



Hindi Vidya Prachar Samiti's
**Ramniranjan Jhunjhunwala College of Arts, Science &
Commerce (Autonomous), Ghatkopar (W)**



Affiliated to
University of Mumbai

**Refer to page no: 02
highlighting component
of Research Project**

Syllabus for M.Sc. IT Part I (Semester I & Semester II)

Program: M.Sc. Information Technology

Program Code: RJSPIT

Choice Based Credit System Syllabus

(With effect from academic year 2021-22)

Course Structure

Semester I

Course Code	Course Name	Group	Teaching Scheme (Hrs/Week)		Credits
			Lectures	Practical	
RJSPIT101	Foundation of Data Science	CC	4	-	4
RJSPIT102	Cloud Computing	CC	4	-	4
RJSPIT103	Advanced Artificial Intelligence	CC	4	-	4
RJSPIT1P1a RJSPIT1P1b	Professional Elective – I Microservice Architecture Modern Networking	PE	3	-	3
RJSPIT1C1	Career Advancement Course Cyber Security - I	CAC	1	-	1
RJSPIT1L1	PG Lab – I Foundation of Data Science	PGL	-	2	2
RJSPIT1L2	PG Lab – II Cloud Computing	PGL	-	2	2
RJSPIT1R1	Mini Project – I	MNP	-	2	2
RJSPIT1S1	Seminar – I	SE	-	2	2
	Total		16	8	24

Semester II

Course Code	Course Name	Group	Teaching Scheme (Hrs/Week)		Credits
			Lectures	Practical	
RJSPIT201	Big Data Analytics	CC	4	-	4
RJSPIT202	Virtualization	CC	4	-	4
RJSPIT203	Image and Vision Processing	CC	4	-	4
RJSPIT2P2a RJSPIT2P2b	Professional Elective – II Blockchain Technology Soft Computing	PE	3	-	3
RJSPIT2C2	Career Advancement Course Cyber Security II	CAC	1	-	1
RJSPIT2L3	PG Lab – III Big Data Analytics	PGL	-	2	2
RJSPIT2L4	PG Lab – IV Virtualization	PGL	-	2	2
RJSPIT2R2	Mini Project – II	MNP	-	2	2
RJSPIT2S2	Seminar – II	SE	-	2	2
	Total		16	8	24

Note: Student have to register for the program as per the following guidelines:

Sr. No.	Category	Credits				Total Credits
		Semester I	Semester II	Semester III	Semester IV	
1	Core Courses (CC)	12 (3 Courses)	12 (3 Courses)	12 (3 Courses)	-	36
2	Professional Electives (PE)	3	3	3	-	09
3	Career Advancement Course (CAC)	1	1	1	-	03
4	PG Labs (PGL)	4 (2 Courses)	4 (2 Courses)	4 (2 Courses)	-	12
5	Mini Project (MNP)	2	2	-	-	4
6	Seminar (SE)	2	2	-	-	4
7	Dissertation – I (Major Project) (DES)	-	-	4	-	4
8	Dissertation – II (Major Project) (DES)	-	-	-	12	12
9	Industrial Internship (II)	-	-	-	12	12
Total Credits		24	24	24	24	96

Semester I – Core Courses

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required (60 Minutes/ Lecture)	Credits
RJSPIT101	Foundation of Data Science	CC	4	40	4

Course Objectives

1. To develop in depth understanding of the key technologies in data science.
2. To provide the basic knowledge of Python libraries like NumPy, Pandas, Matplotlib and Seaborn.
3. To provide the foundation and hands-on-practice on topics in statistical methods and applied probability that forms the basis for data science.
4. To address the issues and the principals of estimation theory, testing hypothesis and regression and prediction.

Unit	Topics	Lectures
Unit I	<p>Introduction to Data Science</p> <p>Era of data science, business intelligence, Business Intelligence vs. Data Science, Life cycle of Data Science, Tools of Data Science, Big data and Hadoop, business analytics, machine learning and artificial intelligence</p> <p>Data Pre-processing</p> <p>Basics of NumPy, Pandas, Matplotlib and Seaborn Libraries, Data Loading, Data Cleaning and Preparation, Data Wrangling, Plotting and Visualization, Data aggregation and Grouping</p> <p>Exploratory Data Analysis</p>	10

	<p>Elements of structured data, rectangular data: Data frames and indexes, non-rectangular data structures, estimates of location: Mean, Median and Robust, estimates of variability: Standard deviation and related estimates, Exploring the data distribution: Percentiles and Boxplots, Frequency table and Histograms, density estimates.</p>	
Unit II	<p>Exploring Binary and categorical data Mode, expected value, Correlation: Scatterplots, exploring two or more variables: hexagonal binning and Counters, two categorical variables, Categorical and numeric data, Visualizing multiple variables. Data Transformations and quality analysis Merge, Rollup, Transpose and Append, Missing Analysis and Treatment, Outlier analysis and treatment. Data and Sampling Distributions Random sampling and sample bias: Bias, Random selection, Selection Bias: Regression to mean, Sampling distributions of a statistic: Central limit theorem, Standard error, Bootstrap, Resampling, Confidence Intervals.</p>	10
Unit III	<p>Distributions Normal distribution: Standard normal and QQ plots, Long-tailed distributions, Student's t-distribution, Binomial distribution, Poisson distribution, Exponential distribution and Weibull distributions. Basic Probability and Terms Events and their Probabilities, Rules of Probability, Conditional probability and independence, Permutations and combinations, Bayer's Theorem, Descriptive Statistics, Compound probability, Conditional probability. Advance Statistics Point estimates, Null hypothesis, Alternative hypothesis, One sample t test, Type I and type II errors, Hypothesis test for categorical variables, Chi-square goodness of fit test.</p>	10
Unit IV	<p>Machine Learning Essentials Types of machine Learning: Supervised, Unsupervised and</p>	10

	<p>Reinforcement Learning, Linear Regression, Linear Regression predictors, Regression metrics, Logistic Regression, Dummy Variables.</p> <p>Predictions</p> <p>Naïve Bayes classification, Decision Trees, Unsupervised Learning, K Means clustering, Choosing an optimal number for k and cluster validation, Feature extraction and principal component analysis. The bias variance trade-off, two extreme cases of bias/variance trade off: under fitting, overfitting, K folds cross-validation, grid searching, Ensembling techniques: Random Forests.</p>	
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References:

1. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython”, O’Reilly, 2nd Edition.
2. Sinan Ozdemir, “Principles of Data Science”, PACKT, 2016
3. Peter Bruce, Andrew Bruce, “Practical Statistics for Data Science”, O’Reilly, 2017.
4. Jose Unpingco, “Python for Probability, Statistics and Machine Learning”, Springer.
5. Allen B. Downey, “Think Stats – Probability and Statistics for Programmers”, Green Tea Press.

Learning Outcomes:

1. The students will get in-depth knowledge of data science related Mathematical and statistical computing concepts.
2. The students will be able to implement the basic machine learning algorithms.

Unit	Course Outcome	Description	Level
I	CO1	To Understand and Describe the various concepts of Data Science and Artificial Intelligence Technology.	1, 2
	CO2	To Understand and Apply the concepts of Python libraries like NumPy, Pandas, Matplotlib and Seaborn to various types of data.	2, 3

	CO3	To Understand and Apply the Data Pre-processing, Data Exploration and Data Analysis techniques.	2, 3
	CO4	To Describe, Summarize and Analyse the various statistical measures for the given rectangular and non-rectangular data/dataset.	1, 2, 4
II	CO5	To Describe, Summarize and Analyse the binary & Categorical Data/ Dataset.	1, 2, 4
	CO6	To Understand and Apply Data Transformation techniques.	2, 3
	CO7	To Understand and Apply the various statistical concepts to the Sampling Distributions and Evaluate the shape of distribution.	2, 3, 5
III	CO8	To Understand and Apply the various statistical concepts to the Probability Distributions.	2, 3
	CO9	To Understand, Generate and Visualise the Probability and Probability Distributions.	2, 4, 6
	CO10	To Understand and Apply the concepts of probability to data sets and Predict the outcome.	2,3
	CO11	To Identify, Evaluate and Conclude the Hypothesis.	1, 5
IV	CO12	To Understand and Apply the various Machine Learning algorithms to datasets and Predict the output.	2, 3
	CO13	To Understand, Apply and Analyse the various machine learning algorithms of classification and Clustering and Evaluate the Results.	2, 3, 4, 5

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT102	Cloud Computing	CC	4	40	4

Course Objective

1. Illustrate the fundamentals of Cloud Computing and its challenges.
2. Analyse different virtualization techniques and their role in enabling the cloud computing system model.
3. Assess cloud characteristics and service attributes, for compliance with enterprise Objectives.
4. Exposure to various cloud architecture based on feature implementation.
5. Insight into various security related issues in cloud computing.
6. Impart knowledge on the various cloud delivery models from both the provider and consumer perspectives based on Cost metrics and Pricing model.

Unit	Topics	Lectures
Unit I	<p>Introduction to Cloud Computing Introduction, Historical developments, Building Cloud Computing Environments.</p> <p>Principles of Parallel and Distributed Computing Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing.</p> <p>Virtualization Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology Examples.</p> <p>Cloud Infrastructure Mechanism Logical Network Perimeter, Virtual Server, Cloud Storage Device,</p>	10

	Cloud usage monitor, Resource replication, Ready-made environment	
Unit II	<p>Cloud Computing Architecture: Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges</p> <p>Cloud Platforms in Industry: Amazon Web Services, Google App Engine, Microsoft Azure.</p> <p>Specialized Cloud Mechanisms: Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database</p> <p>Cloud Management Mechanisms: Remote administration system, Resource Management System, SLA Management System, Billing Management System</p>	10
Unit III	<p>Fundamental Cloud Architectures Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture.</p> <p>Advanced Cloud Architectures Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture.</p>	10
Unit IV	<p>Cloud Security Mechanisms Identity and Access Management (IAM), Single Sign-On (SSO), Cloud Based Security Groups, Hardened Virtual Server Images.</p>	10

	<p>Cloud Delivery Model Considerations</p> <p>Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective</p> <p>Cost Metrics and Pricing Models</p> <p>Business Cost Metrics, Cloud Usage Cost Metrics, Cost management Considerations.</p> <p>Service Quality Metrics and SLAs</p> <p>Service Quality Metrics, SLA Guidelines.</p>	
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<p>References:</p> <ol style="list-style-type: none"> 1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing Foundations and Applications Programming” Morgan Kaufmann Publishers,2013 2. Thomas Erl, Zaigham Mahood, Ricardo Puttini, “Cloud Computing, Concept, Technology and Architecture”, Prentice Hall, 2013. 3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. 4. John W. Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. 5. V.K Pachgare, “Cloud Computing”,PHI Learning,2016. 		
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<p>Learning Outcomes:</p> <p>Students will be able to:</p> <ol style="list-style-type: none"> 1. Understand distributed models and enabling technologies. 2. Design of computer clusters for scalable parallel computing skillfully. 3. Introduction to distributed system environment and programming models along with Performance, Security, and Energy-Efficiency factors. 4. Virtualization of clusters and Data centers along with various cloud computing and Service models-PaaS, SaaS, IaaS. 5. Elaboration of cloud programming, its Software environments features of Cloud and Grid Platforms. 6. Learning of programming on Google app engine Amazon AWS and Microsoft Azure. 7. Performance of Distributed Systems Quality of Service in Cloud computing and its Applications of Social Networks- Facebook. 			
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Unit	Course Outcome	Description	Level
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I	CO1	Understand and Describe the core concepts of the cloud computing paradigm its characteristics, advantages and its challenges.	1, 2
	CO2	Understand and Describe the principles of parallel and distributed computing.	1, 2
	CO3	Analyse different virtualization techniques and their role in enabling the cloud computing system model.	4
	CO4	Describe the Cloud Platform Mechanism.	1
II	CO5	Describe different deployment models available and Understand and differentiate between various cloud computing models.	1, 2
	CO6	Understand and Evaluate the various cloud platforms like AWS, Google App Engine and Microsoft Azure.	2, 3
	CO7	Understand and Identity Cloud Mechanisms that enable the hand-on administration and management of cloud-based IT resources.	2, 3
III	CO8	Understand the various cloud architectures based on feature implementations.	1
	CO9	Explain, Describe and Compare the frontier areas of Cloud Computing Architectures.	1,2
IV	CO10	Identify and Apply the various cloud security mechanisms.	1, 3
	CO11	Apply and Analyse various Cloud Delivery Models and Evaluate cost for cost metric systems for cloud service pricing.	3, 4, 5

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT103	Advance Artificial Intelligence	CC	4	40	4

Course Objectives

- To introduce the concepts of artificial intelligence, related components of artificial intelligence, Knowledge representations, non-monotonic reasoning, statistical technique, semantic network, frame and scripts.

Unit	Topics	Lectures
Unit I	<p>Introduction Introduction to AI problems, Introduction to AI Technique, Level of the Model, Criteria for Success.</p> <p>Problems, Problem Spaces and Search Defining the Problem as a State Space Search, Introduction to Production Systems, Problem Characteristics, Production System Characteristics.</p> <p>Heuristic Search Techniques Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis.</p>	10
Unit II	<p>Knowledge Representation Issues Introduction to Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, Frame Problem.</p> <p>Using Predicate Logic Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Introduction to Computable Functions and Predicates</p>	10

	<p>Resolution, Natural Deduction.</p> <p>Representing Knowledge Using Rules</p> <p>Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning, Matching, Control Knowledge.</p>	
Unit III	<p>Symbolic Reasoning Under Uncertainty</p> <p>Introduction to Non monotonic Reasoning, Logic for Non monotonic Reasoning, Implementation Issues, Augmenting a Problem-solver Implementation of Depth-first Search, Implementation of Breadth-first Search.</p> <p>Statistical Reasoning</p> <p>Probability and Bayes' Theorem, Certainty Factors and Rule-based Systems, Introduction to Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic.</p> <p>Weak Slot-and-Filler Structures</p> <p>Introduction to Semantic Nets, Introduction to Frames.</p> <p>Strong Slot-and-Filler Structures</p> <p>Conceptual Dependency, Scripts, CYC.</p>	10
Unit IV	<p>Knowledge Representation Summary</p> <p>Syntactic-semantic Spectrum of Representation, Logic and Slot-and-filler Structures.</p> <p>Game Playing</p> <p>Minimax Search Procedure, Adding Alpha-beta Cut-offs, Iterative Deepening.</p> <p>Planning</p> <p>An Example Domain: The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems.</p> <p>Understanding</p> <p>What Understands? What Makes Understanding Hard? Understanding as Constraint Satisfaction.</p>	10

References:

1. Kevin Knight, Elaine Rich, B. Nair "ARTIFICIAL INTELLIGENCE" McGraw Hill 3rd Edition 2017.
2. Stuart Russell and Peter Norvig "Artificial Intelligence 3e: A Modern Approach", 3rd Edition.

Learning Outcomes:

1. The students will learn the concepts of artificial intelligence, algorithms and related components of artificial intelligence.

Unit	Course Outcome	Description	Level
I	CO1	Understand the Various AI problems, AI techniques, AI models and criteria of success.	2
	CO2	Understand and Identify the AI Problems and their space.	1, 2
	CO3	Understand and Apply AI Search Algorithms.	1, 3
II	CO4	Understand and Analyse various concepts of knowledge representation and predicate logic.	1, 4
III	CO5	Understand and Analyse various concepts of Symbolic and Statistical Reasoning	2, 4
	CO6	Understand and Apply weak and strong slot-and-filter structures.	2, 3
IV	CO7	Understand and Use the Game Playing techniques and Planning techniques.	2, 6
	CO8	Conclude the spectrum of Knowledge Representation.	5

Semester I - Professional Electives

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT1P1a	Microservice Architecture	PE	4	40	3
<p>Course Objectives</p> <ol style="list-style-type: none"> 1. Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC. 2. Gain a practical understanding of .NET Core. 3. Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio. 					

Unit	Topics	Lectures
Unit I	<p>Microservices</p> <p>Understanding Microservices, Adopting Microservices, The Microservices Way.</p> <p>Microservices Value Proposition</p> <p>Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach.</p> <p>Designing Microservice Systems</p> <p>The Systems Approach to Microservices, A Microservices Design Process,</p> <p>Establishing a Foundation</p> <p>Goals and Principles, Platforms, Culture.</p>	10
Unit II	<p>Service Design</p> <p>Microservice Boundaries, API design for Microservices, Data and</p>	10

	<p>Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies.</p> <p>System Design and Operations</p> <p>Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting.</p> <p>Adopting Microservices in Practice</p> <p>Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.</p>	
Unit III	<p>ASP.NET Core Primer</p> <p>Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App.</p> <p>Delivering Continuously</p> <p>Introduction to Docker, Continuous integration with Wrecker, Continuous Integration with Circle CI, Deploying to Dicker Hub.</p> <p>Building Microservice with ASP.NET Core</p> <p>Microservice, Team Service, API First Development, Test First Controller, creating a CI pipeline, Integration Testing, Running the team service Docker Image.</p> <p>Backing Services</p> <p>Microservices Ecosystems, Building the location Service, Enhancing Team Service.</p>	10
Unit IV	<p>Creating Data Service</p> <p>Choosing a Data Store, building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service.</p> <p>Event Sourcing and CQRS:</p> <p>Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples.</p> <p>Building an ASP.NET Core Web Application</p> <p>ASP.NET Core Basics, Building Cloud-Native Web Applications.</p>	10

	<p>Service Discovery</p> <p>Cloud Native Factors, Netflix Eureka, Discovering and Advertising ASP.NET Core Services. DNS and Platform Supported Discovery.</p>	
<p>References:</p> <ol style="list-style-type: none"> 1. Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen, “Microservice Architecture: Aligning Principles, Practices, and Culture”, O’Reilly, First Edition, 2016. 2. Kevin Hoffman, “Building Microservices with ASP.NET Core”, O’Reilly, First Edition, 2017. 3. Sam Newman, “Building Microservices: Designing Fine-Grained Systems”, O’Reilly, First Edition. 4. Susan J. Fowler, “Building Microservices: Designing Fine-Grained Systems”, O’Reilly, First Edition, 5. Susan J. Fowler, “Production-ready Microservices”, O’Reilly, 2016. 		

<p>Learning Outcomes:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Understand the basic concept and design of microservice. 2. Implement web API using ASP.NET Core MVC. 3. Use Docker as a container to store microservice images. 			
Unit	Course Outcome	Description	Level
I	CO1	Understand and Apply the concepts of Microservice and Microservice Systems.	2, 3
II	CO2	Identify, Understand and Apply the Service design concepts.	1, 2, 3
III	CO3	Identify, Design and Apply the Microservice with ASP.NET core and Backing services.	1, 3, 6
IV	CO4	Create and Apply Data Service and ASP.NET core Web Application.	3, 6
	CO5	Create HTTP Services using ASP.NET core Web API.	6
	CO6	Understand and Discover the ASP.NET core services.	1,2

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT1P1b	Modern Networking	PE	4	40	3

Course Objectives

1. To understand the state-of-the-art in network protocols, architectures and applications.
2. Analyse existing network protocols and networks.
3. Develop new protocols in networking.
4. To understand how networking research is done.
5. To investigate novel ideas in the area of Networking via term-long research projects.

Unit	Topics	Lectures
Unit I	<p>Modern Networking</p> <p>Elements of Modern Networking</p> <p>The Networking Ecosystem, Example Network Architectures: Global Network Architecture, A Typical Network Hierarchy, Ethernet: Applications of Ethernet Standards Ethernet Data Rates, Wi-Fi: Applications of Wi-Fi, Standards Wi-Fi Data Rates, 4G/5G Cellular: First Generation Second Generation, Third Generation Fourth Generation Fifth Generation, Cloud Computing: Cloud Computing Concepts, The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things: Things on the Internet of Things, evolution Layers of the Internet of Things, Network Convergence, Unified Communications.</p> <p>Requirements and Technology</p> <p>Types of Network and Internet Traffic, Elastic Traffic, Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud computing, and Mobile Traffic. Big Data Cloud Computing, Mobile Traffic, Requirements: QoS and QoE, Quality of Service, Quality of</p>	10

	Experience, Routing Characteristics, Packet Forwarding, Congestion Control, Effects of Congestion, Congestion Control Techniques, SDN and NFV Software Defined Networking, Network Functions Virtualization Modern Networking Elements.	
Unit II	<p>Software-Defined Networks</p> <p>SDN: Background and Motivation</p> <p>Evolving Network Requirements: Demand Is Increasing, Supply Is Increasing, Traffic Patterns Are More Complex Traditional Network Architectures are Inadequate, The SDN Approach: Requirements, SDN Architecture Characteristics of Software Defined Networking, SDN- and NFV-Related Standards Standards: Developing Organizations, Industry Consortia, Open Development Initiatives.</p> <p>SDN Data Plane and OpenFlow</p> <p>SDN Data Plane: Data Plane Functions, Data Plane Protocols. OpenFlow Logical Network Device: Flow Table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table. OpenFlow Protocol.</p> <p>SDN Control Plane</p> <p>SDN Control Plane Architecture: Control Plane Functions, Southbound Interface Northbound Interface Routing, ITU-T Model, Open Daylight: Open Daylight Architecture Open Daylight Helium, REST: REST Constraints, Example REST API, Cooperation and Coordination Among Controllers: Centralized Versus Distributed Controllers, High-Availability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management, IETF SDNi, Open Daylight SNDi,</p> <p>SDN Application Plane</p> <p>SDN Application Plane Architecture: Northbound Interface, Network Services Abstraction Layer Network, Applications, User Interface, Network Services Abstraction Layer: Abstractions in SDN, Frenetic, Traffic Engineering: Policy Cop, Measurement and Monitoring, Security: Open Daylight DDoS Application, Data Center Networking: Big Data over SDN, Cloud Networking over SDN, Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer</p>	10
Unit III	<p>Virtualization</p> <p>Network Functions Virtualization: Concepts and Architecture</p>	10

	<p>Background and Motivation for NFV, Virtual Machines: The Virtual Machine Monitor, Architectural Approaches, Container Virtualization, NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements: NFV Benefits, NFV Requirements, NFV Reference Architecture: NFV Management and Orchestration, Reference Points, Implementation. NFV Functionality</p> <p>NFV Infrastructure: Container Interface, Deployment of NFVI Containers, Logical Structure of NFVI Domains, Compute Domain, Hypervisor Domain, Infrastructure Network Domain, Virtualized Network Functions: VNF Interfaces, VNFC to VNFC Communication, VNF Scaling, NFV Management and Orchestration: Virtualized Infrastructure Manager, Virtual Network Function Manager, NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases: Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV.</p> <p>Network Virtualization</p> <p>Virtual LANs: The Use of Virtual LANs, Defining VLANs, Communicating VLAN Membership, IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support; Virtual Private Networks: IPsec VPNs, MPLS VPNs, Network Virtualization: Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, Open Daylight's Virtual Tenant Network; Software-Defined Infrastructure, Software-Defined Storage, SDI Architecture.</p>	
<p>Unit IV</p>	<p>Defining and Supporting User Needs</p> <p>Quality of Service</p> <p>Background, QoS Architectural Framework: Data Plane, Control Plane, Management Plane, Integrated Services Architecture: ISA Approach ISA Components, ISA Services, Queuing Discipline, Differentiated Services: Services, DiffServ Field, DiffServ Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, Service Level Agreements; IP Performance Metrics; OpenFlow QoS Support: Queue Structures, Meters.</p> <p>QoE: User Quality of Experience</p> <p>Why QoE?: Online Video Content Delivery, Service Failures Due to Inadequate QoE Considerations; QoE-Related Standardization Projects; Definition of Quality of Experience: Definition of Quality, Definition of Experience, Quality Formation Process, Definition of Quality of</p>	<p align="center">10</p>

	Experience, QoE Strategies in Practice: The QoE/QoS Layered Model, Summarizing and Merging the ,QoE/QoS Layers, Factors Influencing QoE; Measurements of QoE: Subjective Assessment, Objective Assessment, End-User Device Analytics, Summarizing the QoE Measurement Methods, Applications of QoE.	
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References:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”, Addison Wesley Professional, October 2015.
2. Jim Doherty, SDN and NFV Simplified A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization, Pearson Education, Inc.
3. Rajendra Chayapathi Syed Farrukh Hassan, “Network Functions Virtualization (NFV) with a Touch of SDN”, AddisonWesley.
4. Brad dgeworth, Jason Gooley, Rami, “CCIE and CCDE Evolving Technologies Study Guide”, Pearson Education, Inc, 2019.

Learning Outcomes:

The student will be able to

1. Understand modern networking elements.
2. Implement SDN concept.

Unit	Course Outcome	Description	Level
I	CO1	Describe and Remember the importance and history of Modern Networking.	1, 2
	CO2	Understand and Describe the basic concepts of Modern Networking and Internet of Things.	2
	CO3	Recognise and Understand the requirements and technology of Modern Networks.	1, 2
II	CO4	Understand and Describe SDN concepts, applications and standards across data, control and application plane.	2, 3
	CO5	Understand and Use open flow devices and protocols.	2, 3

III	CO6	Recognise, Understand and Explore the Concepts, Architectures, Functionality and Applications of Network Function Virtualization (NFV).	2, 6
IV	CO7	Understand, Analyse and Evaluate the Quality of Service (QoS) Architectural Frameworks, Services, Service Level Agreements, Performance Metric, and OpenFlow QoS Support.	2, 4, 5
	CO8	Understand, Analyse and Evaluate the Quality of Experience (QoE), Service Failure, Standards, QoE Strategies in Practice, Factors and Measurement and Applications.,	2, 4, 5

Semester I - Career Advancement Course

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT1C1	Cyber Security – I	CC	2	20	1

Course Objectives

1. To get the insight of the security loopholes in every aspect of computing.
2. To understand the threats and different types of attacks that can be launched on computing systems.

Unit	Topics	Lectures
Unit I	<p>Introduction to Security Breaching: Overview of Information Security, Threats and Attack vectors, Concepts of Hacking – Ethical and Unethical, Information Security Controls, Concepts of penetration Testing, Information Security Laws and Standards.</p> <p>Evaluation Security of IT Organisation: Concepts, Methodology, Tools, Countermeasures, Penetration Testing.</p>	05
Unit II	<p>Network Scanning: Concepts, scanning beyond IDS and firewalls, Tools, Banner Grabbing, Scanning Techniques, Network Diagrams, penetration testing.</p> <p>Enumeration: Concepts, Different types of enumeration: Netbios, SNMP, LDAP, NTP, SMTP, DNS, other enumeration techniques, Countermeasures, Penetration Testing</p>	05
Unit III	<p>Analysis of Vulnerability: Concepts, Assessment Solutions, Scoring Systems, Assessment Tools, Assessment Reports.</p>	05

	Breaching System Security: Concepts, Cracking passwords, Escalating privileges, Executing Applications, Hiding files, covering tracks, penetration testing.	
Unit IV	Threats due to malware: Concepts, Malware Analysis, Trojan concepts, countermeasures, Virus and worm concepts, anti-malware software, penetration testing. Network Sniffing: Concepts, countermeasures, sniffing techniques, detection techniques, tools, penetration testing.	05
References: 1. Ric Messier, "CEHv10, Certified Ethical Hacker Study Guide", Sybex – Wiley, 2019. 2. Matt Walker, "All in One, Certified Ethical Hacker", Tata McGraw Hill, 2012. 3. I.P. Specialist, "CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide", IPSPECIALIST, 2018.		

Learning Outcomes: The students will be able to 1. Understand basic concept of Ethical and Unethical Hacking 2. Execute and analyze system secure measures.			
Unit	Course Outcome	Description	Level
I	CO1	Describe and Execute the concepts of Ethical and Unethical Hacking.	1, 2
	CO2	Describe, Execute and Apply the concepts of Penetration Testing and Countermeasures.	1, 2, 3
II	CO3	Describe, Execute and Apply the concepts of Network Scanning and Enumeration.	1, 2, 3
III	CO4	Describe, Execute, Apply and Analyze the Vulnerability and Assessments Tools.	1, 2, 3, 4
	CO5	Describe, Execute and Use the concepts of System Security breaching.	1, 2, 3
IV	CO6	Describe, Execute, Apply and Analyze the Malware Threats and	1, 2, 3, 4

		Anti Malware Software.	
	CO7	Describe, Execute and Apply the concepts and Tools of Network Sniffing and to Execute the Counter Measures.	1, 2, 3, 5

Semester I - PG Labs

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT1L1	PG Lab I Foundation of Data Science	PGL	2	20	2

Course Objectives

1. To introduce data analysis and visualization using mathematical and statistical computing concepts using Python Libraries.

Practical List

1. NumPy, Pandas, Matplotlib and Seaborn Basics
2. Data Collection and Pre-processing
3. Descriptive Statistical Analysis
4. Exploratory Data Analysis
5. Generation of Random Variable
6. Probability Distributions
7. Data and Sampling Distributions
8. Inferential Statistics and Probability
9. Significance and Hypothesis Testing
10. Supervised and Unsupervised Learning Algorithms

Learning Outcomes:

1. The students will be able to analyze data using mathematical and statistical models using R studio / Python.

Unit	Course Outcome	Description	Level

	CO1	Collect and Organise the data and Create the Dataset.	4
	CO2	Perform Descriptive Statistics and Exploratory Data Analysis for the given Dataset.	3
	CO3	Generate random number and data distribution of discrete and continuous type as well and Apply Sampling Methods.	3
	CO4	Evaluate Distribution and Find the Point Estimates.	3, 5
	CO5	Perform Hypothesis Testing using various tests.	6
	CO6	Build the model and Predict the Outcome.	6

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT1L2	PG Lab II Cloud Computing	PGL	2	20	2

Course Objectives

1. To Impart knowledge, practical training and insight into the implementation and Management of various Virtualization technologies with a focus towards applying these technologies in migrating from a traditional network infrastructure to a Cloud based solution.

Practical List

1. Implement Client Server communication model using TCP.
2. Implement Client Server communication model using UDP.
3. Implementation of web services.
4. Implement cluster on Windows Server.
5. Develop a cloud application for Microsoft Azure.
6. Implement virtualization with Xen Server and manage with Xen centre.

7. Develop application for Google App Engine.
8. Implement virtualization using VMWare ESXi Server and managing with vSphere Client.
9. Implement virtualization using Hyper-V.
10. Configuring IAAS using Open Nebula.

Learning Outcomes:

1. They will learn to implement private cloud, search engine, server cluster, Mapreduce and Hadoop, social networking site, blog site, grid computing, and various types of clouds.

Unit	Course Outcome	Description	Level
	CO1	Configure and Manage the Virtual servers and Virtual Machines.	3, 4
	CO2	Design client server Application using TCP and UDP protocol.	6
	CO3	Understand Design, Deploy and Implement Web services.	2, 6
	CO4	Design clusters on Windows.	6
	CO5	Build Applications on Azure Cloud platform and Google App Engine.	6
	CO6	Implement virtualization with Xen Server, ESXi Server and Hyper-V platforms.	6
	CO7	Configure and Use Iaas on Open Nebula Cloud Platform.	4, 6

Semester II – Core Courses

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT201	Big Data Analytics	CC	4	40	4

Course Objectives

1. To introduce the big data technology, Hadoop framework, data analysis of big data, data mining of big data and big data frameworks.

Unit	Topics	Lectures
Unit I	Introduction to Big Data Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.	10
Unit II	Hadoop Framework Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix Vector Multiplication – Hadoop YARN.	10
Unit III	Data Analysis Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data	10

	- Predictive Analytics – Data analysis using R.	
Unit IV	<p>Mining Data Streams</p> <p>Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.</p> <p>Big Data Frameworks</p> <p>Introduction to NoSQL, Aggregate Data Models, HBase: Data Model and Implementations, HBase Clients Examples, Cassandra: Data Model – Examples – Cassandra Clients, Hadoop Integration. Pig – Grunt, Pig Data Model, Pig Latin – developing and testing Pig Latin scripts. Hive Data Types and File Formats, HiveQL Data Definition, HiveQL Data Manipulation, HiveQL Queries.</p>	10
<p>References:</p> <ol style="list-style-type: none"> 1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012. 2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. 2. Learning R – A Step-by-step Function Guide to Data Analysis, Richard Cotton, O’Reilly Media, 2013. 3. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007. 4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013. 5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012. 6. Sridhar Alla, “Big Data Analytics with Hadoop3”, Packt, 2018. 7. Simon Walkowiak, “Big Data Analytics with R: Utilize R to uncover hidden patterns in your Big Data”, Packt, 2016. 		

Learning Outcomes:

The students will be able to:

1. Understand how to leverage the insights from big data analytics.
2. Analyze data by utilizing various statistical and data mining approaches.
3. Perform analytics on real-time streaming data.
4. Understand the various NoSql alternative database models.

Unit	Course Outcome	Description	Level
I	CO1	Discuss and Describe the Big Data concepts, Big Data Applications, Various Analytical Processes and Tools.	2
II	CO2	Discuss, Install and Configure Hadoop Framework, MapReduce and Hadoop Yarn. Discuss and Implement the various MapReduce Algorithms as Well.	2, 3, 6
III	CO3	Describe, Apply and Analyse various methods to Big Data.	2, 3, 4
	CO4	Perform Predictive Analysis using R/Python.	3
IV	CO5	Understand and Describe the Stream Data Model, NoSQL Models and its Architecture.	2
	CO6	Understand, Apply and Use various Big Data Frameworks and leverage the insights from Big Data Insights.	2, 3

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT202	Virtualization	CC	4	40	4

Course Objectives

1. Understanding the basics of virtualization and VMware vSphere product suite.
2. Identify the need for Server Virtualization

3. Describe the components and features of vSphere 6.7 and ESXi
4. Describe how VMware's products help solve business and technical challenges with regard to Server Virtualization

Unit	Topics	Lectures
Unit I	<p>Understanding Virtualization Describing Virtualization, Microsoft Windows Drives Server Growth, Explaining Moore's Law, Understanding the Importance of Virtualization, Examining Today's Trends, Virtualization and Cloud Computing Understanding Virtualization, Software Operation, Virtualizing Servers Virtualizing Desktops Virtualizing Applications.</p> <p>Understanding Hypervisors Describing a Hypervisor, Exploring the History of Hypervisors, Understanding Type 1 Hypervisors, Understanding Type 2 Hypervisors, Understanding the Role of a Hypervisor, Holodecks and Traffic Cops, Resource Allocation, Comparing, Today's Hypervisors, ESX, Citrix Xen, Microsoft Hyper-V.</p> <p>Understanding Virtual Machines Describing a Virtual Machine, Examining CPUs in a Virtual Machine, Examining Memory in a Virtual Machine, Examining Network Resources in a Virtual Machine, Examining Storage in a Virtual Machine, Understanding How a Virtual, Machine Works, Working with Virtual Machines, Understanding Virtual Machine Clones, Understanding Templates, Understanding Snapshots, Understanding OVF, Understanding Containers, understanding VMware Tools</p> <p>Introducing VMware vSphere Exploring VMware vSphere 6.7, Why Choose vSphere?</p>	10
Unit II	<p>Planning and Installing VMware ESXi Planning a VMware vSphere Deployment, Deploying VMware ESXi, Performing, Post installation Configuration. Installing and</p>	10

	<p>Configuring vCenter Server</p> <p>Introducing vCenter Server, Choosing the Version of vCenter Serve, Planning and Designing a vCenter Server Deployment, installing vCenter Server in a Linked Mode Group, Deploying the vCenter Server Virtual Appliance, exploring vCenter Server, exploring vCenter Server's Management Features, Managing vCenter Server Settings, vSphere Web Client Administration.</p> <p>vSphere Update Manager and the vCenter Support Tools</p> <p>vSphere Update Manager, Configuring vSphere Update Manager, Routine Updates, Performing an Orchestrated Upgrade, Investigating Alternative Update Options, vCenter Support Tools</p> <p>Creating and Configuring vSphere Networks</p> <p>Putting Together a Virtual Network, working with vSphere Standard Switches, working with vSphere Distributed Switches, Examining Third Party Distributed Virtual Switches, Configuring Virtual Switch Security.</p>	
<p>Unit III</p>	<p>Creating and Configuring Storage Devices</p> <p>Reviewing the Importance of Storage Design, Examining Shared Storage Fundamentals, Implementing vSphere Storage Fundamentals, Leveraging SAN and NAS Best Practices.</p> <p>Ensuring High Availability and Business Continuity</p> <p>Understanding the Layers of High Availability, Clustering VMs, Implementing vSphere High Availability, Introducing vSphere SMP Fault Tolerance, Planning for Business Continuity.</p> <p>Securing VMware vSphere</p> <p>Overview of vSphere Security, Securing ESXi Hosts, securing vCenter Server, Securing Virtual Machines.</p> <p>Using VM, Templates and vApps</p> <p>Creating and Managing Virtual Machines, Modifying Virtual Machines, Cloning VMs, Creating Templates and Deploying Virtual Machines, Using OVF Templates, Using Content Libraries, working with vApps, Importing Machines from Other Environments.</p>	<p>10</p>

Unit IV	<p>Managing Resource Allocation</p> <p>Reviewing Virtual Machine Resource Allocation, Working with Virtual Machine Memory, Managing Virtual Machine CPU Utilization, Using Resource Pools, Regulating Network I/O Utilization, Controlling Storage I/O Utilization.</p> <p>Balancing Resource Utilization</p> <p>Comparing Utilization with Allocation, exploring vMotion, Using Storage vMotion, combining vMotion with Storage vMotion, Introducing Cross vCenter vMotion, Exploring vSphere Distributed, Resource Scheduler, Working with Storage DRS.</p> <p>Monitoring VMware vSphere Performance</p> <p>Overview of Performance Monitoring, Using Alarms, Working with Performance Charts, Working with resxtp, Monitoring CPU Usage, Monitoring Memory Usage, Monitoring Network Usage, Monitoring Disk Usage.</p> <p>Automating VMware vSphere</p> <p>Why Use Automation? vSphere Automation Options, Automating with PowerCLI, using vCLI from vSphere Management Assistant, Using vSphere, Management Assistant for Automation with vCenter, ESXCLI and PowerCLI, Leveraging the Perl Toolkit with vSphere Management Assistant, Automating with vRealize Orchestrator.</p>	10
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References:

1. Nick Marshall, Scott Lowe (Foreword by) with Grant Orchard, Josh Atwell, "Mastering VMware vSphere 6.7", Publisher: Sybex, Wiley 2019
2. Matthew Portnoy, "Virtualization Essentials", 2nd Edition, Wiley India Pvt. Ltd.

Learning Outcomes:

Student will be able to:

1. Implementing vmwareESXi server virtualization.
2. Managing vmwareESXi with vCentre server.

Unit	Course Outcome	Description	Level
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I	CO1	Understand and Describe the Concepts of Virtualization, Hypervisor, Virtual Machines and VMWare vSphere 6.7.	2
II	CO2	Describe, Install and Configure ESXi and vCenter Server.	2, 3
	CO3	Demonstrate the use of vSphere Update Manager and Create a vSphere Network.	2
III	CO4	Understand and Apply VMware vSphere Security.	2, 3
	CO5	Configure the Virtual servers and Virtual Machines and Manage Resources to ensure Business Continuity.	3
	CO6	Allocate and Configure Storage Devices.	3
	CO7	Create and Manage Virtual Machines and Use the Templates.	3, 4
IV	CO8	Configure and Monitor the resources.	3, 4
	CO9	Monitor performance and Understand the Automation of vSphere.	2, 5

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT203	Image and Vision Processing	CC	4	40	4

Course Objectives

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques
3. To study image restoration procedures. To study the image compression procedures.

Unit	Topics	Lectures
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<p>Unit I</p>	<p>Introduction to Image Processing</p> <p>Example of fields that uses image processing, Steps of image processing, Components, Applications, Image sensors and Image formats.</p> <p>Visual Preliminaries</p> <p>Brightness adaptation and contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, perception of color, Computational model of perceptual processing, Image sampling and quantization, Basic relationship between pixels.</p> <p>Intensity transformations</p> <p>Introduction, Basic intensity transformation functions, Histogram equalization, Local histogram processing, Using histogram statistics for image enhancement.</p>	<p>10</p>
<p>Unit II</p>	<p>Spatial filtering</p> <p>Fundamentals of spatial filtering, Smoothing and sharpening spatial filters, combining spatial enhancement methods, Using fuzzy techniques for intensity transformations and spatial filtering.</p> <p>Colour Image Processing</p> <p>Colour fundamentals, Colour models, Pseudo colour image processing, Basic of full-color image processing, colour transformations, Smoothing and sharpening, Image segmentation bases on colour, Noise in colour images, Colour image compression.</p>	<p>10</p>
<p>Unit III</p>	<p>Image compression</p> <p>Fundamentals, Basic methods, Digital image watermarking, Full motion video compression.</p> <p>Morphological Image Processing</p> <p>Introduction, Erosion and Dilation, Opening and closing, Histogram transformation, Basic morphological algorithms, gray scale morphology. Segmentation</p> <p>Fundamentals, Point, Line and Edge detection, Thresholding, Region based segmentation, Segmentation using morphological watersheds Use of motion in segmentation – Spatial techniques.</p>	<p>10</p>

Unit IV	<p>Content-Based Image Retrieval</p> <p>Image database examples, Image database queries, Query-by-example, Image distance measures, Database organization.</p> <p>Motion from 2D Image Sequences</p> <p>Motion phenomena and applications, Image subtraction, Computing motion vectors, Computing the paths of moving points, Detecting significance changes in video.</p> <p>Image Segmentation</p> <p>Identifying regions, representing regions, identifying contours, Fitting model to segments, identifying higher level structure, Segmentation using motion coherence.</p>	10
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References:

1. Digital Image Processing, Gonzalez and Woods, 3rd Edition, Pearson Education.
2. Digital Image Processing and Analysis, Bhabatosh Chanda, Dwijesh Dutta Majumder, 2nd Edition, PHI.
3. Fundamentals of Digital Image Processing, Anil K Jain, 1st Edition, PHI.

Learning Outcomes:

Student will be able to:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.
5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

Unit	Course Outcome	Description	Level
I	CO1	Explain and understand the fundamental concepts of a digital image processing system and various application areas of image processing. To Understand the various Steps in image processing starting from acquisition of the image.	2

	CO2	Understand the basic relationship between the pixels and analyse the distance measures. Understand, Apply, Compare and analyse the basic intensity techniques for image enhancement, Understand and solve histogram equalization concept for image enhancement.	2, 3, 4
II	CO3	Understand, apply and analyse Smoothing and sharpening spatial filters, Understand and describe color fundamentals. Understand and compare different color models. Understand Pseudo colour image processing and full-color image processing,	1, 2, 3, 4
III	CO4	Understand and calculate data redundancy and compression ratio using variable length coding. Understand and describe general image compression system. Understand, Analyse and evaluate Compression Methods, like- Huffman Coding, LZW Compression. Understand and apply Morphological Image Processing. Understand Point, Line and Edge detection, and Apply gradient operators for edge detection.	
IV	CO5	Understand and compare text-based image retrieval and CBIR and analyse Image distance measures in CBIR. Understand Motion phenomena, image field and Describe change detection using image subtraction method. Computing motion vectors and the paths of moving points.	

Semester II – Professional Electives

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT2P2a	Blockchain Technology	PE	4	40	3

Course Objective

1. Develop a thorough understanding of the fundamentals of Block chain Technology.
2. To cover the technological underpinnings of block chain operations as distributed data structures and decision-making systems, their functionality and different architecture types.
3. To provide a critical evaluation of existing “smart contract” capabilities and platforms, and examine their future directions, opportunities, risks and challenges.
4. Exposure to Decentralized App development, its application areas, current practices, and research activity.

Unit	Topics	Lectures
Unit I	<p>Blockchain: Introduction, History, centralised versus Decentralised systems, layers of blockchain, Importance of blockchain, Blockchain uses and use cases.</p> <p>Working of Blockchain: Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions,</p>	10
	<p>blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling blockchain</p> <p>Working of Bitcoin: Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets</p>	

<p>Unit II</p>	<p>Ethereum:</p> <p>Three parts of blockchain, Ether as currency and commodity, Building trustless systems, Smart contracts, Ethereum Virtual Machine.</p> <p>The Mist browser:</p> <p>Wallets as a Computing Metaphor, The Bank Teller Metaphor, Breaking with Banking History, How Encryption Leads to Trust, System Requirements, Using Parity with Geth, Anonymity in Cryptocurrency, Central Bank Network, Virtual Machines, EVM Applications, State Machines, Guts of the EVM, Blocks, Mining's Place in the State Transition Function, Renting Time on the EVM, Gas, Working with Gas, Accounts, Transactions, and Messages, Transactions and Messages, Estimating Gas Fees for Operations, Opcodes in the EVM.</p> <p>Solidity Programming:</p> <p>Introduction, Global Banking Made Real, Complementary Currency, Programming the EVM, Design Rationale, Importance of Formal Proofs, Automated Proofs, Testing, Formatting Solidity Files, Reading Code, Statements and Expressions in Solidity, Value Types, Global Special Variables, Units and Functions.</p>	<p>10</p>
<p>Unit III</p>	<p>Smart Contracts and Tokens:</p> <p>EVM as Back End, Assets Backed by Anything, Cryptocurrency Is a Measure of Time, Function of Collectibles in Human Systems, Platforms for High Value Digital Collectibles, Tokens as Category of Smart Contract, creating a Token, Deploying the Contract, Playing with Contracts.</p> <p>Mining Ether:</p> <p>Why? Ether's Source, Defining Mining, Difficulty, Self-Regulation, and the Race for Profit, How Proof of Work Helps Regulate Block Time, DAG and Nonce, Faster Blocks, Stale Blocks, Difficulties, Ancestry of Blocks and Transactions, Ethereum and Bitcoin, Forking, Mining, Geth on Windows, Executing Commands in the EVM via the Geth Console, Launching Geth with Flags, Mining on</p>	<p>10</p>

	<p>the Testnet, GPU Mining Rigs, Mining on a Pool with Multiple GPUs.</p> <p>Crypt economics:</p> <p>Introduction, Usefulness of crypto economics, Speed of blocks, Ether Issuance scheme, Common Attack Scenarios.</p>	
Unit IV	<p>Blockchain Application Development:</p> <p>Blockchain Application Development, interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum—Sending Transactions, creating a Smart Contract, Executing Smart Contract Functions, Public vs. Private Blockchains, Decentralized Application Architecture</p> <p>DApp deployment:</p> <p>Seven Ways to Think About Smart Contracts, DApp Contract Data Models, EVM back-end and front-end communication, JSON-RPC, Web 3, JavaScript API, Using Meteor with the EVM, Executing Contracts in the Console, Recommendations for Prototyping, Third-Party Deployment Libraries</p> <p>Use Cases: Chains Everywhere, The Internet of Ethereum Things Retail and E-Commerce Community and Government Financing, Human and Organizational Behavior, Financial and Insurance Applications, Inventory and Accounting Systems, Software Development, Gaming, Gambling, and Investing.</p>	10
<p>References:</p> <ol style="list-style-type: none"> 1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda “Beginning Blockchain A Beginner’s Guide to Building Blockchain Solutions “, Apress publication , 2018. 2. Chris Dannen ,” Introducing Ethereum and Solidity “, Apress publication , 2017. 3. Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler “Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions” 1st Edition. 4. Elad Elrom , The Blockchain Developer , Apress publication , 2019 5. Vikram Dhillon, David Metcalf, Max Hooper, ”Blockchain Enabled Applications 		

“Apress publication 2017

Learning Outcomes:

1. Possess the in-demand skills to play an active role in Blockchain revolution.
2. Understand key features, different types of platforms & Languages of Blockchain Technology.
3. Know how to launch Blockchain in a single node and extend to multiple nodes using BAAS architecture.
4. Enable better strategic business decisions and develop solutions to real-life case studies.
5. Be able to confidently use Blockchain Technology in conjunction with other bleeding edge technologies in the domains of Big Data, Artificial Intelligence, Machine Learning, Analytics & IOT.

Unit	Course Outcome	Description	Level
I	CO1	Understand the technical fundamentals of Blockchain Technology.	2
	CO2	Understand and Describe Core components of Blockchain.	2
	CO3	Understand and Describe the concepts of Bitcoin as a cryptocurrency use case of Blockchain.	2, 3
II	CO4	Demonstrate how Blockchain could be programmed with Ethereum Blockchain.	2, 3, 6
	CO5	Understand , Describe and Use the various aspects of Ethereum Client Applications.	2, 3
	CO6	Understand the fundamentals of Solidity Programming Language and Apply it to design Smart Contract.	2, 3
III	CO7	Describe , Build and Deploy the Smart Contracts and Tokens.	2, 3, 6
	CO8	Describe the functionality of mining to reach consensus and Demonstrate the process of Mining Ether.	2, 3
	CO9	Describe and Evaluate the various aspects of Crypto	2, 3

		Economics.	
IV	CO10	Develop Blockchain Application, Interact with Bitcoin, Blockchain and Ethereum, Create and Execute Smart Contracts.	3, 6
	CO11	Develop and Deploy Decentralised Application DApp and Perform basic transactions in blockchain platforms.	3

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT2P2b	Soft Computing	PE	4	40	3

Course Objectives

1. To learn Soft computing concepts like fuzzy logic, neural networks and genetic algorithm.
2. All these techniques will be more effective to solve the problem efficiently.

Unit	Topics	Lectures
Unit I	<p>Introduction of soft computing soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.</p> <p>Artificial Neural Network Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network.</p>	10

<p>Unit II</p>	<p>Supervised Learning Network Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network.</p> <p>Associative Memory Networks Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.</p>	<p align="center">10</p>
<p>Unit III</p>	<p>UnSupervised Learning Networks Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks.</p> <p>Special Networks Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network</p>	<p align="center">10</p>
<p>Unit IV</p>	<p>Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets Classical sets, Fuzzy sets.</p> <p>Classical Relations and Fuzzy Relations Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.</p> <p>Membership Function Features of the membership functions, fuzzification, methods of membership value assignments.</p> <p>Defuzzification Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.</p>	<p align="center">10</p>

References:

1. Anandita Battacharya Das, “Artificial Intelligence and Soft Computing”, SPD, Third Edition, 2018.
2. S.N.Sivanandam S.N.Deepa, “Principles of Soft computing”, Wiley, Third Edition, 2019.
3. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy Computing and Soft”, Prentice Hall of India, 2004.
4. S.Rajasekaran, G. A. Vijayalakshami, “Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications”, Prentice Hall of India, 2004.
5. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGrawHill,1997.
6. Davis E.Goldberg , “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, 1989.
7. Dan W. Patterson, “Introduction to AI and Expert System”, Prentice Hall of India, 2009.

Learning Outcomes:

The students will be able to

1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Apply neural networks for classification and regression problems.
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.

Unit	Course Outcome	Description	Level
I	CO1	Understand, Describe and Apply the concepts of Soft Computing and Neural Computing.	2, 3
	CO2	Describe and Apply various soft computing techniques like classification, clustering, Bayesian Network and Probabilistic Reasoning.	2, 3
	CO3	Understand the working of Artificial Neural Networks.	2
II	CO4	Understand, Describe and Design the Supervised Learning Networks and Associative Memory Networks.	2, 6
III	CO5	Understand, Describe and Design the Unsupervised Learning Networks and Special Networks.	2, 6

IV	CO6	Understand and Describe the concepts of Fuzzy Logic Fuzzification and Defuzzification.	2
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Semester II – Career Advancement Course

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT2C2	Cyber Security II	PE	2	10	1

Course Objectives

1. To know the countermeasures that can be taken to prevent attacks on computing systems.
2. To test the software against the attacks

Unit	Topics	Lectures
Unit I	<p>Social Engineering Concepts, Impersonation on networking sites, Techniques, Identity theft, Insider threats, countermeasures, Pen testing.</p> <p>Denial of Service and Distributed Denial of service Concepts, techniques, botnets, attack tools, countermeasures, protection tools, penetration testing.</p>	8
Unit II	<p>Hijacking an active session Concepts, tools, application-level session hijacking, countermeasures, network level session hijacking, penetration testing.</p> <p>Evasion of IDS, Firewalls and Honeypots Introduction and concepts, detecting honeypots, evading IDS, IDS and Firewall evasion countermeasures, evading firewalls, penetration testing.</p>	8
Unit III	<p>Compromising Web Servers Concepts, attacks, attack methodology, attack tools, countermeasures patch management, web server security tools, penetration testing.</p>	8

	<p>Compromising Web Applications</p> <p>Concepts, threats, methods, tools, countermeasures, testing tools, penetration testing.</p>	
Unit IV	<p>Performing SQL Injection</p> <p>Concepts, types, methodology, tools, techniques, countermeasures.</p> <p>Compromising Wireless Networks</p> <p>Concepts, wireless encryption, threats, methodology, tools, compromising Bluetooth, countermeasures, wireless security tools, penetration testing.</p>	8
<p>References:</p> <p>1. Ric Messier, “CEHv10, Certified Ethical Hacker Study Guide”, Sybex – Wiley, 2019. 2. Matt Walker, “All in One, Certified Ethical Hacker”, Tata McGraw Hill, 2012. 3. I.P. Specialist, “CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide”, IPSPECIALIST, 2018.</p>		

<p>Learning Outcomes:</p> <p>The students will be able to</p> <ol style="list-style-type: none"> Understand various types of attacks and vulnerabilities, categorize events and perform incident analysis. Understand and analyze various forms of intrusions, threats and perform forensic analysis on them. 			
Unit	Course Outcome	Description	Level
I	CO1	Understand and Use the various techniques of identifying threats and counter measures for Social Engineering.	2, 3
II	CO2	Hijack the Application-level and Network-level sessions, Firewall and Use the counter measure techniques.	3
III	CO3	Understand, Describe/Use the Web Servers and Web Applications attack methodologies, Security and Testing Tools.	2, 3
IV	CO4	Perform SQL injection technique.	6

	CO5	Understand and Describe Wireless Network Concepts and Security Tools.	2
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Semester II – PG Labs

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT2L3	PG Lab III Big Data Analytics	PGL	2	20	2

Course Objectives

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
2. Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
3. Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.
4. Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Practical List

1. To understand the overall programming architecture using Map Reduce API.
2. Store the basic information about students such as roll no, name, date of birth and address of student using various collection types such as List, Set and Map.
3. Basic CRUD operations in MongoDB.
4. Retrieve various types of documents from student's collection.
5. To find documents from Student's collection.
6. Develop Map Reduce Work Application.
7. Creating the HDFS tables
8. Loading HDFS tables in Hive and learn joining of tables in Hive.
9. Supervised Learning Algorithms
10. Unsupervised Learning Algorithms.

Learning Outcomes:

1. The students will be able to handle big data and query big data.

Unit	Course Outcome	Description	Level
	CO1	Describe and Apply fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.	2,3
	CO2	Execute basic CRUD Operations Using Mongo DB.	3
	CO3	Create and Execute the MapReduce Application.	3, 6
	CO4	Perform various operations like Create , Load , and Join HDFS table using Hive.	3, 6
	CO5	Describe and Apply Supervised and Unsupervised algorithms to Big Data.	2, 3

Course Code	Course Name	Group	Number of Lectures Per Week	Total Number of Lectures Required	Credits
RJSPIT2L4	PG Lab III Virtualization	PGL	2	20	2

Course Objectives

1. To implement vmware, vSphere, ESXi and vCenter Server and its various functionality to implement and manage server virtualization.

Practical List

1. Implement VMwareESXi for server virtualization.
 - a. Install VMwareESXi server and vSphere client.

- b. Install vCenter Single Sign-On as Part of a vCenter Server Simple Install
2. Manage VMware ESXi server with vCentre server.
 - a. Create a virtual machine in vmware ESXi Server.
 - b. Migrate the virtual machine from one ESXi server to another ESXi server.
3. Create a Template in the vSphere Client.
 - a. Convert a Virtual Machine to a Template in the vSphere Client.
 - b. Clone a Template in the vSphere Client.
 - c. Clone Virtual Machine to Template in the vSphere Client.
4. Manage the storage and Security of VMware ESXi server.
 - a. Add Virtual storage in VMware ESXi Server with vSphere Client.
 - b. Create a one user account of VMware ESXi server using vSphere WebClient application.
 - c. Prevent Users from Spying on Remote Console Sessions.
5. Upgrade the VMware ESXi server 6.0 to 6.7 using simple installation.
6. Implement the NFS with the vCenter Server.
7. Implement VLAN concept L2/L3 switches.
8. vSphere Monitoring and Performance.
 - a. Monitoring Inventory Objects with different Performance Charts.
 - b. Monitoring Guest Operating System Performance.
 - i. View Performance Statistics for Windows Guest Operating Systems.
9. Manage Xen Server with Xen center.
10. Implement Hyper-V server virtualization.

Learning Outcomes:

The students will be able to

1. Implement server virtualization using VMware ESXi Server and vSphere client.
2. Configure and deploy various features of VMware vSphere.

Unit	Course Outcome	Description	Level

	CO1	Implement ESXi server and vSphere client Virtual Machine (VM). Deploy vCenter Server with a single sign-on facility.	3
	CO2	Create and migrate VM from one ESXi host to another through vCenter Server.	6
	CO3	Understand to Create a template and clone of the virtual machine.	2,6
	CO4	Create iSCSI storage into the ESXi host. Also they will be able to add users and change or update users' roles and settings to enhance security.	6
	CO5	Understand to upgrade ESXi from version 6.0 to 6.7.	2
	CO6	Implement NFS datastore for ESXi host.	3
	CO7	Create and configure VLAN L2/L3 network.	2
	CO8	Analyse the performance, network statistics of VM, ESXi host and cluster of hosts.	4
	CO9	Install and Deploy XenServer and manage XenClient through XenServer and Hyper-V.	6

Evaluation Scheme

Semester I

Course Code	Course Name	Group	Max Marks (Total 600)		
			External	Internal	Practical
RJSPIT101	Foundation of Data Science	CC	60	40	-
RJSPIT102	Cloud Computing	CC	60	40	
RJSPIT103	Advanced Artificial Intelligence	CC	60	40	-
RJSPIT1P1a RJSPIT1P1b	Professional Elective – I Microservice Architecture Modern Networking	PE	60	15	-
RJSPIT1C1	Career Advancement Course Cyber Security - I	CAC	25	-	-
RJSPIT1L1	PG Lab – I Foundation of Data Science	PGL	-	-	50
RJSPIT1L2	PG Lab – II Cloud Computing	PGL	-	-	50
RJSPIT1R1	Mini Project – I	MNP	-	-	50
RJSPIT1S1	Seminar – I	SE	-	-	50
	Total		265	135	200

Semester II

Course Code	Course Name	Group	Max Marks (Total 600)		
			External	Internal	Practical
RJSPIT201	Big Data Analytics	CC	60	40	-
RJSPIT202	Virtualization	CC	60	40	
RJSPIT203	Image and Vision Processing	CC	60	40	-
RJSPIT2P2a RJSPIT2P2b	Professional Elective – II Blockchain Technology Soft Computing	PE	60	15	-
RJSPIT2C2	Career Advancement Course Cyber Security II	CAC	25	-	-
RJSPIT2L3	PG Lab – III Big Data Analytics	PGL	-	-	50
RJSPIT2L4	PG Lab – IV Virtualization	PGL	-	-	50
RJSPIT2R2	Mini Project – II	MNP	-	-	50
RJSPIT2S2	Seminar – II	SE	-	-	50
	Total		265	135	200

Evaluation and Assessment

1. The internal assessment marks shall be awarded as follows:
 - A. 30 marks (Any one of the following):
 - a. Written Test
or
 - b. SWAYAM NPTEL (Advanced Course) of minimum 20 hours and certification examination completed
or
 - c. Valid International Certifications (Prometric, Pearson, Certiport, Coursera, Udemy, edx and the like).
or
 - d. One certification mark shall be awarded one course only. For four courses, the students will have to complete four certifications.
 - B. 10 Marks
The marks given out of 40 for publishing the research paper should be divided into four course and should awarded out of 10 in each of the four courses.
2. Semester End Examination – 60 marks
Question paper covering all units
3. Evaluation of Practical 200 marks (50 marks for each practical)

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Hindi Vidya Prachar Samiti's  
**Ramniranjan Jhunjhunwala College of Arts, Science &  
Commerce (Autonomous), Ghatkopar (W)**



Affiliated to  
**University of Mumbai**

**Refer to page no: 03  
highlighting component  
of Research Project/Internship**

**Syllabus for M.Sc. IT Part II (Semester III & IV)**

**Program: M.Sc. Information Technology  
Program Code: RJSPIT  
Choice Based Credit System Syllabus**

**(With effect from academic year 2022-23)**

M.Sc. Information Technology Part II Syllabus

**Course Structure**

**Semester III**

| Course Code                            | Course Name                                                                                   | Group | Teaching Scheme<br>(Hrs / Weeks) |           | Credits   |
|----------------------------------------|-----------------------------------------------------------------------------------------------|-------|----------------------------------|-----------|-----------|
|                                        |                                                                                               |       | Lectures                         | Practical |           |
| <b>RJSPIT301</b>                       | Deep Learning & Natural Language Processing                                                   | CC    | 4                                | -         | 4         |
| <b>RJSPIT302</b>                       | Cloud Solution Architect                                                                      | CC    | 4                                | -         | 4         |
| <b>RJSPIT303</b>                       | Robotic Process Automation                                                                    | CC    | 4                                | -         | 4         |
| <b>RJSPIT3P3a</b><br><b>RJSPIT3P3b</b> | <b>Professional Elective – III</b><br>Computer Hacking Forensic Investigation<br>Advanced IOT | PE    | 3                                | -         | 3         |
| <b>RJSPIT3C3</b>                       | <b>Career Advancement Course</b><br>Virtual & Augmented Reality                               | CAC   | 1                                | -         | 1         |
| <b>RJSPIT3L5</b>                       | <b>PG Lab – V</b><br>Deep Learning & Natural Language Processing                              | PGL   | -                                | 2         | 2         |
| <b>RJSPIT3L6</b>                       | <b>PG Lab – VI</b><br>Cloud Solution Architect                                                | PGL   | -                                | 2         | 2         |
| <b>RJSPIT3L7</b>                       | <b>PG Lab – VII</b><br>Robotic Process Automation                                             | PGL   | -                                | 2         | 2         |
| <b>RJSPIT3L8a</b><br><b>RJSPIT3P8b</b> | <b>PG Lab – VIII</b><br>Computer Hacking Forensic Investigation<br>Advanced IOT               | PGL   | -                                | 2         | 2         |
|                                        | <b>Total</b>                                                                                  |       | <b>16</b>                        | <b>8</b>  | <b>24</b> |

M.Sc. Information Technology Part II Syllabus

**Semester IV**

| Course Code      | Course Name                         | Group | Teaching Scheme<br>(Hrs / Weeks) |           | Credits   |
|------------------|-------------------------------------|-------|----------------------------------|-----------|-----------|
|                  |                                     |       | Lectures                         | Practical |           |
| <b>RJSPIT4D1</b> | <b>Dissertation (Major Project)</b> | DES   | -                                | -         | 12        |
| <b>RJSPIT4D2</b> | <b>Industrial Internship</b>        | II    | -                                | -         | 12        |
|                  | <b>Total</b>                        |       | -                                | <b>24</b> | <b>24</b> |

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Semester III – Core Courses

| Course code | Course Name                                 | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|---------------------------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT301   | Deep Learning & Natural Language Processing | CC    | 4                           | 40                                                     | 4      |

**Course Objective:**

1. To cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short-term memory cells and convolutional neural networks.
2. To learn sentence structure.
3. To learn Morphological analysis, Lexical analysis, Syntactic and Semantic analysis.
4. To learn feature engineering concepts and rule-based systems for NLP.

| Unit | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Lectures |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | <p><b>Basics:</b> Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.</p> <p><b>Feedforward Networks:</b> Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, autoencoders.</p> <p><b>Deep Neural Networks:</b> Difficulty of training deep neural networks, Greedy layerwise training.</p> <p><b>Better Training of Neural Networks:</b> Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, Adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).</p> | 10       |
| II   | <p><b>Recurrent Neural Networks:</b> Back propagation through time, Long Short-Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10       |

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|                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|                                                                                                                                                                                                                                                                                                       | <p>RNNs</p> <p><b>Convolutional Neural Networks:</b> LeNet, AlexNet.</p> <p><b>Generative models:</b> Restricted Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.</p> <p><b>Recent trends:</b> Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning</p>                                                                                                                                                                                                                                                                                                |    |
| III                                                                                                                                                                                                                                                                                                   | <p><b>Introduction</b></p> <p>Understanding natural language processing, Understanding basic applications, Advantages of togetherness, NLP and Python, Environment setup for NLTK.</p> <p><b>Practical Understanding of a Corpus and Dataset</b></p> <p>What is a corpus? Why do we need a corpus? Understanding corpus analysis, understanding types of data attributes, exploring different file formats for corpora, Resources for accessing free corpora, Preparing a dataset for NLP applications, Web scraping.</p>                                                                                                                                                                  | 10 |
| IV                                                                                                                                                                                                                                                                                                    | <p><b>Understanding the Structure of a Sentences</b></p> <p>Understanding components of NLP, Natural language understanding, Defining context-free grammar, Morphological analysis, Syntactic analysis, Semantic analysis, Handling ambiguity, Discourse integration, Pragmatic analysis.</p> <p><b>Pre-processing</b></p> <p>Handling corpus-raw text, Handling corpus-raw sentences, Basic pre-processing, Practical and customized pre-processing.</p> <p><b>Feature Engineering and NLP Algorithms</b></p> <p>Understanding feature engineering, Basic feature of NLP, Basic statistical features for NLP, Advantages of features engineering, Challenges of features engineering.</p> | 10 |
| <p>References</p> <ol style="list-style-type: none"> <li>1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MITS Press.</li> <li>2. Neural Networks: A Systematic Introduction, Raul Rojas.</li> <li>3. Pattern Recognition and Machine Learning, Christopher Bishop.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |    |

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4. Fundamentals of Deep Learning, Nikhil Buduma with contributions by Nicholas Locascio, O'Reilly.
5. "Python Natural Language Processing", Jalaj Thanaki, Packt.
6. "Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit", By Steven Bird, Ewan Klein, and Edward Loper, NLTK.
7. "Speech and Language Processing", Daniel Jurafsky and James H. Martin, Prentice Hall, 2009.
8. "Foundation of Statistical Natural Language Processing", Christopher D. Manning and Hinrich Schutze, MIT Press, 1999.

**Learning Outcome:**

The students will be able to:

1. The students will learn deep learning algorithms for various neural networks.
2. The students will learn natural language processing concepts, Lexical processing, syntactic processing, semantic processing and modelling.

| Unit | Course Outcome | Description                                                                                                                                                                                | Levels |
|------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| I    | CO1            | Understand the basics of Artificial Neural Networks and the hyperparameters, optimizers, activation functions and accuracy metric                                                          | 2      |
|      | CO2            | Understand the basics of Artificial Neural Networks and the hyperparameters, optimizers, activation functions and accuracy metric.                                                         | 2      |
|      | CO3            | Understand and Build the machine learning algorithms: Classification and Regression using the Multilayer Perceptron.                                                                       | 2      |
|      | CO4            | Understand the architecture of Artificial/Deep Neural Network, training, testing and validating the network/model. Understand the optimization techniques. Building and evaluating the ANN | 2      |

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|     |     |                                                                                                                                                                                    |      |
|-----|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
|     |     | model using TensorFlow and Keras.                                                                                                                                                  |      |
| II  | CO5 | Understand the architecture and building blocks of the Convolutional Neural Network. Building and evaluating the CNN model using TensorFlow and Keras.                             | 2,5  |
|     | CO6 | Understand Recurrent Neural Network and sequential data. Learning case studies of RNN. Understand Forward and Back Propagation approaches of RNN.                                  | 2    |
| III | CO7 | Understand and Use the basics of NLP. Understand and Perform Lexical Analysis. Using various algorithms/ methods for Lexical processing.                                           | 2,3  |
|     | CO8 | Understand the Part-Of-Speech tagging and Rule-Based system. Creating the Parser tree for the given text. Perform the text processing using the information extraction techniques. | 2    |
|     | CO9 | Understand and Perform the Semantic processing. Understand and Use the various databases and algorithms for semantic processing.                                                   | 2, 3 |

| Course code | Course Name              | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT302   | Cloud Solution Architect | CC    | 4                           | 40                                                     | 4      |

**Course Objectives:**

- To study how to make architectural decisions based on AWS architectural principles and best practices.
- To understand AWS architecture, services.
- To study relational management database systems in AWS.



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- To follow practices for security, management

| Unit | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lectures |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | <p><b>Introduction to AWS</b><br/>What Is Cloud Computing, AWS Fundamentals, AWS Cloud Computing Platform.</p> <p><b>Amazon Simple Storage Service (Amazon S3) and Amazon Glacier</b> Storage Object Storage versus Traditional Block and File Storage, Amazon Simple Storage Service (Amazon S3) Basics, Buckets, Amazon S3 Advanced Features, Amazon Glacier.</p> <p><b>Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Elastic Block Store (Amazon EBS)</b> Amazon Elastic Compute Cloud (Amazon EC2), Amazon Elastic Block Store (Amazon EBS).</p> <p><b>Elastic Load Balancing, Amazon CloudWatch, and Auto Scaling</b> Elastic Load Balancing, Amazon CloudWatch, Auto Scaling</p>                                                                                   | 10       |
| II   | <p><b>Amazon Virtual Private Cloud (Amazon VPC)</b><br/>Amazon Virtual Private Cloud (Amazon VPC), Subnets, Route Tables, Internet Gateways, Dynamic Host Configuration Protocol (DHCP) Option Sets, Elastic IP Addresses (EIPs), Elastic Network Interfaces (ENIs), Endpoints, Peering, Security Groups, Network Access Control Lists (ACLs), Network Address Translation (NAT) Instances and NAT Gateways, Virtual Private Gateways (VPGs), Customer Gateways (CGWs), and Virtual Private Networks (VPNs)</p> <p><b>AWS Identity and Access Management (IAM)</b><br/>Principals, Authentication, Authorization, Other Key Features</p> <p><b>Databases and AWS</b><br/>Database Primer, Amazon Relational Database Service (Amazon RDS), Amazon Redshift, Amazon DynamoDB</p> | 10       |
| III  | <p><b>SQS, SWF, and SNS</b><br/>Amazon Simple Queue Service (Amazon SQS), Amazon Simple Workflow</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10       |

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|                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|                                                                                                                                                                                                                                                                                                                                              | <p>Service (Amazon SWF), Amazon Simple Notification Service (Amazon SNS)</p> <p><b>Domain Name System (DNS) and Amazon Route 53</b></p> <p>Domain Name System (DNS), Amazon Route 53 Overview</p> <p><b>Amazon ElastiCache</b></p> <p>In-Memory Caching, Amazon ElastiCache</p> <p><b>Additional Key Services</b></p> <p>Storage and Content Delivery, Security, Analytics, DevOps</p>                                                                                                                                                                                                                                                                                |    |
| IV                                                                                                                                                                                                                                                                                                                                           | <p><b>Security on AWS</b></p> <p>Shared Responsibility Model, AWS Compliance Program, AWS Global Infrastructure Security, AWS Account Security Features, AWS Cloud Service-Specific Security</p> <p><b>AWS Risk and Compliance</b></p> <p>Overview of Compliance in AWS, Evaluating and Integrating AWS Controls, AWS Risk and Compliance Program, AWS Reports, Certifications, and Third-Party Attestations</p> <p><b>Architecture Best Practices</b></p> <p>Design for Failure and Nothing Fails, Implement Elasticity, Leverage Different Storage Options, Build Security in Every Layer, Think Parallel, Loose Coupling Sets You Free, Don't Fear Constraints</p> | 10 |
| <p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. AWS Certified Solutions Architect Official Study Guide: Associate Exam (Aws Certified Solutions Architect Official: Associate Exam) 1st Edition by Joe Baron (Author), Hisham Baz (Author), Tim Bixler (Author), Biff Gaut (Author), Kevin E. Kelly (Author).</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |

| <p><b>Learning Outcome:</b></p> <p>The students will be able to:</p> <ol style="list-style-type: none"> <li>1. Learn AWS architecture, services, relational management database systems, security, management and deployment.</li> </ol> |        |             |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------|--------|
| Unit                                                                                                                                                                                                                                     | Course | Description | Levels |

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|     | Outcome |                                                                                                                    |         |
|-----|---------|--------------------------------------------------------------------------------------------------------------------|---------|
| I   | CO1     | To Understand and Describe the various concepts of Cloud Computing, AWS Fundamentals, AWS Cloud Computing Platform | 1,2     |
|     | CO2     | To Understand and Apply the concepts of Amazon Simple Storage Service (Amazon S3) and Amazon Glacier.              | 2,3     |
|     | CO3     | To Understand and Apply the Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Elastic Block Store (Amazon EBS)  | 2,3     |
|     | CO4     | To Understand and Apply the Elastic Load Balancing, Amazon CloudWatch, and Auto Scaling                            | 2,3     |
| II  | CO5     | To Understand, Apply and Analyze the Amazon Virtual Private Cloud (Amazon VPC)                                     | 2, 3, 4 |
|     | CO6     | To Understand and Apply the AWS Identity and Access Management (IAM)                                               | 2,3     |
|     | CO7     | To Understand and Apply the Databases and AWS                                                                      | 2,3     |
| III | CO8     | To Understand and Describe the SQS, SWF, and SNS                                                                   | 1,2     |
|     | CO9     | To Understand and Describe Domain Name System (DNS) and Amazon Route 53                                            | 1,2     |
|     | CO10    | To Understand and Describe Amazon ElastiCache                                                                      | 1,2     |
|     | CO11    | To Understand, Describe and Apply Additional Key Services                                                          | 1,2,3   |
| IV  | CO12    | To Understand and Describe Security on AWS                                                                         | 1,2     |
|     | CO13    | To Understand and Describe AWS Risk and Compliance                                                                 | 1,2     |
|     | CO14    | To Understand and Describe Architecture Best Practices                                                             | 1,2     |

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| Course code | Course Name                | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|----------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT303   | Robotic Process Automation | CC    | 4                           | 40                                                     | 4      |

**Course Objective:**

- To make the students aware about automation today in the industry.
- To make the students aware about the tools used for automation.
- To help the students automate a complete process

| Unit | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Lectures |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | <p><b>Robotic Process Automation:</b> Scope and techniques of automation, About UiPath</p> <p><b>Record and Play:</b> UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.</p> <p><b>Sequence, Flowchart, and Control Flow:</b> Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow.</p>                                                                                                     | 10       |
| II   | <p><b>Data Manipulation:</b> Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example)</p> <p><b>Taking Control of the Controls:</b> Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points.</p> | 10       |

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|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| III | <p><b>Tame that Application with Plugins and Extensions:</b> Terminal plugin, SAP automation, Java plugin, Citrix automation, Mail plugin, PDF plugin, Web integration, Excel and Word plugins, Credential management, Extensions – Java, Chrome, Firefox, and Silverlight</p> <p><b>Handling User Events and Assistant Bots:</b> What are assistant bots? Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger, Monitoring image and element triggers, an example of monitoring email, Example of monitoring a copying event and blocking it, Launching an assistant bot on a keyboard event.</p>                                                                                                                                                        | 10 |
| IV  | <p><b>Exception Handling, Debugging, and Logging:</b> Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, debugging techniques, Collecting crash dumps, Error reporting.</p> <p><b>Managing and Maintaining the Code:</b> Project organization, Nesting workflows, Reusability of workflows, commenting techniques, State Machine, when to use Flowcharts, State Machines, or Sequences, using config files and examples of a config file, Integrating a TFS server.</p> <p><b>Deploying and Maintaining the Bot:</b> Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots, License management, Publishing and managing updates.</p> | 10 |

**Reference:**

1. Learning Robotic Process Automation, Alok Mani Tripathi, Packt, 1<sup>st</sup> Edition, 2018.
2. Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation, Srikanth Merianda, Createspace Independent Publishing, 1<sup>st</sup> Edition, 2018.
3. The Simple Implementation Guide to Robotic Process Automation (RPA): How to Best Implement RPA in an Organization, Kelly Wibbenmeyer, iUniverse, 1<sup>st</sup> Edition, 2018.

**Learning Outcome:**

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| The student will be able to:                                             |                |                                                                                                                 |         |
|--------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------|---------|
| 1. Implement automation of basic and advanced tasks using UiPath studio. |                |                                                                                                                 |         |
| 2. Understand basics of UiPath Orchestrator and robots.                  |                |                                                                                                                 |         |
| Unit                                                                     | Course Outcome | Description                                                                                                     | Levels  |
| I                                                                        | CO1            | Describe and Understand RPA using UiPath                                                                        | 1, 2    |
|                                                                          | CO2            | Describe and Understand the mechanism of the business process and can provide the solution in an optimized way. | 1, 2    |
| II                                                                       | CO3            | Describe and Understand the features used for interacting with database plugins.                                | 1, 2    |
| III                                                                      | CO4            | Understand and Use the plug-ins and other controls used for process automation.                                 | 2, 3    |
| IV                                                                       | CO5            | Understand, Use and Handle the different events, debugging and managing the errors.                             | 2, 3, 4 |
| V                                                                        | CO6            | Understand to Test and deploy the automated process.                                                            | 2       |

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**Semester III - Professional Electives**

| Course code | Course Name                                | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------------------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3P3a  | Computer Hacking<br>Forensic Investigation | PE    | 3                           | 40                                                     | 3      |

**Course Objective:**

- Explain laws relevant to computer forensics
- Seize digital evidence from pc systems
- Recover data to be used as evidence
- Analyse data and reconstruct events
- Explain how data may be concealed or hidden

| Unit | Topics                                                                                                                                                                                                                                     | Lectures |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | Computer Forensics: The present Scenario, The Investigation Process, Computers – Searching and Seizing, Electronic Evidence, Procedures to be followed by the first responder.                                                             | 10       |
| II   | Setting up a lab for Computer Forensics, Hard Disks and File Systems, Forensics on Windows Machine, Acquire and Duplicate Data                                                                                                             | 10       |
| III  | Recovery of deleted files and partitions, Using Access Data FTK and Encase for forensics Investigation, Forensic analysis of Steganography and Image files, Cracking Application passwords.                                                | 10       |
| IV   | Capturing logs and correlating to the events, Network Forensics – Investigating logs and Network traffic, Investigating Wireless and Web Attacks, Email Tracking and Email Crime investigation. Mobile Forensics, Reports of Investigation | 10       |

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**Reference:**

1. EC-Council CHFIv10 Study Guide, EC-Council, 2018.
2. The official CHFI Exam 312-49 study Guide, Dave Kleiman, SYNGRESS, 2007.
3. Digital Forensics and Incident Response, Gerard Johansen, Packt Publishing, 2020.
4. Guide to Computer Forensics and Investigations, Bill Nelson, Amelia Phillips, Christopher Stuarts, Course Technology, Cengage Learning, 4<sup>th</sup> edition, 2010.

**Learning Outcome:**

The students will be able to:

1. Learn various hacking techniques, data acquisition and investigation.
2. Practically handle different types of investigation and recovery tools.

| Unit | Course Outcome | Description                                                                                                                                           | Levels  |
|------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| I    | CO1            | Understand how to investigate cyber forensics with standard operating procedures.                                                                     | 2       |
| II   | CO2            | Understand and Analyze File systems, Hard disk, digital media, and image file forensics.                                                              | 2, 4    |
|      | CO3            | Understand windows forensics.                                                                                                                         | 2       |
| III  | CO4            | Understand how to recover and Analyze the data using forensics tool                                                                                   | 2, 4    |
| IV   | CO5            | Describe and Understand the knowledge of network analysis and Use it for analyzing internet attacks.                                                  | 1, 2, 3 |
|      | CO6            | Describe and Understand to investigate internet frauds done through various gadgets like mobile, laptops, tablets and become a forensic investigator. | 1, 2    |
|      | CO7            | Understand and Apply rules for report writing and presentation                                                                                        | 2, 3    |



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| Course code | Course Name  | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3P3b  | Advanced IOT | PE    | 3                           | 40                                                     | 3      |

**Course Objective:**

- To learn latest development techniques in Advanced IOT
- To relate and implement different aspects of Blockchain technologies into IOT applications.
- Use microservice architecture and wireless networks in advanced IOT applications

| Unit | Topics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Lectures |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | <b>The Artificial Intelligence 2.0</b> , IoT and Azure IoT Suite, Creating Smart IoT Application                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10       |
| II   | <b>Cognitive APIs</b> , Consuming Microsoft Cognitive APIs, Building Smarter Application using Cognitive APIs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 10       |
| III  | <b>Implementing Blockchain</b> as a service, Capturing, Analysing and Visualizing real-time data, Making predictions with machine learning.                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10       |
| IV   | <b>IoT and Microservices</b> , Service Fabric, build your own IoT platform: Introduction, building blocks for IoT solution, Essentials for building your own platform, Platform requirements, building the platform by initializing cloud instance, installing basic software stacks, securing instance and software, installing node.js and Node-RED, Message broker.<br><b>Building Critical components</b> , configuring message broker, creating REST interface, Rule engine and authentication, documentation and testing, Introspection on what we build and deliverables. | 10       |

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**Reference:**

1. IoT, AI, and Blockchain for .NET- Building a Next-Generation Application from the Ground Up, Nishith Pathak and Anurag Bhandari, Apress, 2018.
2. Microservices, IoT and Azure, Bob Familiar, Apress, 2015.
3. Build your own IoT Platform, Anand Tamboli Apress, 2019.
4. Internet of Things Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari Marco Picone, Luca Veltri, Wiley, 1<sup>st</sup> Edition, 2019.

**Learning Outcome:**

The students will be able to:

1. Understand the implementation of IoT in blockchain, Microservices.
2. Build smart applications using Cognitive API.

| Unit | Course Outcome | Description                                                              | Levels |
|------|----------------|--------------------------------------------------------------------------|--------|
| I    | CO1            | Understand latest developments in IOT                                    | 1      |
| II   | CO2            | Implement API to build smart IOT applications                            | 3, 5   |
| III  | CO3            | Relate Blockchain concepts to IOT applications                           | 4      |
| IV   | CO4            | Prepare full IOT application using concepts of Microservice Architecture | 3, 4   |

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**Seminar III - Career Advancement Course**

| Course code | Course Name                 | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|-----------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3C3   | Virtual & Augmented Reality | CAC   | 1                           | 40                                                     | 1      |

**Course Objective:**

- To understand the concepts of Virtual, Augmented and mixed realities
- To understand design principles for virtual and augmented reality for building virtual world and adding content
- To design models and ideas for VR, AR and mixed reality

| Unit | Topics                                                                                                                                                                                                                                                                                                                  | Lectures |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| I    | <b>Introduction:</b> What Is Virtual Reality, A History of VR, An Overview of Various Realities, Immersion, Presence, and Reality Trade-Offs, The Basics: Design Guidelines, Objective and Subjective Reality, Perceptual Models and Processes, Perceptual Modalities                                                   | 10       |
| II   | <b>Perception</b> of Space and Time, Perceptual Stability, Attention, and Action, Perception: Design Guidelines, Adverse Health Effects, Motion Sickness, Eye Strain, Seizures, and Aftereffects, Hardware Challenges, Latency, Measuring Sickness, Reducing Adverse Effects, Adverse Health Effects: Design Guidelines | 10       |
| III  | <b>Content Creation</b> , Concepts of Content Creation, Environmental Design, Affecting Behaviour, Transitioning to VR Content Creation, Content Creation: Design Guidelines, Interaction, Human-Centered Interaction, VR Interaction Concepts, Input Devices, Interaction Patterns and Techniques, Interaction:        | 10       |

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|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |    |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | Design Guidelines                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |
| IV | <p><b>Design and Art</b> Across Digital Realities, Designing for Our Senses, Virtual Reality for Art, 3D Art Optimization, Computer Vision That Makes Augmented Reality Possible Works, Virtual Reality and Augmented Reality: Cross-Platform Theory</p> <p><b>Virtual Reality Toolkit:</b> Open Source Framework for the Community, Data and Machine Learning Visualization, Design and Development in Spatial Computing, Character AI and Behaviors, The Virtual and Augmented Reality Health Technology Ecosystem</p> | 10 |

**Reference:**

1. The VR Book, Human Centered Design for Virtual Reality Jason Jerald, ACM Books, 1st edition, 2016.
2. Creating Augmented and Virtual Realities Erin Pangilinan, Steve Lukas, Vasanth Mohan, O'Reilly, 1st edition, 2019.
3. Virtual reality with VRTK4 Rakesh Baruah, APress, 1st edition, 2020.

**Learning Outcome:**

The students will be able to:

1. Understanding of principles of VR and AR.
2. Understand VR examples and applications.
3. Application of VR to a problem.
4. Understand trends and technology future VR experiences.

| Unit | Course Outcome | Description                                                 | Levels |
|------|----------------|-------------------------------------------------------------|--------|
| I    | CO1            | Understanding basic concepts of VR                          | 1      |
| II   | CO2            | Understanding design principles                             | 1      |
| III  | CO3            | Designing Content Creation for VR                           | 3      |
| IV   | CO4            | Designing models and ideas for digital, mixed and augmented | 3, 4   |

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**Semester III - PG Labs**

| Course code | Course Name                                 | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|---------------------------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3L5   | Deep Learning & Natural Language Processing | PGL   | 2                           | 20                                                     | 2      |

**Course Objective:**

Will be added after finalizing the contents.

**Learning Outcome:**

The students will be able to

1. create and build various neural networks.
2. implement various natural language processing concepts.

| Unit | Course Outcome | Description                                                                                                                           | Levels |
|------|----------------|---------------------------------------------------------------------------------------------------------------------------------------|--------|
|      | CO1            | Understand and implement the deep learning algorithms for solving the various problems.                                               |        |
|      | CO2            | Understanding and implementing the natural language processing technique to understand and generate the natural language text/speech. |        |

**Practical List:**

1. Implementing deep neural network for performing binary classification tasks.

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2. a) Using a deep feed forward network with two hidden layers for performing multiclass classification and predicting the class.  
b) Using a deep feed forward network with two hidden layers for performing classification and predicting the probability of class.  
c) Using a deep feed forward network with two hidden layers for performing linear regression and predicting values.
3. a) Evaluating feed forward deep network for regression using KFold cross validation.  
b) Evaluating feed forward deep network for multiclass Classification using KFold cross-validation.
4. Demonstrate recurrent neural network that learns to perform sequence analysis for stock price.
5. Implementation of convolutional neural network to predict numbers from number images
6. a. Study of various Corpus – Brown, Inaugural, Reuters etc. with various methods like fields, raw, words, sents, categories,  
b. Create and use your own corpora(plaintext, categorical)  
c. Study Conditional frequency distributions  
d. Study of tagged corpora with methods like tagged\_sents, tagged\_words.  
e. Write a program to find the most frequent noun tags.  
f. Map Words to Properties Using Python Dictionaries
7. a. Study of Wordnet Dictionary with methods as synsets, definitions, examples, antonyms.  
b. Study lemmas, hyponyms, hypernyms, entailments,  
c. Write a program using python to find synonym and antonym of word "active" using Wordnet  
d. Compare two nouns  
e. Handling stopword.  
f. Using nltk Adding or Removing Stop Words in NLTK's Default Stop Word List Using

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Gensim Adding and Removing Stop Words in Default Gensim Stop Words List.

g. Using Spacy Adding and Removing Stop Words in Default Spacy Stop Words List

8. Text Tokenization

a. Tokenization using Python's split() function

b. Tokenization using Regular Expressions (RegEx)

c. Tokenization using NLTK

d. Tokenization using the spaCy library

e. Tokenization using Keras

f. Tokenization using Gensim

9. Important NLP Libraries for Indian Languages and perform:

a. word tokenization in Hindi

b. Generate similar sentences from a given Hindi text input

c. Identify the Indian language of a text

10. Illustrate part of speech tagging.

a. Part of speech Tagging and chunking of user defined text.

b. Named Entity recognition of user defined text.

c. Named Entity recognition with diagram using NLTK corpus – treebank

| Course code | Course Name              | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3L6   | Cloud Solution Architect | PGL   | 2                           | 20                                                     | 2      |



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**Course Objective:**

1. To introduce AWS environment, configuration, routing, peering, creating cloud and managing cloud.
2. To set up a web server in ec2
3. To host a static website on s3, accessible over the internet
4. To setup and configure web application to create S3 bucket, upload a file and read its contents
5. To work on Amazon DynamoDB, and Redshift.
6. To introduce and implement AWS lambda and Amazon API gateway

**Practical List:**

**1 Introduction: Getting Familiarized with AWS Console.**

- A] Creating Aws Free Tier Account
- B] Getting Familiarised With The Aws Console

**2 An Aws Iam User : Creating an AWS IAM User**

- A] Explore users and groups
- B] Add users to groups
- C] Sign-In and test the users

**3 Working With S3 Buckets**

- A] Create a bucket
- B] Upload an object to the bucket
- C] Make an object public
- D] Create a bucket policy
- E] Explore versioning

**4 S3:Multi-Region Storage Backup with Cross-Region Replication**

- A] Create and configure source and destination buckets
- B] Enable cross region-replication on bucket
- C] Configure replication of a single folder
- D] Configure replication using tags

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E] Deleting replicated files

**5 Introduction to Amazon DynamoDB**

A] Create a new table

B] Add data

C] Modify existing items

D] Query the table

E] Delete the table

**6 Introduction to Amazon Redshift**

A] Launch an amazon redshift cluster

B] Launch Pgweb to communicate with the redshift cluster

C] Create a table

D] Load sample data from amazon S3

E] Query data

**7 Introduction to AWS Key management Service**

A] Create KMS master key

B] Configure cloudTrail to store Logs in an S3 Bucket

C] Upload an Image to S3 bucket and encrypt it

D] Access the encrypted image

E] Monitor KMS activity Using CloudTrail Logs

F] Manage encryption keys

**8 Introduction to AWS Lambda**

A] Overview Scenario

B] Create the Amazon S3 Buckets

C] Create an AWS Lambda Function

D] Test Your Function

E] Monitoring and Logging

F] Conclusion

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**9 Introduction to Amazon API Gateway**

A] Overview

B] Technical Concepts

C] Create a Lambda Function

D] Test the Lambda function

E] Conclusion

**10 Case Study: Amazon Architecture**

A] ABP News

B] Buzz dial

C] Classle

**Learning Outcome:**

The students will be able to:

1. Learn AWS architecture, services, relational management database systems, security, management and deployment.

| Unit | Course Outcome | Description                                                                                                  | Levels |
|------|----------------|--------------------------------------------------------------------------------------------------------------|--------|
|      | CO1            | To Understand and Apply AWS environment, configuration, routing, peering, creating cloud and managing cloud. | 2,3    |
|      | CO2            | To Understand and Apply an AWS IAM User.                                                                     | 2,3    |
|      | CO3            | To Understand and Apply Working with S3 Buckets.                                                             | 2,3    |
|      | CO4            | To Understand and Apply S3: Multi-Region Storage Backup with Cross-Region Replication.                       | 2,3    |
|      | CO5            | To Understand and Apply Amazon DynamoDB.                                                                     | 2,3    |
|      | CO6            | To Understand and Apply Amazon Redshift.                                                                     | 2,3    |

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|  |      |                                                                  |     |
|--|------|------------------------------------------------------------------|-----|
|  | CO7  | To Understand and Apply AWS Key management Service.              | 2,3 |
|  | CO8  | To Understand and Apply AWS Lambda.                              | 2,3 |
|  | CO9  | To Understand and Apply Amazon API Gateway.                      | 2,3 |
|  | CO10 | To Understand Amazon Architecture with the help of case studies. | 2   |

| Course code | Course Name                | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|----------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3L7   | Robotic Process Automation | PGL   | 2                           | 20                                                     | 2      |

**Course Objective:**

1. To Acquire knowledge of fundamental UI automation concepts
2. To Gain ability to create and debug workflows using UiPath
3. To Gain ability to Install and automate any process using UiPath

**Practical List:**

1.
  - a. Create a simple sequence-based project.
  - b. Create a flowchart-based project.
  - c. Create an UiPath Robot which can empty a folder in Gmail solely on the basis of recording.
2.
  - a. Automate UiPath Number Calculation (Subtraction, Multiplication, Division of numbers).
  - b. Create an automation UiPath project using different types of variables (number, datetime, Boolean, generic, array, data table)
3.
  - a. Create an automation UiPath Project using decision statements.
  - b. Create an automation UiPath Project using looping statements

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4.
  - a. Automate any process using basic recording.
  - b. Automate any process using desktop recording.
  - c. Automate any process using web recording.
5. Consider an array of names. We have to find out how many of them start with the letter "a". Create an automation where the number of names starting with "a" is counted and the result is displayed.
6.
  - a. Create an application automating read, write and append operation on excel file
  - b. Automate the process to extract data from an excel file into a datatable and vice versa
7.
  - a. Implement the attach window activity.
  - b. Find different controls using UiPath.
  - c. Demonstrate the following activities in UiPath:
    - i. Mouse (click, double click and hover)
    - ii. Type into
    - iii. Type Secure text
8.
  - a. Demonstrate the following events in UiPath:
    - i. Element triggering event
    - ii. Image triggering event
    - iii. System Triggering Event
  - b. Automate the following screen scraping methods using UiPath
    - i. Full Test
    - ii. Native
    - iii. OCR
  - c. Install and automate any process using UiPath with the following plug-ins:
    - i. Java Plugin
    - ii. Mail Plugin
    - iii. PDF Plugin
    - iv. Web Integration
    - v. Excel Plugin
    - vi. Word Plugin
    - vii. Credential Management
9.
  - a. Automate the process of sending mail events (on any email).
  - b. Automate the process of launching an assistant bot on a keyboard event.
  - c. Demonstrate the Exception handling in UiPath.
  - d. Demonstrate the use of config files in UiPath.
10.
  - a. Automate the process of logging and taking screenshots in UiPath.
  - b. Automate any process using the State Machine in UiPath.
  - c. Demonstrate the use of publish utility.
  - d. Create and provision Robot using Orchestrator.

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| <b>Learning Outcome:</b>                                                                                                                                                           |                |                                                                    |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------|--------|
| The student will be able to:                                                                                                                                                       |                |                                                                    |        |
| <ol style="list-style-type: none"> <li>1. Create automated processes using UiPath Studio.</li> <li>2. Implement and deploy automation events using UiPath Orchestrator.</li> </ol> |                |                                                                    |        |
| Unit                                                                                                                                                                               | Course Outcome | Description                                                        | Levels |
|                                                                                                                                                                                    | CO1            | To Understand and Design simple project                            | 2,3    |
|                                                                                                                                                                                    | CO2            | To Understand and Apply decision statements and Looping statements | 2,3    |
|                                                                                                                                                                                    | CO3            | To Understand and Apply recording features of UiPath               | 2,3    |
|                                                                                                                                                                                    | CO4            | To Understand and Apply different plugins of UiPath                | 2,3    |
|                                                                                                                                                                                    | CO5            | To Understand and Create the Robot and maintain the connection.    | 2,6    |

| Course code | Course Name                                | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------------------------------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3L8a  | Computer Hacking<br>Forensic Investigation | PGL   | 2                           | 20                                                     | 2      |

|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
| <b>Course Objective:</b>                                                                                   |
| <ol style="list-style-type: none"> <li>1. To introduce various hacking and investigation tools.</li> </ol> |

|                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Practical List:</b>                                                                                                                                                                                |
| <ol style="list-style-type: none"> <li>1. File System Analysis using The SleuthKit (Autopsy, fsstat, istat, fls and img_stat)</li> <li>2. a. Explore Windows forensic tools (OS Forensics)</li> </ol> |

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- b. Forensics Investigation Using Encase
- c. Using Mobile Forensics software tools
- d. Exploring Mobiledit Forensics
3. Using Forensic Toolkit (FTK) & Writing report using FTK (AccessData FTK)
4. a. Using File Recovery Tools [FTK Imager] Creating Image
- b. Recover Deleted files using Recuva, PC Inspector File Recovery, Recover My Files, R Studio
5. a. Using Web attack detection tools [Wireshark]
- b. Using Log & Traffic Capturing & Analysis Tools [Wireshark]
- c. Using Network Forensic Analysis Tool (NetworkMiner)
- d. Using Network Traffic Analyser tool Iris
6. Dump Memory contents using PMdump
7. Using Data Acquisition Tools [ProDiscover Pro]
8. a. Using Steganography Tools [S-Tools]
- b. Using Whitespace Stegnography tool SNOW
9. a. Performing Password Cracking [Cain & Abel]
- b. Performing Sniffing [Cain & Abel]
10. a. Managing Remote Registry, Network Enumeration, Services, s. IDs [Cain & Abel]
- b. Scan Registry using RegScanner
- c. Study Registry Viewer tool (Alien Registry Viewer)

**Learning Outcome:**

The student will be able to:

1. Install and use various tools for recovery, data acquisition, data duplication.

| Unit | Course Outcome | Description                                                                       | Levels |
|------|----------------|-----------------------------------------------------------------------------------|--------|
|      | CO1            | Understand how to investigate cyber forensics with standard operating procedures. | 2      |
|      | CO2            | Show how to recover the data from the hard disk with legal procedure.             | 3      |

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|  |     |                                                                                                                                             |   |
|--|-----|---------------------------------------------------------------------------------------------------------------------------------------------|---|
|  | CO3 | Show how to recover and Analyze the data using forensics tool                                                                               | 3 |
|  | CO4 | Acquire the knowledge of network analysis and Use it for analysing the internet attacks.                                                    | 4 |
|  | CO5 | Understand how to investigate internet frauds done through various gadgets like mobile, laptops, tablets and become a forensic investigator | 2 |

| Course code | Course Name  | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture) | Credit |
|-------------|--------------|-------|-----------------------------|--------------------------------------------------------|--------|
| RJSPIT3L8b  | Advanced IOT | PGL   | 2                           | 20                                                     | 2      |

**Course Objective:**

1. To introduce Azure, Microservice and APIs to build IOT smart applications

**Practical List:**

1. Loading Raspbian and Windows IoT Core on Raspberry Pi and executing applications on it using Python and node.js.
2. Create a home automation system and control the devices remotely.
3. Create the programs using the Microsoft Cognitive APIs for IoT.
4. Create blockchain on Raspberry Pi and implement and test it. Authenticate IoT with blockchain.
5. Implement Microservices on IoT devices.
6. Build your own IoT platform.
7. Use IoT devices with AWS.
8. Send telemetry from a device to an IoT hub and read it with a service application.
9. Use the Azure CLI and Azure portal to configure IoT Hub message routing.
10. Face Detection using IoT device. (Pi Camera or anything else).



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**Learning Outcome:**

The student will be able to:

1. Create smart IoT Application using Azure, Blockchain and microservice.

| Unit | Course Outcome | Description                                                  | Levels |
|------|----------------|--------------------------------------------------------------|--------|
|      | CO1            | Create smart IoT applications on Azure.                      | 6      |
|      | CO2            | Use Microsoft cognitive APIs to build IoT applications.      | 3      |
|      | CO3            | Implement Blockchain in IoT.                                 | 3      |
|      | CO4            | Install and use microservices in IoT.                        | 3      |
|      | CO5            | Create your own IoT platform and Use it in a customized way. | 6      |

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**Semester IV:**

| Course code | Course Name                         | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture ) | Credit | Marks |
|-------------|-------------------------------------|-------|-----------------------------|---------------------------------------------------------|--------|-------|
| RJSPIT4D1   | Dissertation – I<br>(Major Project) | DES   | -                           | 12                                                      | 12     | 300   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |  |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|
| <p><b>Course Objectives:</b><br/>The student should:</p> <ul style="list-style-type: none"> <li>● be able to apply relevant knowledge and abilities, within the main field of study, to a given problem</li> <li>● within given constraints, even with limited information, independently analyse and discuss complex inquiries/problems and handle larger problems on the advanced level within the main field of study</li> <li>● reflect on, evaluate and critically review one's own and others' scientific results</li> <li>● be able to document and present one's own work with strict requirements on structure, format, and language usage</li> <li>● be able to identify one's need for further knowledge and continuously develop one's own knowledge</li> </ul> |  |  |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|

| Course code | Course Name           | Group | Number of lectures per week | Total Number of Lectures Required (60 Minutes/Lecture ) | Credit | Marks |
|-------------|-----------------------|-------|-----------------------------|---------------------------------------------------------|--------|-------|
| RJSPIT4D2   | Industrial Internship | II    | -                           | 12                                                      | 12     | 300   |

|                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|
| <p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>● Explore career alternatives prior to graduation.</li> <li>● Integrate theory and practice.</li> <li>● Assess interests and abilities in their field of study.</li> <li>● Learn to appreciate work and its function in the economy.</li> <li>● Develop work habits and attitudes necessary for job success.</li> </ul> |  |  |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|

M.Sc. Information Technology Part II Syllabus

- |                                                                                                                                                                                                                                                                                                   |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"><li>● Develop communication, interpersonal and other critical skills in the job interview process.</li><li>● Build a record of work experience.</li><li>● Identify, write down, and carry out performance objectives related to their job assignment.</li></ul> |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

M.Sc. Information Technology Part II Syllabus

**Evaluation and Assessment**

1. The internal assessment marks shall be awarded as follows:

A. 30 marks (Any one of the following):

a. Written Test

or

b. SWAYAM NPTEL (Advanced Course) of minimum 20 hours and certification examination completed

or

c. Valid International Certifications (Prometric, Pearson, Certiport, Coursera, Udemy, edx and the like).

or

d. One certification mark shall be awarded one course only. For four courses, the students will have to complete four certifications.

B. 10 Marks

The marks given out of 40 for publishing the research paper should be divided into four course and should awarded out of 10 in each of the four courses.

2. Semester End Examination – 60 marks

Question paper covering all units

3. Evaluation of Practical 200 marks (50 marks for each practical)

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