JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech. in COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
II YEAR COURSE STRUCTURE & SYLLABUS (R18)

Applicable From 2020-21 Admitted Batch

I YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics - I	3	1	0	4
2	CH102BS	Chemistry	3	1	0	4
3	EE103ES	Basic Electrical Engineering	3	0	0	3
4	ME105ES	Engineering Workshop	1	0	3	2.5
5	EN105HS	English	2	0	0	2
6	CH106BS	Engineering Chemistry Lab	0	0	3	1.5
7	EN107HS	English Language and Communication Skills Lab	0	0	2	1
8	EE108ES	Basic Electrical Engineering Lab	0	0	2	1
		Induction Programme				
		Total Credits	**12**	**2**	**10**	**19**

I YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA201BS	Mathematics - II	3	1	0	4
2	AP202BS	Applied Physics	3	1	0	4
3	CS203ES	Programming for Problem Solving	3	1	0	4
4	ME204ES	Engineering Graphics	1	0	4	3
5	AP205BS	Applied Physics Lab	0	0	3	1.5
6	CS206ES	Programming for Problem Solving Lab	0	0	3	1.5
7	*MC209ES	Environmental Science	3	0	0	0
		Total Credits	**13**	**3**	**10**	**18**

*MC – Mandatory Course

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	CS310PC	Discrete Mathematics	3	0	0	3
2	CS302PC	Data Structures	3	1	0	4
3	MA313BS	Mathematical and Statistical Foundations	3	0	0	3
4	CS304PC	Computer Organization and Architecture	3	0	0	3
5	CS311PC	Python Programming	2	0	0	2
6	SM306MS	Business Economics & Financial Analysis	3	0	0	3
7	CS307PC	Data Structures Lab	0	0	3	1.5
8	CS312PC	Python Programming Lab	0	0	3	1.5
9	*MC309	Gender Sensitization Lab	0	0	2	0
		Total Credits	**17**	**1**	**8**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	CS416PC	Formal Language and Automata Theory	3	0	0	3

2	CS417PC	Software Engineering	3	0	0	3
3	CS403PC	Operating Systems	3	0	0	3
4	CS404PC	Database Management Systems	3	1	0	4
5	CS412PC	Object Oriented Programming using Java	3	1	0	4
6	CS406PC	Operating Systems Lab	0	0	3	1.5
7	CS407PC	Database Management Systems Lab	0	0	3	1.5
8	CS408PC	Java Programming Lab	0	0	2	1
9	*MC409	Constitution of India	3	0	0	0
		Total Credits	**18**	**2**	**8**	**21**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Design and Analysis of Algorithms	3	0	0	3
2		Introduction to Data Science	3	0	0	3
3		Computer Networks	3	0	0	3
4		Data Mining	3	0	0	3
5		Professional Elective - I	3	0	0	3
6		Professional Elective - II	3	0	0	3
7		Data Mining Lab	0	0	3	1.5
8		Computer Networks Lab	0	0	3	1.5
9		Advanced Communication Skills Lab	0	0	2	1
10		Intellectual Property Rights	3	0	0	0
		Total Credits	**21**	**0**	**8**	**22**

III YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Compiler Design	3	1	0	4
2		Machine Learning	3	1	0	4
3		Big Data Analytics	3	1	0	4
4		Professional Elective – III	3	0	0	3
5		Open Elective - I	3	0	0	3
6		Machine Learning Lab	0	0	3	1.5
7		Big Data Analytics Lab	0	0	3	1.5
8		Professional Elective - III Lab	0	0	2	1
9		Environmental Science	3	0	0	0
		Total Credits	**18**	**3**	**8**	**22**

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Predictive Analytics	3	0	0	3
2		Web and Social Media Analytics	2	0	0	2
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		Web and Social Media Analytics Lab	0	0	2	1
7		Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
8		Seminar	0	0	2	1
9		Project Stage – I	0	0	6	3
		Total Credits	**14**	**0**	**10**	**21**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Organizational Behaviour	3	0	0	3
2		Professional Elective -VI	3	0	0	3
3		Open Elective-III	3	0	0	3
4		Project Stage - II	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***Note:** Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

MC - Environmental Science – Should be Registered by Lateral Entry Students Only.MC – Satisfactory/Unsatisfactory

Professional Elective-I

	Data Warehousing and Business Intelligence
	Artificial Intelligence
	Web Programming
	Image Processing
	Computer Graphics

Professional Elective - II

	Spatial and Multimedia Databases
	Information Retrieval Systems
	Software Project Management
	DevOps
	Computer Vision and Robotics

Professional Elective - III

	Software Testing Methodologies
	Data Visualization Techniques
	Scripting Languages
	Mobile Application Development
	Cryptography and Network Security

 # Courses in PE – III and PE – III Lab must be in 1-1 correspondence.Professional Elective –IV

	Quantum Computing
	Database Security
	Natural Language Processing
	Information Storage Management
	Internet of Things

Professional Elective - V

	Privacy Preserving in Data Mining
	Cloud Computing

	Data Science Applications
	Mining Massive Datasets
	Exploratory Data Analysis

Professional Elective – VI

	Data Stream Mining
	Web Security
	Video Analytics
	Blockchain Technology
	Parallel and Distributed Computing

NAME OF THE PROGRAM: R18 B.Tech. COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)						
S.No.	**Semester**	**Course Code**	**Course Name**	**CO No.**	**Course outcome (Cos)**	
1	1 SEM	MA101BS	Mathematics - I	CO1	Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations	
				CO2	Find the Eigen values and Eigen vectors	
				CO3	Reduce the quadratic form to canonical form using orthogonal transformations.	
				CO4	Analyse the nature of sequence and series	
				CO5	Solve the applications on the mean value theorems.	
				C06	Evaluate the improper integrals using Beta and Gamma functions	
2		CH102BS/ CH202BS:	CHEMISTRY	CO1	The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.	
				CO2	The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments	
				CO3	The required skills to get clear concepts on basic spectroscopy and application to medical and other fields.	
				CO4	The knowledge of configurational and conformational analysis of molecules and reaction mechanisms.	
3		EE103ES/ EE203ES	BASIC ELECTRICAL ENGINEERING	C01	Get an exposure to basic electrical laws	
				C02	Understand the response of different types of electrical circuits to different excitations	
				C03	Understand the measurement, calculation and relation between the basic electrical parameters	
				C04	Understand the basic characteristics of transformers and electrical machines.	
4		ME105ES/ ME205ES	Engineering Workshop	CO1	Study and practice on machine tools and their operations	
				CO2	Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.	
				CO3	Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.	
				CO4	Apply basic electrical engineering knowledge for house wiring practice.	
5		EN105HS/ EN205HS	ENGLISH	C01	Use English Language effectively in spoken and written forms.	
				C02	Comprehend the given texts and respond appropriately	
				C03	Communicate confidently in various contexts and different cultures	

				C04	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.	
6	2 SEM	MA201BS	MATHEMATICS - II	C01	Identify whether the given differential equation of first order is exact or not	
				C02	Solve higher differential equation and apply the concept of differential equation to real world problems	
				C03	Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelopiped	
				C04	Evaluate the line, surface and volume integrals and converting them from one to another	
7		AP102BS/ AP202BS	APPLIED PHYSICS	C01	The student would be able to learn the fundamental concepts on Quantum behaviour of matter in its micro state. .	
				C02	The knowledge of fundamentals of Semiconductor physics, Optoelectronics, Lasers and fibre optics enable the students to apply to various systems like communications, solar cell, photo cells and so on	
				C03	Design, characterization and study of properties of material help the students to prepare new materials for various engineering applications.	
				C04	The course also helps the students to be exposed to the phenomena of electromagnetism and also to have exposure on magnetic materials and dielectric materials	
8		CS103ES/ CS203ES	PROGRAMMING FOR PROBLEM SOLVING	C01	To write algorithms and to draw flowcharts for solving problems.	
				C02	To convert the algorithms/flowcharts to C programs	
				C03	To code and test a given logic in C programming language.	
				C04	To decompose a problem into functions and to develop modular reusable code	
				C05	To use arrays, pointers, strings and structures to write C programs	
				C06	Searching and sorting problems.	
9		ME104ES/ ME204ES	ENGINEERING GRAPHICS	C01	Preparing working drawings to communicate the ideas and information.	
				C02	Read, understand and interpret engineering drawings.	
10	3 SEM	CS401PC	DISCRETE MATHEMATICS	CO1	Ability to understand and construct precise mathematical proofs	
				CO2	Ability to use logic and set theory to formulate precise statements	
				CO3	Ability to analyze and solve counting problems on finite and discrete structures	
				CO4	Ability to describe and manipulate sequences	
				CO5	Ability to apply graph theory in solving computing problems	
11		CS302PC	DATA STRUCTUR	CO1	Ability to select the data structures that efficiently model the information in a problem. .	

			ES	CO2	Ability to assess efficiency trade-offs among different data structure implementations or· combinations	
				CO3	Design programs using a variety of data structures, including hash tables, binary and general	
				CO4	Implement and know the application of algorithms for sorting and pattern matching	
				CO5	Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.	
12		MA313BS	MATHEMATICAL AND STATISTICAL FOUNDATIONS	CO1	Apply the number theory concepts to cryptography domain	
				CO2	Apply the concepts of probability and distributions to some case studies	
				CO3	Correlate the material of one unit to the material in other units	
				CO4	Resolve the potential misconceptions and hazards in each topic of study	
13		CS304PC	COMPUTER ORGANIZATION AND ARCHITECTURE	CO1	Understand the basics of instructions sets and their impact on processor design	
				CO2	Demonstrate an understanding of the design of the functional units of a digital computer system.	
				CO3	Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory	
				CO4	Design a pipeline for consistent execution of instructions with minimum hazards	
				CO5	Recognize and manipulate representations of numbers stored in digital computers	
14		CS311PC	PYTHON PROGRAMMING	CO1	Examine Python syntax and semantics and be fluent in the use of Python flow control and functions	
				CO2	Demonstrate proficiency in handling Strings and File Systems	
				CO3	Create, run and manipulate Python Programs using core data structures like Lists Dictionaries and use Regular Expressions.	
				CO4	Interpret the concepts of Object-Oriented Programming as used in Python	
				CO5	Implement exemplary applications related to Network Programming, Web Services and Databases in Python	
15		SM306MS	BUSINESS ECONOMICS AND FINANCIAL ANALYSIS	CO1	The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company	
16	4 SEM	CS416PC	FORMAL LANGUAGES AND AUTOMAT	CO1	Able to understand the concept of abstract machines and their power to recognize the languages	
				CO2	Able to employ finite state machines for modeling and solving computing problems	

			A THEORY	CO3	Able to design context free grammars for formal languages	
				CO4	Able to distinguish between decidability and undecidability	
				CO5	Able to gain proficiency with mathematical tools and formal methods	
17		CS417PC	SOFTWARE ENGINEERING	CO1	Ability to translate end-user requirements into system and software requirements, using e.g. UML, and structure the requirements in a Software Requirements Document (SRD).	
				CO2	Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.	
				CO3	Will have experience and/or awareness of testing problems and will be able to develop a simple testing report	
18		CS403PC	OPERATING SYSTEMS	CO1	Introduce operating system concepts (i.e., processes, threads, scheduling, synchronization, deadlocks, memory management, file and I/O subsystems and protection)	
				CO1	Introduce the issues to be considered in the design and development of operating system	
				CO3	Introduce basic Unix commands, system call interface for process management, interprocess communication and I/O in Unix	
19		CS404PC	DATABASE MANAGEMENT SYSTEMS	CO1	Gain knowledge of fundamentals of DBMS, database design and normal forms	
				CO2	Master the basics of SQL for retrieval and management of data	
				CO3	.Be acquainted with the basics of transaction processing and concurrency control	
				CO4	Familiarity with database storage structures and access techniques	
20		CS412PC	Object Oriented Programming through Java	CO1	Able to solve real world problems using OOP techniques.	
				CO2	Able to understand the use of abstract classes	
				CO3	Able to solve problems using java collection framework and I/o classes	
				CO4	Able to develop multithreaded applications with synchronization.	
				CO5	Able to develop applets for web applications	
				CO6	Able to design GUI based applications	
21	5 SEM		DESIGN AND ANALYSIS OF ALGORITHMS	CO1	Ability to analyze the performance of algorithms	
				CO2	Ability to choose appropriate data structures and algorithm design methods for a specified application	
				CO3	Ability to understand how the choice of data structures and the algorithm design methods impact the performance of programs	
22			INTRODUC	C01	Understand basic terms what Statistical Inference means.	

			TION TO DATA SCIENCE	C02	Identify probability distributions commonly used as foundations for statistical modelling. Fit a model to data	
				C03	Describe the data using various statistical measures	
				C04	Utilize R elements for data handling	
				C05	Perform data reduction and apply visualization techniques	
23			COMPUTER NETWORKS	CO1	Gain the knowledge of the basic computer network technology. 2. 3.. 4.	
				CO2	Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.	
				CO3	Obtain the skills of subnetting and routing mechanisms	
				CO4	Familiarity with the essential protocols of computer networks, and how they can be applied in network design and implementation	
24			DATA MINING	C01	Ability to understand the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.	
				C02	Apply preprocessing methods for any given raw data.	
				C03	Extract interesting patterns from large amounts of data	
				C04	Discover the role played by data mining in various fields	
				C05	Choose and employ suitable data mining algorithms to build analytical applications	
				C06	Evaluate the accuracy of supervised and unsupervised models and algorithms	
25			COMPUTER GRAPHICS (Professional Elective – I)	C01	Acquire familiarity with the relevant mathematics of computer graphics.	
				C02	Be able to design basic graphics application programs, including animation	
				C03	Be able to design applications that display graphic images to given specifications	
26			DEVOPS (Professional Elective – II)	C01	Identify components of Devops environment	
				C02	Describe Software development models and architectures of DevOps	
				C03	Apply different project management, integration, testing and code deployment tool	
				C04	Investigate different DevOps Software development models	
				C05	Assess various Devops practices	
				C06	Collaborate and adopt Devops in real-time projects	
27	6 SEM		COMPILER DESIGN	C01	Demonstrate the ability to design a compiler given a set of language features.	
				C02	Demonstrate the the knowledge of patterns, tokens & regular expressions for lexical analysis.	
				C03	Acquire skills in using lex tool & yacc tool for devleoping a scanner and parser.	
				C04	Design and implement LL and LR parsers	

				C05	Design algorithms to do code optimization in order to improve the performance of a program in terms of space and time complexity.	
				C06	Design algorithms to generate machine code.	
28			MACHINE LEARNING	C01	Understand the concepts of computational intelligence like machine learning.	
				C02	Ability to get the skill to apply machine learning techniques to address the real time problems in different areas.	
				C03	Understand the Neural Networks and its usage in machine learning application	
29			BIG DATA ANALYTICS	C01	Ability to explain the foundations, definitions, and challenges of Big Data and various Analytical tools.	
				C02	Ability to program using HADOOP and Map reduce, NOSQL	
				C03	Ability to understand the importance of Big Data in Social Media and Mining.	
30			CRYPTOGRAPHY AND NETWORK SECURITY (Professional Elective – III)	C01	Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues.	
				C02	Ability to identify information system requirements for both of them such as client and server	
				C03	Ability to understand the current legal issues towards information security.	
32	7 SEM		PREDICTIVE ANALYTICS	C01	Understand prediction-related principles, theories and approaches.	
				C02	Learn model assessment and validation.	
				C03	Understand the basics of predictive techniques and statistical approaches.	
				C04	Analyze supervised and unsupervised algorithms.	
33			WEB AND SOCIAL MEDIA ANALYTICS	C01	Knowledge on decision support systems.	
				C02	Apply natural language processing concepts on text analytics.	
				C03	Understand sentiment analysis.	
				C04	Knowledge on search engine optimization and web analytics	
34			NATURAL LANGUAGE PROCESSING (Professional Elective – IV)	C01	Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.	
				C02	Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems	
				C03	Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.	
				C04	Able to design, implement, and analyze NLP algorithms	
				C05	Able to design different language modeling Techniques	

35			CLOUD COMPUTING (Professional Elective – V)	C01	Ability to understand various service delivery models of a cloud computing architecture.	
				C02	Ability to understand the ways in which the cloud can be programmed and deployed	
				C03	Understanding cloud service providers.	
37	8 SEM		ORGANIZATIONAL BEHAVIOUR	C01	Demonstrate the applicability of analyzing the complexities associated with management of individual behavior in the organization	
				C02	Analyze the complexities associated with management of the group behavior in the organization.	
				C03	Demonstrate how the organizational behavior can integrate in understanding the motivation (why) behind behavior of people in the organization	
38			WEB SECURITY (Professional Elective – VI)	C01	Understand the Web architecture and applications	
				C02	Understand client side and service side programming	
				C03	Understand how common mistakes can be bypassed and exploit the application	
				C04	Identify common application vulnerabilities	