and Tracking: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.

UNIT - IV

Behavioural Analysis & Activity Recognition

Event Modelling- Behavioural Analysis- Human Activity Recognition-Complex Activity Recognition Activity modelling using 3D shape, Video summarization, shape-based activity models- Suspicious Activity Detection.

UNIT - V

Human Face Recognition & Gait Analysis

Introduction: Overview of Recognition algorithms – Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition

TEXT BOOKS:

1. A. Murat Tekalp, “Digital Video Processing”, second edition, Pearson, 2015

2. Rama Chellappa, Amit K. Roy-Chowdhury, Kevin Zhou. S, “Recognition of Humans and their Activities using Video”, Morgan & Claypool Publishers, 2005.
3. Yunqian Ma, Gang Qian, “Intelligent Video Surveillance: Systems and Technology”, CRC Press (Taylor and Francis Group), 2009.

REFERENCE BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
2. Yao Wang, Jorn Ostermann and Ya-Qin Zhang, “Video Processing and Communications”, Prentice Hall, 2001.
3. Thierry Bouwmans, Fatih Porikli, Benjamin Höferlin and Antoine Vacavant, “Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation”, CRC Press, Taylor and Francis Group, 2014.
4. Md. Atiqur Rahman Ahad, “Computer Vision and Action Recognition-A Guide for Image Processing and Computer Vision Community for Action Understanding”, Atlantis Press, 2011.

DS864PE: BLOCKCHAIN TECHNOLOGY (Professional Elective –VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites

1. Knowledge in information security and applied cryptography.
2. Knowledge in Computer Networks.

Course Objectives:

- To learn the fundamentals of Blockchain and various types of block chain and consensus mechanisms.
- To understand the public block chain system, Private block chain system and consortium blockchain.
- Able to know the security issues of blockchain technology.

Course Outcomes:

- Understanding concepts behind crypto currency
- Applications of smart contracts in decentralized application development
- Understand frameworks related to public, private and hybrid blockchain
- Create blockchain for different application case studies

UNIT - I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency – Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT - II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT - III

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Need of Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT - IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain In Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT - V

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyper ledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

TEXT BOOK:

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhilasj K A and Meena Karthikeyan, Universities Press.

REFERENCE BOOKS:

1. Michael Juntao Yuan, Building Blockchain Apps, Pearson, India.
2. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
3. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson.

DS865PE: PARALLEL AND DISTRIBUTED COMPUTING (Professional Elective –VI)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- To learn core ideas behind parallel and distributed computing.
- To explore the methodologies adopted for parallel and distributed environments.
- To understand the networking aspects of parallel and distributed computing.
- To provide an overview of the computational aspects of parallel and distributed computing.
- To learn parallel and distributed computing models.

Course Outcomes:

- Explore the methodologies adopted for parallel and distributed environments.
- Analyze the networking aspects of Distributed and Parallel Computing.
- Explore the different performance issues and tasks in parallel and distributed computing.
- Tools usage for parallel and distributed computing.
- Understand high performance computing techniques.

UNIT - I

Parallel and Distributed Computing— Introduction- Benefits and Needs- Parallel and Distributed Systems- Programming Environment- Theoretical Foundations- Parallel Algorithms— Introduction- Parallel Models and Algorithms- Sorting- Matrix Multiplication

UNIT - II

Architecture of Parallel and Distributed Systems, Parallel Operating Systems.

UNIT - III

Management of Resources in Parallel Systems- Parallel Database Systems and Multimedia Object Servers.

UNIT - IV

Networking Aspects of Distributed and Parallel Computing- Process- Parallel and Distributed Scientific Computing.

UNIT - V

Multimedia Applications for Parallel and Distributed Systems

TEXT BOOK:

1. Jacek Błażewicz, et al., “Handbook on parallel and distributed processing”, Springer Science & Business Media, 2013.

REFERENCE BOOKS:

1. George F. Coulouris, Jean Dollimore, and Tim Kindberg, “Distributed systems: concepts and design”, Pearson Education, 2005.
2. Gregor Kosec and Roman Trobec, “Parallel Scientific Computing: Theory, Algorithms, and Applications of Mesh Based and Meshless Methods”, Springer, 2015.
3. Andrew S. Tanenbaum, and Maarten Van Steen, “Distributed Systems: Principles and Paradigms”. Prentice-Hall, 2007.

DS831OE: INTRODUCTION TO SOCIAL MEDIA MINING (Open Elective –III)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites

1. Data Analytics.

Course Objectives

- The purpose of this course is to provide the students with knowledge of social media mining principles and techniques.
- This course is also designed to give an exposure of the frontiers of social media mining (Facebook, twitter)
- To introduce new technology for data analytics and introduce community Analysis
- To introduce various Recommendation algorithms

Course Outcomes

- Understand social media and its data.
- Apply mining technologies on twitter, Facebook, LinkedIn and Google.
- Learn about community
- Apply various Recommendation Algorithms
- Analyze the Behavior of people

UNIT - I

Introduction

Social Media Mining, New Challenges for Mining

Graph Essentials

Graph Basics, Graph Representation, Types of Graphs, Connectivity in Graphs, Special Graphs, Graph Algorithms

UNIT - II

Network Measures

Centrality, Transitivity and Reciprocity, Balance and Status, Similarity.

Network Models

Properties of Real-World Networks, Random Graphs, Small-World Model, Preferential Attachment Model

UNIT - III

Data Mining Essentials

Data, Data Preprocessing, Data Mining Algorithms, Supervised Learning, Unsupervised Learning

Community Analysis

Community Detection, Community Evaluation, Community Evaluation

UNIT - IV

Information Diffusion in Social Media

Herd Behavior, Information Cascades, Diffusion of innovations, Epidemics

Influence and Homophily

Measuring Assortativity, Influence, Homophily, Distinguishing Influence and Homophily

UNIT - V

Recommendation in Social Media

Challenges, Classical Recommendation Algorithms, Recommendation Using Social Context, Evaluating Recommendations

Behavior Analytics
Individual Behavior, Collective Behavior.

TEXT BOOK:

1. Social Media Mining (An Introduction), Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, Cambridge University Press, Draft Version: April 20, 2014

REFERENCE BOOKS:

1. Mining the Social Web, 2nd Edition Data Mining Face book, Twitter, LinkedIn, Google+, GitHub, and More By Matthew A. Russell Publisher: O'Reilly Media.
2. Social Media Mining with R [Kindle Edition] NATHAN DANNEMAN RICHARD HEIMANN

DS832OE: DATA VISUALIZATION USING PYTHON (Open Elective –III)

B.Tech. IV Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives:

- Learn data wrangling techniques
- Introduce visual perception and core skills for visual analysis

Course Outcomes:

- Perform data wrangling
- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Evaluate visualization techniques

UNIT - I

An Introduction to Data Visualization in Python, Types of Plots- statistical plots, Images, Networks/ Graphs, Geographical, 3D and Interactive, Grids and Meshes

UNIT - II

Manipulating and visualizing data with Pandas: defining data frames, Creating and manipulating data frames, visualization with pandas

Matplotlib: Features of matplotlib, Anatomy and Customization of matplotlib plot, Plotting and plot customization, Customizing a plot, Visualization examples,

UNIT - III

Seaborn: Features of seaborn, Creating plots with seaborn, Visualization examples

Altair: Altair's declarative API, creating an Altair Chart and Plot, Changing mark/PlotTypes, Global Configuration, Encoding arguments, Altair Datatypes, CreatingTitles, Properties, Tooltips, Saving Altair Charts, Making Plots Interactive, Visualization Examples,

UNIT - IV

Plotly: Plotly and JSON, Online and Offline plotting, Structure of Plotly Plot, Graph Objectives VS Dictionaries, Plotly Express, updating plots- Adding and Updating Traces, Creating Subplots, Drop-Down Menus, Dash Interactivity, Example Plots

UNIT - V

CGPlot2/Plotnine: The Gammar of Graphics, Creating Plots, Changing Geoms, Stats, Faceting, Coordinates, Annotations, Scaling, Themes, Legends, and Palettes, Visualization Examples.

TEXT BOOKS:

1. Daniel Nelson, Data Visualization in Python
2. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick A K Peters, Ltd.

REFERENCE BOOKS:

1. Jacqueline Kazil and Katharine Jarmul, Data Wrangling with Python: Tips and Tools to Make Your Life Easier, O'Reilly.
2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.