G H RAISONI INSTITUTE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An Autonomous Institute affiliated to RTM Nagpur University, Nagpur)

Department of Data Science

B. Tech. in Data Science

Scheme –2020-2021

Scheme and Curriculum of B. Tech Data Science Scheme Summary

Semester	Credits	Hours	Marks	No. of Theory Heads	No. of Practical Heads	Total Heads
I	18	26	575	5	7	12
II	19	26	550	5	6	11
III	21	26	550	5	4	9
IV	22	27	600	6	4	10
V	25	31	600	6	5	11
VI	22	27	600	6	5	11
VII	18	24	550	4	1	5
VIII	15	27	475	1	1	2
Total	160	214	4500	38	34	71

Course Category Credits Summary

Semester	No. of Credits for Course Category						Total
	Core (C)	Basic Science and Humanities (BS &H)	Skills (A)	Electives (EL)	Open Electives (OE)	Project/ Internship (P)	
I	9	6	3	0	0	0	18
II	6	11	2	0	0	0	19
III	15	4	2	0	0	0	21
IV	12	4	0	3	2	1	22
V	17	2	1	3	0	2	25
VI	13	5	2	0	2	0	22
VII	0	0	0	14	0	4	18
VIII	0	0	0	0	3	12	15
TOTAL	72	32	10	20	7	19	160

Course Code	Name of Courses	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		TOTAL MARKS
			L	T	P	Total Hour		TAE	CAE	ESE	INT	EXT	
SEMESTER-VII													
UDSL43X	**Department Elective- III**	EL	3	-	-	3	3	10	15	50	-	-	75
UDSL44X	**Department Elective- IV**	EL	3	-	-	3	3	10	15	50	-	-	75
UDSL45X	**Department Elective-V**	EL	3	-		3	3	10	15	50		-	75
UDSP45X	**Department Elective-V Practical**	EL	-		2	2	1	-	-	-	25	-	25
UDSL46X	**Department Elective-VI**	EL	3	-		3	3	10	15	50		-	75
UDSP45X	**Department Elective-VI Practical**	EL	-	-	2	2	1	-	-	-	25	-	25
UDSP401	**Project**	P	-	-	8	8	4	-	-	-	100	100	200
TOTAL			**12**	**-**	**12**	**24**	**18**	**40**	**60**	**200**	**150**	**100**	**550**

Elective-III	
Subject Code	**Name of Subject**
UDSL431	Image & Video Analytics
UDSL432	Cryptography & Cyber Security
UDSL433	Operation Research
UDSL434	Evidence Acquisition & Recovery
UDSL435	Programming for Analytics
UDSL436	Industrial & Medical IoT

Elective-IV	
Subject Code	Name of Subject
UDSL441	Finance Analytics
UDSL442	Deep Web and Dark net
UDSL443	Quantum Computing
UDSL444	Cyber Forensic and Cyber Defence
UDSL445	Text Processing
UDSL446	AWS Cloud computing & Security

Elective-V	
Subject Code	**Name of Subject**
UDSL451	Next Generation Database
UDSP451	Next Generation Database
UDSL452	NoSQL using MongoDB
UDSP452	NoSQL using MongoDB-Practical
UDSL453	Recommendation Systems with Machine Learning
UDSP453	Recommendation Systems with Machine Learning
UDSL454	Network Security
UDSP454	Network Security
UDSL455	Virtual Reality
UDSP455	Virtual Reality
UDSL456	Machine Learning with TensorFlow
UDSP456	Machine Learning with TensorFlow-Practical

Elective-VI	
Subject Code	**Name of Subject**
UDSL461	Predictive Modeling & Analytics
UDSP461	Predictive Modeling & Analytics-Practical
UDSL462	Data Mining & ETL
UDSP462	Data Mining & ETL
UDSL463	Business Intelligence
UDSP463	Business Intelligence
UDSL464	Information Retrieval & Text Mining
UDSP464	Information Retrieval & Text Mining
UDSL465	Stock Market Analysis
UDSP465	Stock Market Analysis-Practical
UDSL466	Salesforce CRM
UDSP466	Salesforce CRM-Practical

SEMESTER-VII

Course Title: Image and Video Analytics (UDSL431)

Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	--	--	3	10	15	50	-	-
Course Code	UDSL431									
Teaching Mode	Offline				TOTAL	75			--	
Duration of ESE	2.5					75				

Course Objectives	To impart knowledge on the basic principles and concepts in digital image and video processing.
	To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.
Course Outcomes	Understand the requirements of image processing
	Illustrate the principles and techniques of digital image in applications related to digital imaging system
	Demonstrate the image recognition and motion recognition
	Understand the fundamentals of digital video processing
	Illustrate the motion estimation, segmentation and modelling
	Design and Analysis of video processing in application

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	3							2	1
CO2	2	3	3	2	2	2							2	1
CO3	2	3	3	1	2	3							2	1
CO4	2	3	3	3	2	2							2	1
CO5	2	3	3	3	2	3							2	1

Unit	Contents	Hours
I	**Introduction:** Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Histogram Processing, Spatial filtering, Frequency Domain filtering.	6
II	**Image Segmentation, Compression and Colour Image Processing:** Image Segmentation –Detection of Discontinuities. - Edge Linking and Boundary Detection. - Thresholding. - Region-Based Segmentation. Image Compression – Encoder-Decoder model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, JPEG and JPEG 2000. Colour Image Processing – Colour Models, Color Transformations Color Image Smoothing and Sharpening, Color Noise Reduction, Color-Based Image Segmentation.	8
III	**Feature extraction and Texture Analysis:** Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction, PCA - SIFT – SURF. Texture Analysis - Concepts and classification, statistical, structural and spectral analysis.	8
IV	**Object recognition and Image Retrieval:** Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template- Matching. Content Based Image Retrieval - Feature based image retrieval, Object Based Retrieval	6
V	**Digital video processing:**Dig ital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation.	6
Text Books	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice-Hall, 2008	
	A. Murat Tekalp, "Digital Video Processing", Second Edition, Prentice Hall, 2015.	
Reference Books	Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press,2011	
	Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", Tsinghua University Press, 2009.	
	Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012	
	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010	
	Boguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice", Wiley 2013	
Online TL Material	**http://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm**	
	https://www.cs.cmu.edu/~cil/v-images.html	
	http://www.imageprocessingplace.com/root_files_V3/image_databases.htm	

Course Title: Cryptography & Cyber Security(Elective-III)

Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	EL	3	--	--	3	10	15	50		
Course Code	UDSL432									
Teaching Mode	Offline				TOTAL	75			--	
Duration of ESE	2.5					75				

Course Objectives	Understand basics of Cryptography and Cyber Security
	Discuss security of a message over insecure channel by various means
	Describe how to maintain the Confidentiality, Integrity and Availability of a data.
	Assess the various cryptocurrencies characteristics and basics of IP security with key management.
Course Outcomes	**On the successful completion of the course, students will be able to**
	CO1:Describe security of the data over the network.
	CO2:Discuss the applications cryptography and cyber security.
	CO3:Understand security issues in Wireless LAN and web.
	CO4:Implement the Algorithms for with various cryptocurrencies.
	CO5:Analysis of IP Security & Key Management.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	3							2	1
CO2	2	3	3	2	2	2							2	1
CO3	2	3	3	1	2	3							2	1
CO4	2	3	3	3	2	2							2	1
CO5	2	3	3	3	2	3							2	1

Unit	Contents	Hours
I	**UNIT I - Introduction to Cryptography and Block Ciphers** Introduction to security attacks - services and mechanism - introduction to cryptography -Conventional Encryption: Conventional encryption model - classical encryption techniques -substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and block ciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion and diffusion - Fiestal structure - data encryption standard(DES) - strength of DES - differential and linear cryptanalysis of DES - block cipher modes of operations - triple DES – AES.	**8**
II	**Unit II - Confidentiality and Modular Arithmetic** Confidentiality using conventional encryption - traffic confidentiality - key distribution – random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.	**8**
III	**Unit III - Public key cryptography and Authentication requirements** Principles of public key crypto systems - RSA algorithm - security of RSA - key management –Diffie-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography –Elgamal encryption - Message Authentication and Hash Function: Authentication requirements -authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.	**8**
IV	**Unit IV- Integrity checks and Authentication algorithms with Cryptocurrencies** MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME. **Cryptocurrencies:** History, A basic crypto currency, Creation of coins, Payments and double spending, Bitcoin – Digital Signatures as Identities – eWallets – Personal Crypto security - Bitcoin Mining	**8**
V	**Unit V -IP Security and Key Management** IP Security: Architecture - Authentication header - Encapsulating security payloads – combining security associations - key management. Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principles – trusted systems.	**4**
Text Books	William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI.	
	Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.	
Reference Books	W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.	
	Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.	
Video Lectures	http://nptel.ac.in/courses/106105031/lecture by Dr. Debdeep Mukhopadhyay IIT Kharagpur https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/ lecture by Prof. Robert Morris and Prof. Samuel Madden MIT.	

Course Title: Operation Research (Elective-III)-UDSL433										
Semester:	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term:	**ODD**	**TH**	**TU**	**PR**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category:	**EL**	**3**	**---**	**--**	**3**	**10**	**15**	**50**	**--**	**--**
Course Code:	**UDSL433**									
Teaching Mode:	**Offline**	**3**			**Total**	**75**			**--**	
Duration of ESE:	**2.5**					**75**				

Course Objectives	Identify a real-world problem as a mathematical programming model
	Describe specialized linear programming problems like the transportation and assignment problems.
	Understand how to model and solve problems using dynamic programming
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1:Show linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
	CO2:Summarize construct linear integer programming models and its solution techniques
	CO3:Determine optimal strategy for Minimization of Cost of shipping of products from source to Destination.
	CO4:Discuss fundamental of simulations
	CO5:Develop mathematical skills to analyze and solve network models arising from a wide range of applications

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		3		3					3			3	
CO2	2	2	2	3	3									2
CO3	2	2	1			3							3	
CO4	2									3				
CO5	2													

Course Contents:

Unit	Contents	Hours
I	**Overview of Operations Research:** Origin of OR and its definitions, OR with special emphasis on interdisciplinary and system approach, Orientation-iconic, analogue and mathematical models	**8**
II	**Linear Programming and its Applications:** Vector spaces, Basis, Linear transformations, Convex sets, Extreme points and convex polyhedral sets Theory of Simplex method, Simplex Algorithm, Degeneracy, Duality theory, primal dual algorithms, Transportation problems, Assignment problems, Sensitivity analysis.	**8**
III	**Graphical Analysis of Linear Programming Problems:** Introduction, Graphical Analysis, Some Basic Definitions, Graphical Methods to Solve LPP, Some Exceptional Cases, Important Geometric Properties of LPP	**8**
IV	**Simulation:** Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation, Monte-Carlo Simulation	**8**
V	**Project Scheduling and PERT-CPM:** Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT	**4**
Text Books	Ravindran, Philips, Solberg, Operations Research Principles and Practices, Wiley India Edition	
	J. K. Sharma: Fundamentals of Operations Research, Macmillan.	
Reference Books	H. A. Taha, Operations Research –An introduction, PHI	
	KantiSwarup, P. K. Gupta and Man Mohan, Operations Research- An Introduction, S. Chand & Company.	
Online TL Material	https://nptel.ac.in/courses/110106062	

Course Title : Evidence Acquisition & Recovery (UDSL434)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**		
Course Code	**UDSL434**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Introduces general idea, structure and functions of Evidence collection and admissibility
	Introduces general idea, structure and functions of Indian Laws CrPC, Evidence Act, IPC, and ITA200
	Making students aware of Evidence acquisition and recovery
Course Outcomes	**Students will be able to**
	Understand and apply the basic concepts of Forensics to acquire and recover evidence.
	Illustrate Practical the importance of Evidence admissibility in court.
	Understand and apply various stages of evidence life cycle in evidence collection and recovery.
	Understand the role of Law in establishing Evidence admissibility.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**Indian Laws for Criminal Investigation:** CrPC 1973 (amendment 2022), Evidence Act 1872, IPC 1860, ITA2000	4
II	**Searches and Seizures of Computers and Electronic Evidence:** What Is Privacy and Why Is It Important? Constitutional Source of Privacy Protection: The Fourth Amendment Search Warrants Searching a Computer for Evidence, Amendments in CrPC **Digital Evidence in the Courtroom:** Duty of Experts, Admissibility, Level of Certainty in Digital Forensics, Direct vs Circumstantial Evidence, scientific evidence, presenting digital evidence	8
III	**Preparing for Digital Investigations:** Understanding Law Enforcement Agency Investigations, Following Legal Processes, Understanding Private-Sector Investigations **Handling a Digital Crime scene:** published guidelines for handling Digital Crime scenes, Fundamental principles, preparing to handle Digital Crime scenes, surveying the Digital Crime scene, preserving the Digital Crime scene	8
IV	**Data acquisition:** Understanding Storage Formats for Digital Evidence Raw Format Proprietary Formats, Advanced Forensic Format. Determining the Best Acquisition Method Contingency Planning for Image Acquisitions Using Acquisition Tools. Network Acquisition Tools Remote Acquisition with ProDiscover Remote Acquisition with EnCase Enterprise Remote Acquisition with R-Tools R-StudioRemote Acquisition with WetStone US-LATT PRO Remote Acquisition with F-Response Using Other Forensics Acquisition ToolsPassMark Software ImageUSB ASR Data SMART Runtime Software ILookIX IXImager, SourceForge	8
V	**Digital Evidence on Different System:** Digital Evidence on Windows systems: File systems, Data recovery, log Files, Registry, internet traces,program Analysis, Digital Evidence on UNIX systems, UNIX Evidence Acquisition Boot Disk, File systems overview of Digital Evidence processing tools.	8
Text Books	Computer Forensics and Investigations (5th Edition). By Bill Nelson, Amelia Phillips, Christopher Stuart, 2016.	
	Computer Forensics and Cyber Crime: An Introduction (3rd Edition). By Marjie T. Britz, 2013.	
Reference Books	A Practical Guide to Computer Forensics Investigations (2nd Edition). By Darren R. Hayes, 2019.	

Course Title : Programming for Analytics (UDSL435)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**		
Course Code	**UDSL435**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	This course is used to provide an Introduction to R programming language that combines standard programming capabilities with statistical analysis.
COURSE OUTCOMES	Analyze data using the statistical tool R.
	Create vectors, lists, matrices, arrays and data frames using R.
	Create array, data frame using R
	Understand the looping and control flow in R language.
	Draw charts and graphs using R.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	INTORDUCTION: Features of R – How to install and run R – Comments in R – Reserved words – Identifiers – Constants – Variables – Operators (Arithmetic, Relational, Logical, Assignment, Miscellaneous Operators) – Operator Precedence – Strings.	4
II	Basic Data Types, Vectors, Lists and Matrices: Basic Data Types (Numeric, Integer, Complex, Logical, Character) – Creating, combining vectors – Accessing Vector Elements – Modifying Vectors – Deleting Vectors- Vector arithmetic and Recycling – Vector Element Sorting – Reading Vectors – Creating Lists –Accessing List elements – Updating List Elements –Merging Lists – List to Vector conversion – Creating matrices – Accessing Matrix Elements – Matrix Arithmetic – Matrix Manipulation – Matrix Operations.	8
III	Arrays, Factors and Data Frame: Creating Arrays – Accessing Array Elements – Array Element Manipulation – Array Arithmetic – Creating factors – Accessing Factor Components – Modifying factors – Creating Data Frames – Accessing Data Frames Components – Modifying Data Frames –Aggregating Data – Sorting Data – Merging Data – Reshaping data – Sub-setting data – Data Type Conversion	8
IV	Flow Control & Functions: Decision making (using if statement - if…else statement - Nested If…Else statement - if-else-function - Switch statement) – Loops (for loop – while Loop – repeat Loop) – Loop Control statements – break statement – next statement – Function definition and Function Calling – Function without arguments – Built-in functions (Mathematical functions – Character functions – statistical functions – date and time functions – other functions – Recursive function)	8
V	Charts & Graphs: Bar charts (Plotting bars vertically and horizontally – Plotting categorical data – Grouped bar chart – Stacked bar chart) – Histogram (Simple histogram – Histogram with labels, breaks and density lines) – Line graphs (Simple line graph & Graphs with Multiple lines) – Pie charts (Simple Pie chart –Pie chart with slice percentages – 3D Pie charts)	8
Text Books	W. N. Venables, D. M. Smith, An Introduction to R, R Core Team, 2018.	
	John Verzani, simpleR – Using R for Introductory Statistics, CRC Press, Taylor & Francis Group, 2005	
Reference Books	Beginner's guide for Data Analysis using R Programming by Dr. Jeeva Jose.	
Online TL Material	www.selfinvestors.com (Market commentary	

Course Title : Industrial and Medical IoT (UDSL436)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**DS**	**3**	**-**	**--**	**3**	**10**	**15**	**50**		
Course Code	**UDSL436**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Differentiate between IoT and IIoT
	Describe IoT perspective in thinking and building solutions
	Discuss the tools and techniques that enable IoT solution and Security aspects
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1: Describe the basic concepts of IoT/IIoT and its differences.
	CO2: Discuss the solution for real time application i.e. e-Health Body Area Networks, Home Automation.
	CO3:Classify IoT protocols and software for Medical IoT.
	CO4:Assess the existing hardware platforms and sensor interfaces for various healthcare-based Applications.
	CO5: Design and develop IoT based applications in Industry and healthcare using IOT based approach.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	3							2	1
CO2	2	3	3	2	2	2							2	1
CO3	2	3	3	1	2	3							2	1
CO4	2	3	3	3	2	2							2	1
CO5	2	3	3	3	2	3							2	1

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Basics of IOT, what is Industrial IOT, differentiate between IOT and IIOT, Evolution of IIOT, Components – Types of Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends & future Real-life examples, Key point – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation. Importance of Industrial IOT in Manufacturing Processes. Use of IIOT in plant maintenance, Sustainability through Business excellence tools. Pro's and con's in implementing IIOT, Application in health care systems	**8**
II	**Architectures:** Summary of IOT components, Architectures of Industrial IOT, Advantages & limitations, Architecture of Industrial Internet, various components of IIOT : Routers, Modem, Cloud brokers, Sensors, Gateways, servers and its integration, Wireless Sensor Networks and its design for IOT	**8**
III	**Sensor and Interfacing:** Basics of sensors and actuator, characteristics of sensors in IIOT, Transducers, classification, sensor architecture, Types of sensors and actuators, Interfacing of sensors, Requirements of IIOT sensors, Characteristics of actuators. Protocols in IIOT: BACNet, Ethernet, HART, MODBUS etc. Fundamentals of CC3100 SDK: recognize the important APIs. Discuss Energia Wi-Fi libraries. Requirements for MIOT sensors.	**8**
IV	**Protocols and Cloud:** Needs and Types of protocols, Zigbee, Z wave, SPI, I2C, Wi-Fi, Wi-Fi direct, BACNet, IIOT protocols: CoAP, MQTT and AMQP. IIOT cloud platforms: Cloud or Edge IIoT Platform, predix, thing works, azure etc. Data analytics, cloud services. **Internet of Medical Things Introduction and System:** Introduction, IoMT Devices-On-Body Devices, In- Home Devices, Community Devices, In-Clinic Devices, In-Hospital Devices, IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer.	**8**
V	**IOT Analytics and Applications:** Role of Analytics in IOT, Data visualization Techniques, Statistical Methods, introduction to R programming. IoT Applications: Smart Metering, City Automation, Automotive Applications ,e-Health Body Area Networks, Home Automation, Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector.	**4**
Text Books	Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer	
	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications	
	HakimaChaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications	
Reference Books	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications	
	Inside the Internet of Things (IoT), Deloitte University Press	

Course Title : Finance Analytics (UDSL441)-Elective IV										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL441**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	To provide a strong foundation in financial analytics in order to handle complex financial data, build advanced analytical models and deliver effective visualization product and comprehensive reports.
Course Outcomes	**At the end of the course the student should be able to**
	Analyze and model financial data
	Construct and optimize asset portfolios
	Evaluate and model Risk on various financial assets
	Use the most powerful and sophisticated routines in R for analytical finance.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**R in Finance:** R computations, data structures, financial, probability, and statistics calculations, visualization. Documentation with R Markdown. Functions, loops, control bootstrapping, simulation, and more visualization.	4
II	**Macro-financial Analysis:** Descriptive Analytics, Data from FRED, Yahoo, and other sources, Empirical characteristics of economic and financial time series. Boostrapping confidence intervals	8
III	**Market Risk:**Risk Measures, Quantile (i.e., Value at Risk) and coherent (i.e., Expected Shortfall) risk measures, Portfolio Loss and Capital Requirements, Historical and General Pareto Distribution estimation and simulation for portfolio capital measurement	8
IV	**Portfolio Analytics:** Cash and Risky Asset, Risk tolerances, thresholds and the allocation of collateral and risky asset, Tangency Portfolio, Minimum variance, tangency, and optimal allocation with multiple risky assets and quadratic programming.	8
V	**Enterprise Risk Analytics:** Enterprise Risk Simulation • Specifying and simulating enterprise risk scenarios as a portfolio with quantile and coherent risk measures. Build an interactive financial web application using all of the finance and R platform tools	8
Text Books	[Teetor] Paul Teetor. 2011. R Cookbook. O'Reilley: Sebastopol, CA	
	William G. Foote. 2017. Financial Engineering Analytics: A Topical Manual Using R	
	[Ruppert and Matteson] David Ruppert and David S. Matteson. 2014. Statistics and Data Analysis for Financial Engineering, Second Edition, Springer	
Reference Books	[Brealey, et al.] Richard Brealey, Stewart Myers, and Franklyn Allen, 2015. Principles of Corporate Finance, various editions, McGraw-Hill.	
	[McNeil, et al.] Alexander McNeil, Rudiger Frey, and Paul Embrechts, 2015. Quantitative Risk Management: concepts, Techniques, and Tools Princeton, 2014.	

Course Title : Deep Web & Darknet (UDSL442)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL442**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Perform security self-assessments by understanding Deep web and darknet.
	Understand the Differentiate between deep, dark, and surface web.
	Understand laws, regulations, and privacy considerations.
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1:Understand the concept of deep web and Dark Net
	CO2:Illustrate basics of deep, dark and web and law, regulations related to its privacy concern.
	CO3:Evaluate the security concern and risk involved in Darknet
	CO4: Understand and analyze the ethical and legal considerations associated with Darknet activities.
	CO5:Implement effective security measures to protect personal information in Darknet environments,

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2	2							2	2	1
CO2	2	3	3	2	3								2	1
CO3	2	3	3	1	2	3		3					2	1
CO4	2	3	3	3	3								2	1
CO5	2	3	3	3	2			1				2	2	1

Course Contents:

Unit	Contents	Hours
I	Unit 1: Introduction to the Deep Web and Darknet: Overview of the Deep Web, Definition of the Deep Web, Differences between the Deep Web and Surface Web, Understanding the size and scope of the Deep Web, Introduction to the Darknet, Key technologies used in the Dark net (e.g., Tor, I2P),Common misconceptions and myths about the Darknet, Anonymity and Privacy, Risks and challenges associated with maintaining anonymity	**6**
II	Unit 2: Navigating the Darknet: Accessing the Darknet, Setting up and configuring the Tor browser Alternative methods for accessing the Darknet (e.g., I2P),Darknet Marketplace, Types of goods and services available on Darknet marketplace, Understanding the escrow system and cryptocurrencies (e.g., Bitcoin),Hidden Services and Onion Sites, Identifying and exploring Onion sites	**8**
III	Unit 3: Deep Web Security and Risks: Darknet Threat Landscape: Common cyber threats and risks in the Darknet, Malware, scams, and phishing techniques Dealing with illegal activities and law enforcement risk, OpSec (Operational Security), Importance of OpSec in the Darknet, Techniques for maintaining online anonymity and security, Challenges and limitations in investigating Darknet activities	**8**
IV	Unit 4: Ethical and Legal Considerations: Ethical Implications of the Darknet, Debates surrounding anonymity, privacy, and freedom of speech, ray areas and ethical dilemmas in Darknet usage, Legal Frameworks and Jurisdiction, International legal perspectives on the Darknet, Challenges in prosecuting Darknet-related crimes, Case studies of high-profile legal actions, Emerging Technologies and Counter measures: innovation and law enforcement.	**8**
V	Unit 5: Darknet Security and Defence: Darknet Security Measures, Steps to protect personal information and data Secure communication protocols and encryption methods, Implementing multi-factor authentication and strong passwords Threat Intelligence and Monitoring, Understanding threat intelligence in the Darknet, Tools and techniques for monitoring Darknet activities, Responding to potential threats and vulnerabilities, Darknet Defence Strategies: Implementing network and system-level defences ,Incident response and recovery in Darknet environments	**6**
Text Books	Montgomery, Douglas C., Introduction to Statistical Quality Control, 5th edition, John Wiley &Sons, 2004	
	Juran, J. M. and Gryna, F. M., Quality planning and analysis, McGraw Hill, 3rd Ed., 1993.	
Reference Books	The dark web: breakthroughs in research and practice, Resourse management Association, IGI global	
	Dark Web: Exploring and Data Mining the Dark Side of the Web, Hasinchun Chen, Springer	
Online TL Material	https://www.fortinet.com/products/sase	
	https://www.sans.org/white-papers/37012/	
	https://www.deepdotweb.com/2016/05/09/tor-viable-alternative/	
	https://www.fortinet.com/products/sase	
	https://www.fortinet.com/products/sase	

Course Title: Quantum Computing (UDSL443)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL443**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Understand basic concepts of quantum computing
	Discuss and learn quantum search algorithms.
	Implement quantum information for solving real world problem
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1:Understand the quantum mechanism and algorithms.
	CO2:Implement simple quantum algorithms and information channels in the quantum circuit model
	CO3:Assess simple quantum error-correcting code
	CO4:Analyze about quantum information channels
	CO5:Design and simulate the quantum circuit

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2								2	1
CO2	2	3	3	2	2								2	1
CO3	3	3	3	1	3								2	1
CO4	2	3	3	3	2								2	1
CO5	2	3	3	3	3								2	1

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Overview, Quantum computation, algorithm, mechanics of quantum, postulates of quantum mechanics	**8**
II	**Quantum computation:** Quantum circuits, the Fourier transform of quantum and its applications, search algorithms, physical realization of Quantum computers	**8**
III	**Quantum information:** Distance measurement, error-correction, Noise and operations, Entropy and information, Quantum information concept and theory	**8**
IV	**Background Mathematics and Physics:** Hilber space, entanglement, measurements and Probabilities, density correlation and operators, quantum mechanics details, Measurements in quantum bases other than computational basis.	**8**
V	**Quantum Circuits:** Single and multiple qubit gates, quantum circuits design.	**4**
Text Books	Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", ISBN: 9780521635035.	
	Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008.	
Reference Books	N. David Mermin, "Quantum Computer Science", Cambridge 2007	
	Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.	
	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.	

Course Title: Cyber Forensics and Cyber Defense (UDSL454)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**DS**	**3**	**-**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	UDSL454									
Teaching Mode	**Offline**	**2**			**TOTAL**	**75**			**--**	
Duration of ESE	**2**					**75**				

Course Objectives	Introduces general idea, structure and functions of Cyber and digital Forensics
	Introduces general idea, structure and functions of designing and executing Cyber defense strategies
	Making students aware of Cyber Forensic tools.
	Making students aware of Cyber Laws (International and Indian).
	Making students aware of how to use different cyber defense strategies and tools.
Course Outcomes	**Completion of this course will enable students to**
	Understand and apply the basic concepts of Cyber Forensics and Cyber defense.
	Illustrate Practical Use of various cyber forensic tools to investigate the cyber space.
	Understand and apply various Cyber defense tools and strategies.
	Understand the role of Law in Cyber defense and how to use it.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2	2	3							2	1
CO2	2	3	3	2	2	2							2	1
CO3	2	3	3	1	2	3							2	1
CO4	2	3	3	3	2	2							2	1
CO5	2	3	3	3	2	3							2	1

Unit	Contents	Hours
I	**Introduction**: Cyber Crime- Overview, Internal and External Attacks, Online and offline attacks. Cybercrimes against Individuals – E-mail spoofing and other online frauds, Phishing and its forms, Spamming, Cyber defamation, Cyberstalking and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Cybercrime against organization – Unauthorized access of computer, Denial-of service (DOS) attack,	**8**
II	**Cyber Attacks**: Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet	**8**
III	**Transaction Security**: Securing a transaction: Encryption, digital signatures, virtual private networks, Internet fraud, Identity theft, Industrial, espionage, Cyber terrorism, Security hardware and software, intrusion detection for securing networks, Biometric-based security issues and challenges. PGP, Two factor authentication	**6**
IV	**Network Defense Tools**: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Statefull Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System, DMZ,	**8**
V	**Cyber Crime and Law**: Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Chain of custody, Digital evidence Indian Penal Code, Criminal Procedure Code, Information Technology Act2000	**8**
Text Books	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley	
Reference Books	Information Security policies and procedures: A Practitioner's Reference Thomas R. Peltier Prentice Hall	
	Cyberlaw: the Law of the Internet Jonathan Rosenoer Springer-Verilag	

Course Title : Text Processing(UDSL445)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**-**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL445**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objective	Be able to work with typography and grids in layout design
	Efficiently use various colour modes
	Have the ability to record an action and create rollover states
Course Outcomes	**On the successful completion of the course, students will**
	Develop Language Modelling for various text corpora across the different languages
	Design and develop applications for text or information extraction/summarization/classification
	Illustrate computational methods to understand language phenomena of word sense disambiguation
	Apply different Machine translation techniques for translating a source to target language(s)
	Develop Language Modelling for various text corpora across the different languages

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**Introduction to NLP:** NLP & its Challenges, History of NLP, Advantages of NLP, Disadvantages of NLP, Components of NLP, Applications of NLP, NLP pipeline, Phases of NLP, NLP APIs, NLP Libraries,	8
II	**Language Modelling and Part of Speech Tagging:** Unigram Language Model, Bigram, Trigram, N-gram, Advanced smoothing for language modelling, Empirical Comparison of Smoothing Techniques, Applications of Language Modelling, Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition	8
III	**Words and Word Forms:** Bag of words, skip-gram, Continuous Bag-Of-Words, Embedding representations for words Lexical Semantics, Word Sense Disambiguation, Knowledge Based and Supervised Word Sense Disambiguation.	8
IV	**Text Analysis, Summarization and Extraction:** Sentiment Mining, Text Classification, Text Summarization, Information Extraction, Named Entity Recognition, Relation Extraction, Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR, Text Normalization: Basic pre-processing, Word and sentence segmentation, Lemmatization, Stemming, Morphology.	8
V	**Machine Translation:** Need of MT, Problems of Machine Translation, MT Approaches, Direct Machine Translations, Rule-Based Machine Translation, Knowledge Based MT System, Statistical Machine Translation (SMT), Parameter learning in SMT (IBM models) using EM), Introduction to Transformer, Encoder-decoder architecture, Neural Machine Translation	4
Reference Books	1.Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition Jurafsky, David, and James H. Martin, PEARSON 2. Foundations of Statistical Natural Language Processing, Manning, Christopher D., and Hinrich Schütze, Cambridge, MA: MIT Press	

Course Contents:

Course Title : AWS: Cloud Computing and Security (UDSL444)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**--**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL444**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Discuss enabling technologies and main building blocks of Cloud Computing.
	Describe the different operations in AWS cloud.
	Illustrate the different type of storage technologies.
	Summarize the solutions to prevent the storage concern.
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1: Understand and the compute services available in AWS
	CO2: Define methods of deploying and operating in the AWS Cloud
	CO3: Analyze the data from Amazon using Standard SQL
	CO4: Configure and Implement the load balancing in cloud
	CO5: Design and configure the server less cloud and data encryption using AWS

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**1**	**2**	**2**	**2**							**2**	**2**
CO2	**2**	**3**	**3**	**3**	**3**								**2**	**1**
CO3	**2**	**3**	**3**	**3**	**3**								**2**	**1**
CO4	**3**	**3**	**3**	**3**	**3**							**2**	**2**	**1**
CO5	**3**	**3**	**3**	**3**	**3**							**2**	**2**	**1**

Course Contents:

Unit	Contents	Hours
I	**Fundamentals of AWS Cloud Computing:** Introduction, Architecture, Models, Amazon Web Services Introduction, AWS Global Infrastructure, Comparison with GCP (Google Cloud Platform) & Microsoft Azure. **Elastic Compute Cloud:** Introduction to EC2 instance ,EC2 instance types & Pricing Models , Creating AMI and Image Templates , Understanding Security Groups - a Server side Firewall	**8**
II	**Virtual Private Cloud:** Virtual Private Cloud, Subnets, Private and Public Subnets, Internet Gateways, Peering & NAT Gateways, VPN Setup, IP Addressing in AWS. Tortoise SVN.	**8**
III	**Storage:** Introduction, Storage Types , Static Website Hosting , Versioning , Life Cycle Policy , Cross Region Replication , Encryption , Basics of Athena ,Introduction to EFS , Connect a drive via network , Share the drive among multiple servers.	**8**
IV	**Elastic Load Balancers and Elasticity:** Understanding High Availability Configuration, ELB Configuration with Classic and Application Load Balancers, Auto Scaling, Relational Databases Introduction, Database structure in MySQL, DynamoDB.	**4**
V	**Serverless Computing:** Lambda, setting up Server Auto Start with a Lambda Function, Elastic Beanstalk, Host a Sample PHP website using Elastic Beanstalk. **AWS CLI and SDK:** Getting Started with AWS CLI , AWS CLI setup on EC2 instances , Connect EC2 instance with other AWS services like S3 or SNS or SES **AWS Encryptions :**AWS Security , KMS Overview , SSM Parameter Store , CouldHSM	**8**
Text Books	Data Communication & networking: Forouzan, B. A.	
	Data and Computer Communications, W. Stallings TMH Publications	
	Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, Brian J.S. Chee and Curtis Franklin CRC Press, ISBN :9781439806128	
Reference Books	Mastering Cloud Computing: Foundations and Applications Programming, Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi	
	Distributed and Cloud Computing, From Parallel Processing to the Internet of Things,Kai Hwang, Geoffrey C Fox, Jack G Dongarra	

Course Title : Next Generation Databases (UDSL451)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**1**	**2**	**5**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL451**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**-**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
	Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.
Course Outcomes	Explain the detailed architecture, Database properties and storage requirements
	Differentiate and identify right database models for real time applications
	Outline Key value architecture and characteristics
	Design Schema and implement CRUD operations, distributed data operations
	Compare data ware housing schemas and implement various column store internals

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**INTRODUCTION TO NOSQL CONCEPTS:** Data base revolutions: First generation, second generation, third generation, Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with Data base sharding, Brewers CAP theorem.	**8**
II	**NOSQL DATA ARCHITECTURE PATTERNS:** NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to Data nodes	**8**
III	**KEY VALUE DATA STORES:** From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Architecture and implementation Terms, Designing Structured Values, Limitations of KeyValue Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration	**8**
IV	**DOCUMENT ORIENTED DATABASE:** Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: Mongo DB and/or Cassandra	**8**
V	**DATA MODELING WITH GRAPH:** Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection	**4**
Text Books	Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, An introduction to Information Retrieval, Cambridge University Press	
	Daniel Abadi, Peter Boncz and Stavros Harizopoulas, The Design and Implementation of Modern Column-Oriented Database Systems, Now Publishers.	
Reference Books	Guy Harrison, Next Generation Database: NoSQL and big data, Apress.	

Course Contents:

Course Title : No SQL using MongoDB (UDSL452)-Elective-V										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**1**	**2**	**5**	**10**	**15**	**50**	**25**	**25**
Course Code	**UDSL452**									
Teaching Mode	**Offline**				**Total**	**75**			**50**	
Duration of ESE	**2.5**					**125**				

Course Objectives	Distinguish the different types of NoSQL databases
	Familiarize with NoSQL database Technology
	State the CAP theorem and explain it main points
Course Outcomes	**Upon successful completion of this course, student will be able to:**
	CO1: Understand different types of NoSQL Databases, mongodb architecture and data modeling.
	CO2: Understand and analyze the MongoDB & CRUD commands
	CO3: Demonstrate and analyze working of Indexing , Pipeline and Database operation.
	CO4: Understand and demonstrate replication in mongodb
	CO5: Understand and apply advanced mongodb concepts

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	-	2	-	-	-	-	-	3	2	1
CO2	3	3	-	2	-	2	-	-	-	-	-	3	2	1
CO3	3	3	3	2	3	2	-	-	-	-	-	3	2	1
CO4	3	3	3	2	-	1	-	-	-	-	-	3	2	1
CO5	3	3	3	3	3	3	-	-	-	-	-	3	2	1

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Introduction to NoSQL Databases. NoSQL features, Different types of NoSQL, databases. Introduction to MongoDB: MongoDB architecture, Data modelling in MongoDB, Advantages of MongoDB over RDBMS, Mongo Shell, Configuration file in MongoDB. **Database features**: Choosing the right database , Database era, Taking decisions on database , Strengths and weakness of database , Free and open source database	**8**
II	**Documents and collections:** JSON File format for storing documents Introduction to Documents, Collections, Database Commands in Mongodb, Inserting and Saving Documents, Inserting multiple documents **CRUD Operation**: Updating Documents , Removing Documents , Document Replacement , Operator and Modifiers	**8**
III	**Indexing:** Indexing in MongoDB, Single index, Finding index, Multikey index Aggregation: Aggregation Framework, Pipeline Operations-: match, sort, group **Pipeline operations**: Pipeline Operations- project, limit, skip, Map Reduce, Aggregation commands **Database operations** : Backup and restore., Export and import of data, Importing from JSON file	**8**
IV	**Replication** , Advantages of replication , Implementation of replication , Managing Configuration File in MongoDB , Setting up replica set in MongoDB, MongoDB Sharding.	**8**
V	**Advanced MongoDB :** MongoDB - Relationships, MongoDB - Covered Queries, MongoDB - Analyzing Queries, , MongoDB - Advanced Indexing, MongoDB-MapReduce MongoDB Text Search .	**4**
Text Books	Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.	
Online TL Material	https://www.ibm.com/cloud/learn/nosql-databases	
	https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp	
	https://www.geeksforgeeks.org/introduction-to-nosql	

Sr. No.	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1,PSO2
1	Downloading and Installation of MongoDB Setting path in environment variable.	CO1	PO1 , PO2, PO5	PSO1
2	Identify MongoDB environment using Mongo Shell and Configuration file in MongoDB	CO1	PO1 , PO2, PO5	PSO1
3	Create a database and collection using the MongoDB environment. For example, a document collection meant for analyzing Restaurant records can have fields like restaurant_id, restaurant_name, customer_name, locality, date, cuisine, grade, comments. etc.	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1
4	Create Database , document , collection and apply CRUD operations on it	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1
5	Create index on emp_id in collection emp_professional_details and Create multiple index on emp_id, emp_name in collection emp_professonal details.	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1
6	Demonstrate unwind command, skip command, limit command	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1
7	Study implementation of replication in MongoDB	CO4	PO1 , PO2, PO3, PO4, PO5	PSO1
8	Create backup of collections, Delete some records and then restore them from backup.	CO4	PO1 , PO2, PO3, PO4, PO5	PSO1
9	Implement MongoDB MapReduce	CO5	PO1 , PO2, PO3, PO4, PO5	PSO1
10	Implement MongoDB Text Search	CO5	PO1 , PO2, PO3, PO4, PO5	PSO1 , PSO2

Course Title: Virtual Reality (UDSL455)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**1**	**2**	**5**	**10**	**15**	**50**		
Course Code	**UDSL455**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Be able to work with typography and grids in layout design
	Efficiently use various colour modes
	Have the ability to record an action and create rollover states
Course Outcomes	**On the successful completion of the course, students will**
	Develop creativity in advertising
	Understand the basics of typography, grids in layout design, colour modes
	Describe the design concepts of Virtual Reality
	Develop creativity in advertising
	Implement a Smart filer using VR principles

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**Types of advertising:** Broadcast media - print media - social media - Basic elements of visual design - Principles of visual design - Creating - Headlines and Body content - Pre-press technology and Post-press technology- Prepress processes - Press - Post press technology	8
II	**Grids in layout design:** Anatomy of a grid - Types of layout design - Mixed design - Design process - Brand Management - Branding - Brand identity design - Design thinking process	8
III	**Designing for VR:** Visual aid - UI depth and eye strain - Constant velocity - Maintaining head tracking - Guiding with light - Leveraging scale - Spatial audio - Gaze Cues Image Size and resolution - Pixel density - Eye buffers - Optimal resolutionCreating Panoramic Images	8
IV	**Color Modes:** Changing color mode - Type tool options - Work path from type – Layers panel - Types of layers - Features of layers - Shape tools and Painting Tools - Brush tools - Gradient tools - Effects panel - Graphics panel - Photo effects	8
V	**Filter Gallery:** Applying filters - Smart filters - Channels panel - Actions panel – Change settings - Exclude commands - Inserting a non-recordable menu command - Batch command - Rollovers - Creating buttons - Make layer duplicates - Create rollover states 360-degree illustrations for VR - Panorama – Planning and drawing 360-degree illustration - Exporting for VR	4
Text Books	Karl Aspelund, "The Design Process", 3rd Edition, 2014	
	Brian Wood, "Adobe Illustrator CC Classroom", 1st Edition, 2019	
Reference Books	Joseph A. Gatto, "Exploring Visual Design: The Elements and Principles", 2010	

Course Title : Machine Learning with Tensor flow (UDSL452)-Elective-V										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**1**	**2**	**5**	**10**	**15**	**50**	**25**	**25**
Course Code	**UDSL452**									
Teaching Mode	**Offline**				**Total**	**75**			**50**	
Duration of ESE	**2.5**					**125**				

Course Objectives	Establish and cultivate a broad and comprehensive understanding of important library used for Machine Learning Algorithms.
	Describes the fundamentals of sensation, perception, technical and engineering aspects of machine learning based systems.
	Summarize the aspects for betterment of existing technology using machine learning.
Course Outcomes	CO1: Understand fundamental of Machine learning and Tensorflow
	CO2: Apply the preprocessing steps to make data usable using TensorFlow
	CO3: Use prediction feature with Tensorflow
	CO4: Understand fundamentals of Protocol buffers.
	CO5: Build Machine learning based models using Tensorflow.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

Course Outcome	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3										3	
CO2	3	3	3		3									3
CO3	3	3	3											3
CO4	3	3	3										3	
CO5	3	3												

UNIT	CONTENTS	HOURS
I	**Getting started with machine learning and Tensorflow:** Introduction to Machine learning, Fundamentals of Machine learning, Types of Machine Learning, Introduction to Tensorflow, Ensuring that TensorFlow works, Representing tensors, Tensor types, Creating operators, Executing operators with sessions, Understanding code as a graph, Setting session configurations, Writing code in Jupyter, Using variables, Saving and loading variables, Visualizing data using TensorBoard.	9
II	**Loading and Preprocessing Data with TensorFlow** The Data API, Chaining Transformation, Shuffling the data, Preprocessing the data, putting everything together, prefetching, using the data with TF. Keras, TF record format, compressed TF record files.	7
III	**Prediction with Tensorflow** Train, tune and use time series, sequence and prediction models. Train models to predict values for both univariate and multivariate time series, prepare data for time series learning, Understand Mean Absolute Error (MAE) and how it can be used to evaluate accuracy of sequence models, Use RNNs and CNNs for time series, sequence and forecasting models.	7
IV	**Protocol Buffers** A Brief Introduction to Protocol Buffers, TensorFlow Protobufs, Loading and Parsing Examples, Handling Lists of Lists Using the Sequence Example Protobuf, The Features API, Categorical Features, Crossed Categorical Features, Encoding Categorical Features Using One- Hot Vectors, Encoding Categorical Features Using Embeddings, Using Feature Columns for Parsing, Using Feature Columns in Your Models.	7
V	**TF Transform** The TensorFlow Datasets (TFDS) Project	6
Text Books	Machine Learning with Tensor Flow NISHANT SHUKLA WITH KENNETH FRICKLAS	
	Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow	
Reference Books	Deep Learning with TensorFlow 2nd edition by Giancarlo Zaccone.	
	Pro Deep Learning with TensorFlow A Mathematical Approach to Advanced Artificial Intelligence in Python	
	Learn TensorFlow 2.0, Implement Machine Learning and Deep Learning Models with Python	
e-Books	https://www.tensorflow.org/text/tutorials/text_generation	

Sr. No	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1,PSO2
1	Study the Installation procedure of TensorFlow and Data Flow Graphs	CO1	PO1 , PO2, PO5	PSO1
2	Write a program to create tensors using different functions	CO1	PO1 , PO2, PO5	PSO1
3	Demonstrate loading and preprocessing of datasets	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1
4	Perform compression of the data with tf.keras	CO2	PO1 , PO2, PO3, PO4, PO5	PSO1
5	Perform the Time Series Forecasting with RNNs	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1
6	Perform prediction using time series or sequential data.	CO3	PO1 , PO2, PO3, PO4, PO5	PSO1
7	Study and Parse data from serialized protocol buffers.	CO4	PO1 , PO2, PO3, PO4, PO5	PSO1
8	Perform One-Hot Encoding For Multi Categorical Variables.	CO4	PO1 , PO2, PO3, PO4, PO5	PSO1
9	Design a model for image to image translation using TFDS	CO5	PO1 , PO2, PO3, PO4, PO5, PO11	PSO1
10	Design a real time model for sentimental analysis using TFDS	CO5	PO1 , PO2, PO3, PO4, PO5,PO11	PSO1 , PSO2
Open Ended Experiments / New Experiments				
1.	Build a TensorFlow object detection model using any SSD model that detect all the classes of COCO dataset (80 classes) using the webcam and deploy it.(Real-time stream)			
2.	Build a TensorFlow real time mask detection model (custom object detection) using Label-Img tool.(Real-time stream)			
Details of Online Laboratory Resource Material Instruction / Operating Manuals				
1.	https://www.tutorialspoint.com/tensorflow/tensorflow_installation.html			
2.	https://www.tensorflow.org			
3.	https://www.udemy.com/course/complete-guide-to-tensorflow-for-deep-learning-with-python/			

Course Title : Predictive Modeling and analytics (UDSL461)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**-**	**--**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL461**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Introduces general idea and information about Predictive Modeling & Analytics.
	Making students aware about basic knowledge of Predictive Modeling & Analytics.
	Study recent tools in the Data Analytics
Course Outcomes	**On the successful completion of the course, students will**
	Understand and apply the basic concepts of Predictive Modeling & Analytics
	Illustrate concepts of Data Analytics with practical examples
	Interpret various Predictive Modeling Concepts

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**Introduction:** Introduction to Predictive Modeling, Data Analytics vs Data Science, Predictive Modeling Types - Classification , Clustering, Forecast , Outliers , Time Series.	**4**
II	**Exploratory Data Analysis and Visualizations:** Exploratory Data Analysis (EDA) – Importance, Cleanup and Transformation of Data, Dealing With Missing Values, Outliers, Adding and Removing Variables, Graphs.	**8**
III	**Predicting a Continuous Variable:** Introduction to Continuous Variables. Predictive Accuracy, Cross-Validation Technique, Improving Model Fit, Model Selection Strategies, Challenges of Predictive Modeling, Model using XLMiner, Types of Regression Models.	**8**
IV	**Predicting a Binary Outcome:** Introduction: Classification, Types of Classification Model: Binary Classification, Multi Class Classification, Multi Label Classification and Imbalance Classification. Techniques of Performance Measure.	**8**
V	**Trees and Other Predictive Models:** Introduction to Advanced Predictive Modeling Techniques, Trees: Classification Trees, Regression Trees, Bagging, Boosting, Random Forest, Building Trees with XLMiner, Introduction to Neural Networks.	**8**
Text Books	Modeling Techniques in Predictive Analytics: Business Problems Book by Thomas W. Miller	
	Predictive Analytics: The Power to Predict Who Will Click, Buy, Book by Eric Siegel	
	Machine Learning For Dummies Book by John Mueller and Luca Massaron	
Reference Books	Introduction to Machine Learning with Python: A Guide for Data Scientists Book by Andreas C. Müller and Sarah Guido	
	Predictive Analytics Using R Book by Jeffrey Strickland	
Online TL Material	https://towardsdatascience.com/machine-learning/home	

Course Title : Data Mining & ETL (UDSL462)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**DS**	**3**	**-**	**-**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	UDSL462									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Introduces general idea and information about Data Mining Principles.
	Students will be aware with the knowledge of different Data Mining models & applications
	Study recent tools in the Data Mining.
Course Outcomes	**On the successful completion of the course, students will**
	Understand the Data Mining functionalities.
	Discuss the Data warehousing & OLAP technology.
	Describe the Associations & Correlations.
	Implement the Classification & Prediction examples.
	Understand the concept of Data in Cluster Analysis

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Out comes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Unit	Contents	Hours
I	**Unit I:** Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major Issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation	**8**
II	**Unit II**: Data Warehouse and OLAP Technology for Data Mining**:** Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction	**8**
III	**Unit III:** Mining Frequent Patterns, Associations and Correlations**:** Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining	**8**
IV	**Unit IV:** Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods	**8**
V	**Unit V:** Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis	**4**
Text Books	Data Mining – Concepts and Techniques, Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.	
Reference Books	1. Data Mining Techniques, Arun K Pujari, 3rd edition, Orient Blackswan Universities Press, 2013. 2. Data Warehousing Fundamentals, Paulraj Ponnaiah, John Wiley & Sons,2001.	

Course Title : Information Retrieval and Text Mining(UDSL464)										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**-**	**-**	**3**	**10**	**15**	**50**	**-**	**-**
Course Code	UDSL464									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	Describe models like vector-space, probabilistic And language models to identify the similarity of query and document.
	Implement clustering algorithms like hierarchical agglomerative clustering and k-means algorithm
Course Outcomes	Demonstrate genesis and diversity of information retrieval situations for text and Hyper media.
	Describe hands-on experience store, and retrieve information from www using semantic approaches
	Demonstrate the usage of different data/file structures in building computational search engines
	Analyze the performance of information retrieval using advanced techniques such as classification, clustering, and filtering over multimedia
	Analyze ranked retrieval of a very large number of documents with hyperlinks between them.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	3	-	-	-	-	-	2	-	-	2	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	2	-	-	-	-	-	-	-	-	3	-	-	3	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	3

Unit	Contents	Hours
I	Introduction: Retrieval strategies: vector space model, Probabilistic retrieval strategies: Simple term weights, Non binary independence model, Language models.	**8**
II	Retrieval Utilities: Relevance feedback, clustering, N-grams, Regression analysis, Thesauri.	**6**
III	Semantic networks, parsing Cross –Language: Information Retrieval: Introduction, Crossing the Language barrier.	**8**
IV	Efficiency: Inverted Index, Query processing, Signature files, Duplicate document detection	**8**
V	Integrating structured data and text. A historical progression, Information retrieval as relational application, Semi Structured search using a relational schema. Distributed Information Retrieval: A theoretical Model of Distributed retrieval, web search	**6**
Text Books	1.Information Retrieval By Cambridge University Press, England, 2009 2.David A. Grossman, OphirFrieder, Information Retrieval – Algorithms and Heuristics, Springer, 2nd Edition(Distributed by Universal Press), 2004	
Reference Books	1. Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory And Implementation, Springer, 2004. 2. Shumen Chakrabarti, Mining the Web : Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers, 2002. 3. Christopher D Manning, Prabhakar Rashaan, Hinrich Schutze, An Introduction to Information Retrival.	

Sr. No	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO1,PSO2
1	Understand the basics of IR and set up the environment.	CO1	PO1 , PO4, PO10	PSO1
2	Implement and understand the vector space model for IR.	CO1	PO1 , PO4, PO10	PSO1
3	Learn preprocessing techniques to clean and prepare text data.	CO2	PO2	PSO2
4	Understand basic text mining concepts.	CO2	PO2	PSO2
5	Implement NER to extract entities from text.	CO3	PO2, PO3	PSO2
6	Analyze sentiments in text data.	CO3	PO2, PO3	PSO2
7	Create a basic search engine using inverted index.	CO4	PO1, PO10	PSO1
8	Discover topics within a collection of documents.	CO4	PO1, PO10	PSO1
9	Extract structured information from unstructured text.	CO5	PO4	PSO2
10	Explore advanced techniques in IR.	CO5	PO4	PSO2
Open Ended Experiments / New Experiments				
1.	Analyze sentiments from social media posts to detect trends and public opinion. Collect and preprocess social media data, build and train sentiment analysis models, visualize sentiment trends.			
2.	Extract and classify named entities from legal documents. Collect legal document corpus, preprocess data, implement NER models, evaluate model performance.			
Details of Online Laboratory Resource Material Instruction / Operating Manuals				
1.	https://www.nltk.org/			
2.	https://scikit-learn.org/			
3.	https://www.tutorialspoint.com/data_mining/dm_mining_text_data.htm			

Course Title : Stock Market Analysis (UDSL464)-Elective-VI										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	**-**	**1**	**4**	**10**	**15**	**50**	**-**	**-**
Course Code	**UDSL464**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**--**	
Duration of ESE	**2.5**					**75**				

Course Objectives	To providing a detailed analysis of the stock markets
	To providing all majors and backgrounds an alternative to the conventional finance class
Course Outcomes	CO1 - Understand the basic concept of Stock Market Analysis.
	CO-2 Demonstrate the Concept of how to invest in Stock Market.
	CO3 - Analyze the ability and knowledge to make their own decisions with their investment decisions in the stock market
	CO-4 Decide to start investing on their own with a solid foundation.
	CO-5 Design their own portfolio

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**	**3**	**2**	**2**	**3**							**2**	**1**
CO2	**2**	**3**	**3**	**2**	**2**	**2**							**2**	**1**
CO3	**2**	**3**	**3**	**1**	**2**	**3**							**2**	**1**
CO4	**2**	**3**	**3**	**3**	**2**	**2**							**2**	**1**
CO5	**2**	**3**	**3**	**3**	**2**	**3**							**2**	**1**

Course Contents:

Unit	Contents	Hours
I	**INTRODUCTION:** Overview of the Course: Why invest? Why the stock market? Basics of Investing I: Getting familiarized with terminology: types of stocks, indices, exchanges, brokerage accounts, order types, bull / bear markets, primary & secondary market.	4
II	**BASICS OF INVESTING:** Basics of Investing II: Introductory concepts: margin, shorting, stock splits, market capitalization, dividends, stock market psychology Stock Market Simulation begins. Basics of Investing III: Introductory concepts: portfolio basics, risk / return, financial goals, stock news Understanding the different securities (mutual funds, ETFs, CDs, money market).	8
III	**FINANCIAL STATEMENT ANALYSIS:** Financial Statements Primer Income statement, balance sheet, cash flow statement, ratios Earning estimates. Introduction to Investment Strategies & Analysis I Qualitative vs. quantitative analysis, technical vs. fundamental analysis, value vs. growth investing, ratio analysis, CAN SLIM system.	8
IV	**STOCK CHART ANALYSIS:** Stock Chart Analysis I: Introduction to stock chart terminology / concepts: trends, channels, support and resistance, volume. Stock Chart Analysis II: Using technical analysis (stock charts) for buy decisions: market bottoms, chart formations & consolidations, timing buy points. Stock Chart Analysis III: Using technical analysis (stock charts) for sell decisions: market tops, climax tops, churning, support breakdown.	8
V	**WRAP-UP TOPICS:** Other topics / Semester Wrap-Up Possible discussion topics: investment banking, hedge funds, private equity, careers. Stock Market PowerPoint Template: Stock Market Risk Management Strategies, Stock Market PPT Infographics, Bull Market & Bear Market, Stock Market Bull & Bear, Market of Different Countries and Silhouette, Stock Exchange Image, Stock Market Soaring Public Domain, Rising Stock Price PPT	8
Text Books	Technical Analysis of Stock Trend; Robert D Edwards, Visions Book.	
	Technical Analysis Explained; Martin J Pring; McGraw Hill.	
	Handbook of Technical Analysis, Darell R Jobman; Probus.	
Reference Books	Technical Analysis of Stocks, options; William Eng, Probus.	
	Technical Analysis, Jack D Schwager, John Wiley & Sons.	
Online TL Material	finance.yahoo.com (Yahoo! Finance)	
	www.reuters.com (Reuters Business) Resources	
	www.investors.com (Learning Center)	
	www.investorwords.com (Investor Words)	
	www.investopedia.com (Investopedia)	
	www.canslim.net (CANSLIM.net)	

List of practical:

Sr No.	Name of Practical	CO
1.	Introduction of Stock Market Analysis, types of stocks, indices, exchanges.	CO1
2.	To Study and create of brokerage accounts, order types, bull / bear markets, primary & secondary market	CO1
3.	To Study and demonstrate of margin, shorting, stock splits, market capitalization, dividends, stock market psychology, Stock Market Simulation.	CO2
4.	To Study and demonstrate of portfolio basics, risk / return, financial goals, stock news.	CO2
5.	To Study and demonstrate of Financial Statements, Primer Income statement, balance sheet, cash flow statement, ratios, Earning estimates.	CO3
6.	To Study and demonstrate of Qualitative vs. quantitative analysis, technical vs. fundamental analysis, value vs. growth investing, ratio analysis, CAN SLIM system.	CO3
7.	To Study and demonstrate of stock chart terminology, trends, channels, support and resistance, volume.	CO4
8.	To Study and demonstrate of using technical analysis (stock charts) for buy decisions: market bottoms, chart formations & consolidations, timing buy points. And technical analysis (stock charts) for sell decisions: market tops, climax tops, churning, support breakdown	CO4
9.	To Study and demonstrate of investment banking, hedge funds, private equity, careers	CO5
10.	To Create Stock Market PowerPoint Template: Stock Market Risk Management Strategies, Stock Market PPT Infographics, Bull Market & Bear Market, Stock Market Bull & Bear, Market of Different Countries and Silhouette, Stock Exchange Image, Stock Market Soaring Public Domain, Rising Stock Price PPT	CO5

Course Title: Salesforce CRM (UDSL465)-Elective-VI										
Semester	**VII**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	**ODD**	**Th**	**Tu**	**Pr**	**Credits**	**TAE**	**CAE**	**ESE**	**INT**	**EXT**
Course Category	**EL**	**3**	1	**2**	**5**	**10**	**15**	**50**	**25**	**-**
Course Code	**UDSL465**									
Teaching Mode	**Offline**				**TOTAL**	**75**			**25**	
Duration of ESE	**2.5**					**100**				

Course Objectives	Impart knowledge on the basic principles and concepts of Salesforce CRM
	Explore and demonstrate real CRM in solving practical problems of commercial and scientific interests.
Course Outcomes	CO1: Understand the basic concept of CRM & different types of Cloud.
	CO2: Demonstrate the concept of Page Layout, Views, Schema Builder, Applications, objects & Fields.
	CO3: Illustrate the different types of Relationships, Email Templates, and Automation Tools.
	CO4: Analyze & apply the concept of Data Migration Tools, Reports & Dashboards.
	CO5: Develop the Concept of Profile, Sharing Rules, Assignment Rules, Validation Rules, and Formulas.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**3**	**2**	**2**	**3**	**3**			**1**	**-**	**2**	**2**	**3**	**3**
CO2	**3**	**3**	**3**	**2**	**3**	**2**			**1**	**-**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**			**1**	**2**	**2**	**2**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**3**			**1**	**2**	**2**	**2**	**3**	**3**

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Introduction to Cloud Computing, SaaS Vs. PaaS Vs. IaaS, CRM Process & Lead Conversion process, Cloud Services, Server Instances & Multi-Tenant Architecture, Editions & Creating New Account, Record Management.	8
II	**Page Layout** : Enhanced List View & Schema Id, Applications, Objects, Governor Limit, Data Types (Field Types), Page Layouts, Field History Tracking, Schema Builder	8
III	**Relationships:** Different Types of Association (Relationship), Roll -Up Summary, Different Types of Email Templates, Automation Tools (Workflow Rules, Process Builders).	8
IV	**Data Management / Data Migration :** Data Management Tools (Data Import Wizard , Data Export Wizard , Data Loader Tool – Installation Process, CSV file Import & Export Process , Different functions of Data Loader) , Different Types of Report & Dashboards.	8
V	**Profiles**: Profiles, User Management, Role Hierarchy, OWD, Manual Sharing, Groups, Automated Sharing, Queue, Assignment Rules, Validation Rules, Formulas.	8
Text Books	Salesforce for Beginners – by Sharif Shaalan (Paperback)	
	Salesforce CRM – The Definitive Admin Handbook –Paul Goodey (Paperback)	
Reference Books	Mastering Salesforce CRM Administration – Rakesh Gupta (Packet Publishing)	
Online TL Material	https://trailhead.salesforce.com/	
	https://trailblazer.me/	

Salesforce Practical List

Sr. No.	Name of Experiments /Mini Projects/Case Studies	CO Mapped	PO Mapped	PSO
1	Introduction to Cloud Computing, SaaS Vs. PaaS Vs. IaaS, CRM Process & Lead Conversion process, Cloud Services.	CO1	PO1, PO2, PO5	PSO1
2	Creation of New Account in Salesforce CRM & Elaborate Record Management.	CO1	PO1, PO2, PO5	PSO1
3	Creation of New Application, Objects and Fields as consider as related project.	CO2	PO1, PO2, PO3,PO5	PSO1
4	Creation of New Page Layout, Field History Tracking & Schema Builder.	CO2	PO1, PO2, PO3,PO5	PSO1
5	Creation of different Relationship with fields as per requirement and also apply Roll-up summary.	CO3	PO1, PO2, PO3,PO5	PSO1
6	Creation of different types of Email Templates.	CO3	PO1, PO2, PO3,PO5	PSO1
7	Study & Implement the Workflow Rules Automation Tool	CO4	PO1, PO2, PO5	PSO1
8	Study & Implement the Process Builder Automation Tool	CO4	PO1, PO2, PO5	PSO1
9	Study & Implement the Data Import Wizard, Data Export Wizard Migration Tool.	CO4	PO1, PO2, PO5	PSO1
10	Study & Implement the Data Loader Tool.	CO4	PO1, PO2,	PSO1
11	Study & Implement Profiles, User Management, Role Hierarchy, OWD, Manual Sharing.	CO5	PO1, PO2, PO5	PSO1
12	Study & Implement the different validation rules.	CO5	PO1, PO2, PO5	PSO1