Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College of Arts, Science & Commerce (Autonomous), Ghatkopar (W)

Affiliated to

University of Mumbai

Syllabus for MSc IT Part II (Semester III & IV)

Program: M.Sc. Information Technology
Program Code: RJSPIT

Choice Based Credit System Syllabus

(With effect from the academic year 2019-20)

Course Structure

Semester-III

Course Code	Course Nomenclature	Total Lectures	Credits	% of Assessment		
				Internal	EA	Total
RJSPIT301	Deep Learning	40	04	40	60	100
RJSPIT302	Robotics	40	04	40	60	100
RJSPIT303	Computer Hacking Forensics Investigation	40	04	40	60	100
RJSPIT304	Amazon Web Services	40	04	40	60	100
RJSPIT3P1	Deep Learning	20	02	-	50	50
RJSPIT3P2	Robotics	20	02	-	50	50
RJSPIT3P3	Computer Hacking Forensics Investigation	20	02	-	50	50
RJSPIT3P4	Amazon Web Services	20	02	-	50	50
	Total		24	-	-	**600**

Semester-IV

Course Code	Course Nomenclature	Total Lectures	Credits	% of Assessment		
				Internal	External	Total
RJSPIT401	Natural Language Processing	40	04	40	60	100
RJSPIT402	Software Defined Networking	40	04	40	60	100
RJSPIT403	Virtual & Augmented Reality	40	04	40	60	100
RJSPIT404	Blockchain Technology	40	04	40	60	100
RJSPIT405	Project	20	04	-	100	100
RJSPIT4P1	Natural Language Processing	20	02	-	50	50
RJSPIT4P2	Software Defined Networking	20	02	-	50	50
	Total		24	-	-	**600**

Total credits for M.Sc. Part II = Semester III: 24 + Semester IV: 24 = 48

Semester III

Course Code: RJSPIT301 **Course Name: Deep Learning**		
Lectures /Hrs. :40	**Total Marks: 100**	**Credits: 04**
Course Objectives: 1. To introduce deep learning and various types of neural network.		
Unit	**Description**	**No. of Lectures**
Unit I	**Introduction to Artificial Neural Networks** The biological neurons, The artificial neuron, ANNs and the backpropagation algorithm, Weight optimization, Stochastic gradient descent. **Training of neural networks** The various techniques used in training of artificial neural networks, Gradient descent rule, perceptron learning rule, tuning learning rate, A stochastic process, optimization techniques, Regularization techniques, regression techniques, Lasso L1, Ridge L2, vanishing gradients, transfer learning, Unsupervised pre-training, Xavier initialization, and vanishing gradients.	8
Unit II	**DNN: Deep Neural Networks** Mapping the human mind with Deep Neural Networks, various building blocks of Artificial Neural Networks, The architecture of DNN, its building blocks, The concept of reinforcement learning in DNN, The various parameters and layers, Activation functions and optimization algorithms in DNN.	8
Unit III	**CNN: Convolutional Neural Networks** Introduction to CNN, CNN's Application, Architecture of a CNN, Convolution and Pooling layers in a CNN. Understanding and visualizing a CNN, Transfer Learning and fine-tuning Convolutional Neural Networks, Feature maps, Kernel filter, pooling, Deploying convolutional neural network in TensorFlow.	8
Unit IV	**RNN: Recurrent Neural Networks** Intro to RNN Model, Application use cases of RNN,	8

	Modeling sequences, Training RNNs with Back-propagation, Long Short-Term Memory (LSTM), Recursive Neural Tensor Network Theory, Recurrent Neural Network Model, Basic RNN cell, unfolded RNN, training of RNN, and dynamic RNN, Time-series predictions.	
Unit V	**GPU in Deep Learning** Introduction to GPUs and how they differ from CPUs, The importance of GPUs in training Deep Learning Networks, The forward pass and backward pass training technique, The GPU constituent with simpler core and concurrent hardware. **Autoencoders & Restricted Boltzmann Machine (RBM)** Introduction to RBM and autoencoders, deploying it for deep neural networks, Collaborative filtering using RBM, Features of autoencoders, Applications of autoencoders.	8

References:

1. Nikhil Buduma, Nicholas Locascio "Fundamental of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", 1st Edition.
2. Laurene Fausett "Fundamentals of Neural Networks", 1st Edition.
3. B. Yegnanarayana "Artificial Neural Networks".
4. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly.
5. Giancarlo Zaccone, Md. Rezaul Karim, "Deep Learning with TensorFlow", 2nd Edition.
6. Douwe Osinga, "Deep Learning Cookbook: Practical Recipes To Get Started Quickly", O'Reilly.
7. Antonio Gulli, Amita Kapoor, "TensorFlow 1.x Deep Learning Cookbook, Packt.
8. Dr. PKS Prakash, Achyutuni Sri Krishna Rao, "R Deep Learning cookbook", Packt, 2017.
9. Francois Chollet, "Deep Learning with Python", Manning.

Learning Outcome:

1. The students will learn deep learning algorithm for various neural networks.
2. Building and evaluating the networks for various deep learning applications.

Unit	Course Outcome	Description
I	CO1	Understand the basics of Artificial Neural Networks and the hyperparameters, optimizers, activation functions and accuracy metric.
	CO2	Understand and Build the machine learning algorithms: Classification

		and Regression using the Multilayer Perceptron.
II	CO3	Understand the architecture of Artificial/Deep Neural Network, training, testing and validating the network/model. Understand the optimization techniques. Building and evaluating the ANN model using TensorFlow and Keras.
III	CO4	Understand the architecture and building blocks of the Convolutional Neural Network. Building and evaluating the CNN model using TensorFlow and Keras.
IV	CO5	Understand Recurrent Neural Network and sequential data. Learning case studies of RNN. Understand Forward and Back Propagation approaches of RNN.
V	**CO6**	Understand and Use the Graphical Processing Unit. Understand the Autoencoders and the Restricted Boltzmann Machine.

Course Code: RJSPIT3P1
Course Name: Deep Learning

Lectures/ Hrs. :20	**Total Marks :50**	**Credits : 02**

Course Objectives:

1. To introduce create and build neural networks.
2. Evaluate the neural networks.

Practical List

1. Building Artificial Neural Networks.
2. Training Neural Network.
3. Feed-Forward Neural Network.
4. Building Deep Neural Network.
5. Building Convolutional Neural Network.
6. Building Recurrent Neural Network.
7. Deep Reinforcement Learning.
8. Generative Adversarial Networks.

Learning Outcome:

1. The students will be able to create and build various neural networks.

Unit	**Course Outcome**	**Description**

	CO1	Understand and Use TensorFlow for mathematical operations.
	CO2	Understand and Use Keras to build the various neural networks.
	CO3	Building, Training, Testing, Validating and Evaluating the neural networks.

Course Code: RJSPIT302 **Course Name: Robotics**		
Lectures/ Hrs. :40	**Total Marks: 100**	**Credits : 04**

Course Objectives:

1. To introduce Robotics and its functional elements.
2. To explain the concepts of direct and inverse kinematics
3. To introduce the manipulator differential motion and control
4. To explain various path planning techniques
5. To introduce the dynamics and control of manipulators

Unit	**Description**	**No. of Lectures**
Unit I	**Basic Concepts** Brief history-Types of Robots–Technology-Robot classifications and specifications-Design and controlissues- Various manipulators – Sensors - work cell - Programming languages. Fundamentals of Robot Technology, Programming and Applications	8
Unit II	**Direct And Inverse Kinematics** Mathematical representation of Robots - Position and orientation – Homogeneous transformation - Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom- Direct Kinematics-Inverse kinematics- SCARA robots- Solvability – Solution Methods-Closed form solution	8
Unit III	**Manipulator Differential Motion and Statics** Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance. **Sensors and Effectors in Robotics** Types of effectors, mechanical grippers, transducers and sensors in	8

	Robotics	
Unit IV	**Path Planning** Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.	8
Unit V	**Dynamics And Control** Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation - Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.	8

References:

1. R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw Hill, 4th Reprint, 2005.
2. John J. Craig, "Introduction to Robotics Mechanics and Control", 3rd Edition, Pearson Education 2009.
3. M. P. Groover, M. Weiss, R. N. Nageland, N. G. Odrej, "Industrial Robotics", McGraw-Hill Singapore.
4. Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, Sixth impression, 2010.
5. K. K. Appu Kuttan, "Robotics", I K International, 2007.
6. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
7. B. K. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
8. S. Ghoshal, "Embedded Systems & Robotics – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

Learning Outcome:

1. Ability to understand basic concept of robotics.
2. To analyze Instrumentation systems and their applications to Robotics
3. Understanding of the differential motion and statics in Robotics
4. Understand various path planning techniques.
5. Understand dynamics and control in robotics industries.

Unit	Course Outcome	Description
I	CO1	Introduce, Recall and Explain basic concepts of robotics, work cells and programming languages associated with it.
	CO2	Apply the technologies and Visualize different applications

II	CO3	Construct and analyze mathematical representation of robots
	CO4	Apply DH Parameters to different types of robots and study solution methods and obtain solutions to evaluate solvability matrix
III	CO5	Obtain the solutions for combined linear and angular velocities experienced by robotic arm manipulator
	CO6	Construct static analysis of Force moment balance
IV	CO 7	Demonstrate use of joint space technique on p degree polynomial to generate position and orientation planning
V	CO8	Apply Lagrangian mechanics to manipulators to generate force control mechanics of robotic manipulator

Course Code: RJSPIT3P2
Course Name: Robotics

Lectures/ Hrs. :20	**Total Marks :50**	**Credits : 02**

Course Objectives:

1. To introduce robotic operating system, robotic programming and simulation for various robot activities.

Practical List

Using Robotic Operating System / UI Path

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system.
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place.
5. Robot programming and simulation for Color identification.
6. Robot programming and simulation for Shape identification.
7. Robot programming and simulation for machining (cutting, welding).
8. Robot programming and simulation for writing practice.
9. Robot programming and simulation for any industrial process (Packaging, Assembly).
10. Robot programming and simulation for multi process.

Learning Outcome:

1. The students will be able to do programming and simulation for various robot

	activities.	
Unit	**Course Outcome**	**Description**
	CO1	Implement the concepts of Robotics - DH Parameters, Transformation matrix, Rotation matrix etc
	CO2	Apply different techniques of path mapping, forward & inverse Kinematics using robotic simulators
	CO3	Build or generate a SCARA / PUMA robot with an end effector tool performing tasks like - cutting/ welding / painting

Course Code: RJSPIT303
Course Name: Computer Hacking Forensic Investigation

Lectures /Hrs. :40	**Total Marks: 100**	**Credits : 04**

Course Objectives:

1. To get an insight on the computer forensic world, investigation process and Data acquisition and duplication.
2. To understand anti-forensics techniques, Investigation of email crimes and web attacks.
3. To explore various forensic domains like Operating system, Network, Database and mobile forensics.
4. To understand significance and rules for report writing.

Unit	**Description**	**No. of Lectures**
Unit I	Computer forensics in today's world, Computer Forensics Investigation Process, Understanding hard disks and file systems.	8
Unit II	Data acquisition and duplication, Defeating anti-forensics techniques Operating system forensics.	8
Unit III	Network forensics, Investigating web attacks, Database forensics.	8
Unit IV	Cloud forensic, Malware forensics, Investigating email crimes.	8
Unit V	Mobile forensic, Forensics report writing and presentation1.	8

References:

1. IT Security and Risk Management (Main reference), Slay, J and Koronios, A , 2006

Edition, Wiley
2. Incident Response and Computer Forensics, Chris Prosise and Kevin Mandia, 2003 Edition, McGraw-Hill
3. Information Systems Security- Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, Wiley ,2009
4. Ethical Hacking Review Guide, Kimberly Graves, Wiley Publishing.
5. Ethical Hacking, Ankit Fadia, 2nd Edition, Macmillan India Ltd., 2006.
6. Insider Computer Fraud, Kenneth C, Brancik, 2008, Auerbach Publications.

Learning Outcome:

1. The students will learn various hacking techniques, data acquisition and investigation.

Unit	Course Outcome	Description
I	CO1	Describe forensics in today's world, the history of computer forensics, and its objectives and Understand what computer-facilitated crimes are as well as the reasons for cybercrime.
	CO2	Understand computer forensic flaws and risks, modes of attack, the stages of forensic investigation in tracking cyber criminals, concepts to be considered during the planning, construction, and operation of a data forensic facility. Analyze the rules of computer forensics and the legal issues surrounding computer forensics.
	CO3	Describe, Understand and Analyze File systems, Hard disk, digital media, and image file forensics
	CO4	Understand and Apply investigation of computer crime and company policy violations.
II	CO5	Understand, Apply and Differentiate various ways to recover deleted file and deleted partition and to acquire and duplicate data
	CO6	Describe and Understand anti-forensics techniques
	CO7	Describe, Understand and Apply windows and linux forensics
III	CO8	Understand techniques and concepts of network and database forensics
	CO9	Describe and Understand web attacks investigation

IV	CO10	Understand techniques and concepts of cloud and Malware forensics
	CO11	Describe and Understand email crimes and violations and Demonstrate the investigation of email crimes using tools and technique.
V	CO12	Understand the basic concepts of mobile device forensics and Describe procedures for acquiring data from cell phones and mobile devices
	CO13	Understand and create rules for report writing and presentation

Course Code: RJSPIT3P3
Course Name: Computer Hacking Forensic Investigation

Lectures/ Hrs. :20	**Total Marks: 50**	**Credits : 04**

Course Objectives:

1. To introduce various hacking and investigation tools.

Practical List

1. Using system hacking tools.
2. Study of backdoors and Trojan tools.
3. Study of sniffing tools.
4. Study of Denial-of-Service attack tools.
5. Study of Hijacking tools.
6. Study of webserver attack tools.
7. Study of SQL injection and web server tools.
8. Study of wireless hacking tools.
9. Data acquisition and imaging.
10. Investigation of drive and network.

Learning Outcome:

1. The students will learn various hacking techniques, data acquisition and investigation with the help of tools.

Unit	**Course Outcome**	**Description**
	CO1	Use tools for image processing and analysis
	CO2	Study and Use tools for duplicating the data and Create reports for the

		investigation case.
	CO3	Understand and Use tools for investigating drive and network
	CO4	Study and Use tools for acquiring data and perform steganography
	CO5	Use tools for mobile forensics and password recovery
	CO6	Study of sniffing and DoS tools

Course Code: RJSPIT304 **Course Name: Amazon Web Services**		
Lectures /Hrs. :40	**Total Marks: 100**	**Credits : 04**
Course Objectives: 1. To introduce AWS architecture, services, relational management database systems, security, management and deployment.		
Unit	**Description**	**No. of Lectures**
Unit I	**Introduction to AWS** What Is Cloud Computing, AWS Fundamentals, AWS Cloud Computing Platform. **Amazon Simple Storage Service (Amazon S3) and Amazon Glacier Storage** Object Storage versus Traditional Block and File Storage, Amazon Simple Storage Service (Amazon S3) Basics, Buckets, Amazon S3 Advanced Features, Amazon Glacier. **Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Elastic Block Store (Amazon EBS)** Amazon Elastic Compute Cloud (Amazon EC2), Amazon Elastic Block Store (Amazon EBS).	8
Unit II	**Amazon Virtual Private Cloud (Amazon VPC)** 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	8

	Gateways (VPGs), Customer Gateways (CGWs), and Virtual Private Networks (VPNs) **Elastic Load Balancing, Amazon CloudWatch, and Auto Scaling** Elastic Load Balancing, Amazon CloudWatch, Auto Scaling	
Unit III	**AWS Identity and Access Management (IAM)** Principals, Authentication, Authorization, Other Key Features **Databases and AWS** Database Primer, Amazon Relational Database Service (Amazon RDS), Amazon Redshift, Amazon DynamoDB **SQS, SWF, and SNS** Amazon Simple Queue Service (Amazon SQS), Amazon Simple Workflow Service (Amazon SWF), Amazon Simple Notification Service (Amazon SNS)	8
Unit IV	**Domain Name System (DNS) and Amazon Route 53** Domain Name System (DNS), Amazon Route 53 Overview **Amazon ElastiCache** In-Memory Caching, Amazon ElastiCache **Additional Key Services** Storage and Content Delivery, Security, Analytics, DevOps	8
Unit V	**Security on AWS** Shared Responsibility Model, AWS Compliance Program, AWS Global Infrastructure Security, AWS Account Security Features, AWS Cloud Service-Specific Security **AWS Risk and Compliance** Overview of Compliance in AWS, Evaluating and Integrating AWS Controls, AWS Risk and Compliance Program, AWS Reports, Certifications, and Third-Party Attestations **Architecture Best Practices** 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	8

References:

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).

Learning Outcome:

1. The students will learn AWS architecture, services, relational management database systems, security, management and deployment.

Unit	Course Outcome	Description
I	CO1	Understand and Demonstrate the knowledge of core architectural aspects of Cloud Computing, AWS Fundamentals, AWS Cloud Computing Platform.
	CO2	Describe, Understand about Amazon Simple Storage Service (Amazon S3) and Amazon Glacier Storage
	CO3	Describe, Understand about Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Elastic Block Store (Amazon EBS)
II	CO4	Describe, Understand and Apply the basic of Amazon VPC
	CO5	Describe, Understand and Apply the Elastic Load Balancing, Amazon CloudWatch, Auto Scaling
III	CO6	Understand and Demonstrate the Principals, Authentication, Authorization, Other Key Features of AWS IAM,
	CO7	Understand and Describe Databases and AWS , Amazon RDS, Amazon Redshift, Amazon DynamoDB
	CO8	Describe, Understand SQS, SWF, and SNS
IV	CO9	Describe, Understand Domain Name System (DNS), Amazon Route 53 Overview
	CO10	Describe, Understand Amazon ElastiCache and Additional Key Services
V	CO11	Describe, Understand Security on AWS
	CO12	Describe, Understand AWS Risk and Compliance
	CO13	Describe, Understand and Compare Architecture Best Practices

Course Code: RJSPIT3P4
Course Name: Amazon Web Services

Lectures/ Hrs. :20	Total Marks :50	Credits : 02

Course Objectives:

1. To introduce AWS environment, configuration, routing, peering, creating cloud and managing cloud.

Practical List

1. Getting Familiarized with AWS Console.
2. Creating an AWS IAM User.
3. Managing Virtual Private Cloud (VPC).
4. Creating and Configuring Internet Gateways.
5. Creating and Configuring NAT Gateways.
6. Configuring Routing Tables.
7. VPC Peering Between Two VPCs.
8. Working with Amazon Elastic Cloud Compute (EC2).
9. Creating and Configuring Security Groups.

Learning Outcome:

1. The students will learn AWS environment, configuration, routing, peering, creating cloud and managing cloud.

Unit	Course Outcome	Description
	CO1	Describe, Understand and discuss about AWS console and creating AWS Free Tier Account.
	CO2	Create and Implement an AWS IAM User.
	CO3	Create, Analyze and Implement Virtual Private Cloud (VPC).
	CO4	Creating and Configuring Nat Gateways.
	CO5	Create, Analyze VPC Peering Between Two VPC's.
	CO6	Create, Analyze Amazon Elastic Cloud Compute (Ec2).
	CO7	Creating and Configuring S3 Buckets.
	CO8	Creating and Configuring Security Groups.

Semester IV

Course Code: RJSPIT401 **Course Name: Natural Language Processing**		
Lectures/Hrs. :40	**Total Marks: 100**	**Credits : 04**
Course Objectives: 1. To introduce natural language processing concepts, Lexical processing, syntactic processing, semantic processing and modeling.		
Unit	**Description**	**No. of Lectures**
Unit I	**Lexical Processing** **Introduction to NLP** Regular expressions: Quantifiers – I, Regular Expressions: Quantifiers – II, Comprehension: Regular Expressions, Regular Expressions: Anchors and Wildcard, Regular Expressions: Characters Sets. Greedy versus Non-greedy Search, Commonly Used RE Functions Regular Expressions: Grouping, Regular Expressions: Use Cases. **Basic Lexical Processing** Word Frequencies and Stop Words, Tokenization, Bag-of-Words Representation, Stemming and Lemmatization, Final Bag-of-Words Representation, TF-IDF Representation, Building a Spam Detector - I, Building a Spam Detector – II. **Advanced Lexical Processing** Canonicalisation, Phonetic Hashing, Edit Distance, Spell Corrector -I, Spell Corrector – II, Pointwise Mutual Information – I, Pointwise Mutual Information – II.	8
Unit II	**Syntactic Processing** **Introduction to Syntactic Processing** Parsing, Parts-of-Speech, Different Approaches to POS Tagging, Lexicon and Rule-based POS Tagging, Stochastic Parsing, The Viterbi Heuristic, Markov Chain and HMM, Learning HMM Model, HMM and the Viterbi Algorithm: Pseudocode, HMM & the Viterbi Algorithm: Python Implementation, Deep Learning Based POS Taggers. **Parsing** Why Shallow Parsing is Not Sufficient, Constituency Grammars,	8

	Top-Down Parsing, Bottom-Up Parsing, Probabilistic CFG, Chomsky Normal Form, Dependency Parsing. **Information Extraction** Understanding the ATIS data, Information Extraction, POS Tagging, Rule-Based Models, Probabilistic Models for Entity Recognition, Naive Bayes Classifier for NER, Decision Tree Classifiers for NER, HMM and IOB labeling, CRFs - Another Probabilistic Approach. **Conditional Random Fields** Training a CRF model, Predicting using CRF, Python Implementation of CRF.	
Unit III	**Semantic Processing** **Introduction to Semantic Processing** Concepts and Terms, Entity and Entity Types, Arity and Reification Schema, Semantic Associations, Databases - WordNet and Concept Net, Word Sense Disambiguation - Naive Bayes, Word Sense Disambiguation - Lesk Algorithm, Lesk Algorithm Implementation. **Distributional Semantics** Occurrence Matrix, Co-occurrence Matrix, Word Vectors, Word Embeddings, Latent Semantic Analysis (LSA), Comprehension - Latent Semantic Analysis, Skipgram Model, Comprehension - Word2Vec, Generate Vectors using LSA, Basics of Topic Modelling with ESA, Introduction to Probabilistic Latent Semantics Analysis (PLSA).	8
Unit IV	**Topic Modelling** The Output of a Topic Model, Defining a Topic, Matrix Factorization Based Topic Modelling, Probabilistic Model, Probabilistic Latent Semantic Analysis (PLSA), Expectation Maximization in PLSA, Comprehension - Multinomial Distribution in Topic Modelling, Latent Dirichlet Allocation (LDA), LDA - An extension of PLSA Use LDA to Generate a Corpus, Parameter Estimation using Gibbs Sampling.	8
Unit V	**Building Chatbots with Rasa** Natural Language Understanding (NLU), Dialogue-Flow Management. Creating Conversational Stories & Defining Actions, Chatbot Deployment, ML and AI in Business.	8
References: 1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with		

Python", O'REILLY, 1st Edition.
2. Jalaj Thanaki, "Python Natural Language Processing", Packt.
3. Andy Smith, "Practical NLP", Kindle Edition.

Learning Outcome:

1. The students will learn natural language processing concepts, Lexical processing, syntactic processing, semantic processing and modeling.

Unit	Course Outcome	Description
I	CO1	Understand and Use the basics of NLP. Understand and Perform Lexical Analysis. Using various algorithms/ methods for Lexical processing.
II	CO2	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.
III	CO3	Understand and Perform the Semantic processing. Understand and Use the various database and algorithms for semantic processing.
IV	CO4	Understand and Use the various techniques and algorithms for Topic modelling.
V	CO5	Understand the various components of NLP. Understand the various case studies of NLP. Build and evaluate small applications of NLP.

Course Code: RJSPIT4P1
Course Name: Natural Language Processing

Lectures/ Hrs. : 20	Total Marks :50	Credits : 02

Course Objectives:

1. To introduce implementation of various natural language processing concepts.

Practical List

1. Word Analysis.
2. Word generation.
3. Morphology.
4. N-Grams.
5. N-Gram Smoothing.
6. POS Tagging: Hidden Marcov Model.
7. POS Tagging: Viterbi Decoding.

8. Building POS Tagger.
9. Chunking.
10. Building chunker.

Learning Outcome:

1. The students will be able to implement various natural language processing concepts.

Unit	Course Outcome	Description
	CO1	Understand and Implement the text preprocessing and analysis concepts.
	CO2	Build and Implement the models for NLP text processing.

Course Code: RJSPIT402
Course Name: Software Defined Networks

Lectures /Hrs. :40	Total Marks: 100	Credits : 04

Course Objectives:

1. To compare the layers of OSI and TCP/IP models and functionality of various fundamental elements of networking.
2. To describe the fundamental characteristics of SDN, definitions, use cases, and history.
3. To identify at a concept/definition level the OpenFlow® Protocol operations and list the packet types and contents.
4. To understand and identify SDN architectural components, standards bodies, controller design, API's and applications.

Unit	Description	No. of Lectures
Unit I	**Networking Concepts** Ethernet networks, Collision domains and broadcast domains Function of routers and switches, Routing Protocols (RIP, OSPF, ISIS, BGP) , Optical network fundamentals – SONET/SDH, OTN, IP Network Services (DHCP, DNS, ARP, NAT, ICMP), Layer 2 addressing, including address resolution, IPv4 and IPv6 fundamentals, Layer 3 / IP addressing, including subnet masks, Longest match routing, Connection-oriented vs. connectionless protocols, Packet Filtering with Match/Action Pairs.	8

Unit II	**SDN Concepts** History of SDN (Clean Slate, Ethane, OpenFlow®, donation to ONF), What is SDN? (Control and forwarding), SDN Value Proposition, SDN Use Cases in the Data Center, SDN Use Cases in Campus Networks, SDN Use Cases in Service Providers, SDN Use Cases in the Enterprise, SDN Use Cases in Mobile Networks, The six characteristics of an SDN Network (Plane Separation, Simplified Forwarding Element, Centralized Control, Network Automation, Virtualization, and Openness), SDN Devices (Controllers, Switches, Orchestration, API's), Overlay Networking Abstractions (NFV, VxLAN, etc.).	8
Unit III	**OPENFLOW** TCP level secure channel/communication/session establishment between controller/switch, Message Types, Basic Operation/Packet Matching, Differences between OpenFlow® versions, Proactive vs Reactive Flows Statistics/Counters, Setting up a flow, Policy Enforcement, OpenFlow® Management and Configuration Protocol (OF-Config, OAM, OFDPA, OVSDB, etc.), Flow Table Entry Format, Flow Timers, Pipeline Processing Match Types, Match Actions.	8
Unit IV	**SDN Architecture and Ecosystem** SDN Layers, SDN Architecture compared to Traditional Network, Architectures, Northbound API's, Southbound API's, East/West API's Security and Availability, Packet and Optical Integration methods Migration Strategies, Hybrid Mode Switches, Organization in the SDN Ecosystem, Standards Bodies and Industry alliances, Network Operators and Enterprises, Network Equipment Manufacturers, Software vendors Academic and Industry research institutions and labs, Open Source Initiatives, Purpose Structure, Technical Working Groups, Open Source Software Development, Activities and Initiatives, Controller Placement and Redundancy, SDN Applications (service chaining, virtualized network functions, analytics).	8
Unit V	**OpenFlow Agents** Indigo, Linc, OVS, CPqD/ONF Driver (aka "libFluid"), OpenFlow, Controllers, NOX, POX, ONOS, ODL, Floodlight, RYU, Open Source SDN Distributions (OSSDN Atrium, etc.), Open vSwitch, Orchestration Systems, Open-Source Initiatives (OPNFV, OCP, ODCA, Open Config).	8

Learning Outcome:

1. Identify and compare the layers of OSI and TCP/IP models and functionality of various fundamental elements of networking.
2. Describe the fundamental characteristics of SDN, definitions, use cases, and history.
3. Identify at a concept/definition level the OpenFlow® Protocol operations and list the packet types and contents.
4. Understand and Identify SDN architectural components, standards bodies, controller design, API's and applications.

Unit	Course Outcome	Description
I	CO1	Describe and Understand the layers of OSI and TCP/IP models and functionality of various fundamental elements of networking.
	CO2	Describe, Understand and Apply optical network fundamentals
II	CO3	Describe the fundamental characteristics of SDN, definitions, use cases, and history
	CO4	Understand and Apply SDN use cases in Campus Networks, Service Providers, Enterprise, Mobile Networks and Network Function Virtualization
III	CO5	Describe and Understand concept/definition level the OpenFlow Protocol operations and list the packet types and contents.
	CO6	Understand and Compare Flow table and reactive-proactive flow of message
IV	CO7	Describe and Understand layers of SDN architecture and applications of SDN
	CO8	Describe, Understand and Compare organization in SDN ecosystem
V	CO9	Describe and Understand OpenFlow controllers
	CO10	Understand Open vSwitch and Open-Source Initiatives

Course Code: RJSPIT4P2
Course Name: Software Defined Networks

Lectures	Total Marks :50	Credits : 02

/Hrs. :20		

Course Objectives:

1. To introduce SDN controllers, OpenFlow and HP Controller.

Practical List

1. Applications - Wireshark, Bash scripts, FlowMaker, HP Network Protector, HP Network Visualizer, HP Network Optimizer.
2. Controllers - Learn OpenDaylight (ODL), ONOS, RYU, Floodlight and the HP/HPE VAN SDN Controllers.
3. OpenFlow Infrastructure - Mininet switches (Open vSwitch).
4. Cool 4 port OpenFlow switch from Northbound Networks course content added.
5. Program a hardware OpenFlow switch with an SDN Controller and SDN app.
6. OpenFlow switch and integrate with SDN Controllers.
7. Setup a Pi Zero or other Pi with OpenFlow.
8. Install HP Controller.
9. Install FlowMaker on HP Controller.

Learning Outcome:

1. The student will be able to handle SDN controllers, OpenFlow and HP Controller.

Unit	Course Outcome	Description
	CO1	Understand and implement Wireshark and bash script application on ubuntu
	CO2	Describe and Understand Hewlett-Packard controller, HP Network Protector, HP Network Visualizer, HP Network Optimizer, Cisco XNC controller
	CO3	Understand and Install ODL controller and Implement OVS on ODL
	CO4	Understand and Implement Mininet topology
	CO5	Install and implement RYU, Floodlight and ONOS controller

Course Code: RJSPIT403
Course Name: Virtual and Augmented Reality

Lectures /Hrs. :40	Total Marks: 100	Credits : 04

Course Objectives:

1. To introduce the concepts of virtual reality, visual perception, visual rendering and virtual reality systems.
2. Study the Side effects of Virtual Reality and methods of obtaining a good VR solution.

Unit	Description	No. of Lectures
Unit I	**Introduction to Virtual Reality** What is Virtual Reality? Modern VR Experiences, History. **Introduction to Augmented Reality:** Definition and scope, Biref history, Examples, Related Fields. **Birds Eye View**: Hardware, Software, Human Physiology and Perception **Geometry of Virtual Worlds**: geometric models, changing position and orientation, viewing and chaining transformations.	8
Unit II	**Light and optics**: Basic behavior of light, lenses, optical aberrations, human eye, camera, displays. **Physiology of Human Vision**: From Cornea to photoreceptors, From photoreceptors to visual Cortex, Eye Movements, Implications for VR **Visual Perception:** Perception of depth, Perception of motion, perception of color, combining sources of Information, Visual Rendering.	8
Unit III	**Visual Rendering:** Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive photos and videos. **Motion in Real and Virtual World:** Velocities and accelerations, vestibular systems, mismatched motion and vection. **Tracking and Interaction:** Tracking 2D orientation, Tracking 3D orientation, Tracking attached bodies, 3D scanning environments, Motor programs and remapping, Locomotion, Manipulation, Social Interaction, Additional Interaction mechanisms.	8
Unit IV	**Audio:** physics of sound, Physiology of human hearing, Auditory perception, Auditory rendering. **Evaluating VR Systems and Experiences:** Perceptual Training, Recommendations for developers, Comfort and VR sickness, experiences on Human subjects.	8
Unit V	**Experience Design:** Applying VR to a problem, Will VR meet	8

	your goals? creating VR application, Designing a VR experience, The future of VR design. **Future of VR Reality:** The state of VR, The field of VR research, Trends, Technology Futures, Software, Application Futures.	

References:

1. Virtual Reality Stevan M LaValle, Cambridge university Press.
2. Understanding Virtual Reality: Interface, Application and Design William R. Sherman, Alan B. Craig.
3. Augmented Reality Principles and Practice Dieter Schmalstieg Tobias Hollered.

Learning Outcome:

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

Unit	Course Outcome	Description
I	CO1	List and Identify Virtual and Augmented Reality scenarios, Learn the Basic Concepts related to Virtual and Augmented Reality
	CO2	Demonstrate different geometric models to describe viewing transformations
II	CO3	Understand physiology of human eye and implement visual perception in a VR system
III	CO4	Visualize the concept of Visual Rendering and Implement Tracking and Interaction between 2D and 3D orientation of rigid bodies
IV	CO5	Analyze the concept of Audio perception and apply in VR / AR systems
	CO6	Evaluate the VR / AR system experience
V	CO7	Generate a case study by applying VR to a problem
	CO8	Study the present systems and predict the future of VR

Course Code: RJSPIT404
Course Name: Blockchain Technology

Lectures /Hrs. :40	Total Marks: 100	Credits : 04

Course Objectives:

1. Develop a thorough understanding of the fundamentals of Blockchain 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

Unit	Description	No. of Lectures
Unit I	**Blockchain Fundamentals** Introduction to Blockchain, Program Overview & Structure, Gartner's Hype Curve and Evolution of Blockchain Technology, Blockchain Need & Genesis, Key Characteristics of Blockchain, P2P System Cryptography, Hashing and Transactions, Digital Signatures, Blockchain Structure, Mining and Consensus, How Blockchain Works, Centralization and Decentralization, Byzantine General Problems, How is Blockchain Different, Smart Contracts, Story of mysterious Satoshi, Bitcoin Whitepaper, Understanding Bitcoin, Components of a Block, How they are joined together through Blockchain, Forks: soft & hard forks, Ummer blocks, Different forks from Bitcoin, Wallets, Transactions, Public & Private keys, Merkle tree, Mining, PoW, Nonce difficulty level, Double spending attack: Physical & digital world with history, How bitcoin can fix this, history of attacks on Bitcoin and crypto.	8
Unit II	**Web Technologies & Programming Fundamentals** Introduction to programming, Types of Programming & Software Development, Operating Systems – Ubuntu & RHEL, DBMS-Database Management System, Types of Database, Networking Cloud Computing, Basic Web – HTML5 / CSS3 / Bootstrap, Introduction to JavaScript, Code 2 (Arithmetic Operations), Inbuilt methods, Array, data types, operators, Logic and control structures, Objects and functions, Important concepts in functions, Object Oriented JS, Bugs and Error handling, ES6, Compiler, Introduction to Node.js & environment setup, Node.js Fundamentals, Node Module System & NPM, Create Server, API using Node JS & Express JS, MongoDB & MYSQL database, Asynchronous NodeJS – Async/Await, Web Sockets & HTTP Server.	8

Unit III	**Introduction to Ethereum** The need of Ethereum, Participation of users in Ethereum, Ethereum Foundation, Ethereum Whitepaper, How Ethereum Works, Ethereum network, Accounts & its creation, Ethereum Virtual Machine, Transactions and Types, Gas – Transactional Fee & Incentivization's, Blockchain Structure & Formation, Mining & Consensus, Smart Contracts, Consensus – PoW, New Proposal – PoS Casper, Introduction to DAO, Introduction to Dapp.	8
Unit IV	**Building Ethereum Applications** Dapp & its components, Client app, Smart contract Web3js, Use Metamask to do transaction, Use the account keys directly to the application, Programming languages, Types of Architecture design, Client, Web3js, Network, Account/wallet. Client, Middleware, Web3js, Network, Account/wallet Programming in Solidity & Introduction, What is solidity, Solidity basics, Solidity Data Types, Functions and modifiers, Inheritance, Libraries, Solidity Events, ERC20, ERC223, ERC771 Tokens, Auditing security and testing, Using Remix, Testnet, Metamask, Test RPC, Dapp Development Tools.	8
Unit V	**Alternate Public, Federated and Private Blockchain and comparisons** Limitation of Public Blockchains, Limited scalability, Limited privacy, Storage, constrains, Non scalable consensus, Lack of tools, Lack of query capability. **Enterprise expectations on Blockchain** Highly scalable, Granular level permission, Using existing storage, Rich query interface, Integration with legacy systems, Interoperability between Blockchain platforms, Private transactions, What is private and Consortium Blockchain. **Benefits of private Blockchain** Network governance, Transactions is cheap, Validators are known, Transaction approval is fast, Read permission is restricted.	8

References:

1. 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.

Learning Outcome:

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
I	CO1	Understand the technical fundamentals of Blockchain Technology.
	CO2	Understand and Describe the core components of Blockchain.
	CO3	Understand and Demonstrate the concepts of Bitcoin as a cryptocurrency use case of Blockchain.
II	CO4	Understand and Apply Web Technologies Tools.
	CO5	Understand and Apply Programming concept in Blockchain implementation.
III	CO6	Understand how Blockchain could be programmed with Ethereum Blockchain.
	CO7	Understand and Use the various Ethereum client applications.
IV	CO8	Understand the fundamentals of Solidity Programming Language. Apply it to design smart contract.
	CO9	Design, build, and deploy smart contracts.
V	CO10	Understand and Analyze various blockchain types.
	CO11	Evaluate and Differentiate between the various cloud Characteristics.

Course Code: RJSPIT405 **Course Name: Project**	
Total Marks : 100	**Credits : 04**

Learning Outcome:

1. Apply the concepts, tools and Techniques to the specific application, that use learnt during the program. Design, Develop, Test and Deploy the project into the required environment.

Unit	Course Outcome	Description
	CO1	Apply the concepts, Tools and Techniques to the specific the application, that use learnt during the program.
	CO2	Design, Develop, Test and Deploy the project into the required environment.
	CO3	Evaluate the performance of the application project.

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