

**SCHEME OF INSTRUCTION & EXAMINATION**

**B.E. (INFORMATION TECHNOLOGY) – VII Semester**

S. No.	Course Code	Course Title	Scheme of Instruction			Contact Hours / Week	Scheme of Examination		Duration in Hours	Credits
			L	T	P / D		CI E	SEE		
<b>Theory Courses</b>										
1.	SPC 701 IT	Internet of Things	3	-	-	3	40	60	3	3
2.	SPE – IV	Professional Elective – III	3	-	-	3	40	60	3	3
3.	SPE – V	Professional Elective – IV	3	-	-	3	40	60	3	3
4.	SPE – VI	Professional Elective – V	3	-	-	3	40	60	3	3
5.	SOE – II	Open Elective – II	3	-	-	3	40	60	3	3
<b>Practical / Laboratory Courses</b>										
6.	SPC 711 IT	Internet of Things Lab	-	-	4	4	40	60	3	2
7.	SPE 712 IT	Professional Elective – III Lab	-	-	2	2	40	60	3	1
8.	SPE 713 IT	Professional Elective – IV Lab	-	-	2	2	40	60	3	1
9.	SPW 711 IT	Project Work – I	-	-	6	6	50	-	3	3
			<b>15</b>	<b>-</b>	<b>14</b>	<b>29</b>	<b>370</b>	<b>480</b>	<b>27</b>	<b>22</b>

<b>Professional Elective – III</b>		
<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>
1.	SPE 721 IT	Database Security
2.	SPE 722 IT	Deep learning
3.	SPE 723 IT	Data mining & Data ware housing
4.	SPE 724 IT	Cloud computing
5.	SPE 725 IT	PHP

<b>Professional Elective – IV</b>		
<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>
1.	SPE 731 IT	IOT Security
2.	SPE 732 IT	Big Data Analytics
4.	SPE 733 IT	Data Science using R
5.	SPE 734 IT	VLSI Design
6.	SPE 735 IT	Agile Software Development

<b>Professional Elective – V</b>		
<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>
1.	SPE 741 IT	Computer Forensics
2.	SPE 742 IT	Semantic Web
3.	SPE 743 IT	Data Science & Virtualization
4.	SPE 744 IT	Block chain Technology
5.	SPE 745 IT	Software Quality Assurance & Testing

<b>Open Elective – I</b>		
<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>
1.	SOE 751 CSE	SOFTWARE ENGINEERING
2.	SOE 752 CSE	DATA SCIENCE USING R
3.	SOE 753 ADC	DATABASE MANAGEMENT SYSTEMS
4.	SOE 754 ECE	INTERNET OF THINGS
5.	SOE 755 ECE	FUNDAMENTALS OF IoT
6.	SOE 756 ECE	DIGITAL SIGNAL PROCESSING
7.	SOE 757ECE	EMBEDDED SYSTEMS AND ITS APPLICATIONS
8.	SOE 758 IT	CYBER SECURITY
9.	SOE 759 MBA	INTELLECTUAL PROPERTY RIGHTS

Course Code	Course Title				Core / Elective		
SPC 701 IT	Internet of Things				Core		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Embedded System	3	-	-	-	40	60	3

**Course Objectives:**

1. To explore the design characteristics of IoT, Communication models between processes or applications in heterogeneous environments for engineering problems.
2. To impart knowledge on enabling technologies, techniques, resources, and use of modern IT tools for providing IoT-based based solutions.
3. To apply contextual knowledge to assess the commercial applications/tools/technologies by considering societal, health, safety, legal and cultural issues for IoT applications.

**Course Outcomes:**

At the end of the course, students will be able to

1. Demonstrate the basic principles as well as the core concepts related to the Internet of Things.
2. Analyze the core architectural concepts to meet the challenges in implementing the connected devices.
3. Describe different types of sensors and programming aspects for the domain specific IoT.
4. Differentiate between the Network Layer protocols and Application layer protocols.
5. Design an IoT network and push the real-time data to the cloud server.

**UNIT-I**

**Introduction to the Internet of Things:**

Definition & Characteristics of IoT, Genesis of IoT, IoT Impact and Challenges

**IoT Network Architecture and design:** M2M IoT Architecture, IoT World Forum Standardized Architecture, Simplified IoT Architecture, Core IoT Functional stack.

**Application Domains of IoT:** Smart Home, Smart Cities, Smart Environment, Logistics, Agriculture, Industry, Health, and Lifestyle.

## **UNIT-II**

### **Engineering IoT Networks**

**Things in IoT:** Sensors, Actuators, Smart Objects, Wireless Sensor Networks, Communication protocols in WSNs, Criteria for connecting smart objects, IoT Access Technologies, IEEE 802.15.4 standard.

## **UNIT-III**

**IP at the IoT Network Layer:** Need for optimization in IP in IoT Networks, IP versions, 6LoWPAN, Comparison of IP protocol stack and IoT Protocol stack, IP Protocol for smart objects (IPSO) Alliances.

## **UNIT-IV**

**IoT Application Layer protocols:** COAP, MQTT, Message format, Comparison between COAP and MQTT Protocol.

## **UNIT-V**

**IoT Platforms Design Methodology:** Introduction, IoT Platform Design Methodology, IoT Physical Devices & Endpoints, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Other IoT Devices, ESP32 functional diagram and programming.

**IoT Physical Servers & Cloud Offerings:** Introduction to Cloud Storage Models & Communication APIs, WAMP – Auto Bahn for IoT, Firebase cloud operations, Integration of Firebase with ESP32.

### **Text Books:**

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, et.al, Pearson Publisher, 1<sup>st</sup> Edition.
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things: A Hands-On Approach, VPT edition1, 2014.
3. Jonathan Follett, Designing for Emerging - UX for Genomics, Robotics, and the Internet of Things Technologies, O 'Reilly, 2014.

Course Code	Course Title					Core / Elective	
SPE 721 IT	Database Security					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Database Systems and Mathematics	3	-	-	-	40	60	3

**Course Objectives:**

1. To study the different models involved in database security and their applications in real time world
2. To protect the database and information associated with them.
3. To statistical Database Protection & Intrusion Detection Systems

**Course Outcomes:**

At the end of the course, students will be able to

1. understand unauthorized data, data modification and data confidentiality
2. Manage database security on application level
3. Conduct database auditing for security and reliability.
4. Design and implement secure database systems.
5. Implement typical security projects on enterprise systems.

**UNIT-I**

Introduction to Databases Security Problems in Databases Security Controls Conclusions, Security Models

Introduction Access Matrix Model Take-Grant Model Acten Model PN Model Hartson and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases

**UNIT-II**

**Security Models:-** Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu's Model The Lattice Model for the Flow Control conclusion Security Mechanisms Introduction User Identification/Authentication Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria

**UNIT-III**

**Security Software Design Introduction** A Methodological Approach to Security Software Design  
Secure Operating System Design Secure DBMS Design Security Packages Database Security Design  
Statistical Database Protection & Intrusion Detection Systems Introduction Statistics Concepts and  
Definitions Types of Attacks Inference Controls evaluation Criteria for Control Comparison  
.Introduction IDES System RETISS System ASES System Discovery

#### **UNIT-IV**

Models For The Protection of New Generation Database Systems -1 Introduction A Model for the  
Protection of Frame Based Systems A Model for the Protection of Object Oriented Systems SORION  
Model for the Protection of Object-Oriented Databases

#### **UNIT-V**

Models For the Protection of New Generation Database Systems -2 A Model for the Protection of New  
Generation Database Systems: the Orion Model Jajodia and Kogan's Model A Model for the  
Protection of Active Databases Conclusions

#### **Textbooks:**

1. Database Security and Auditing, Hassan A. Afyouni, India Edition, CENGAGE Learning, 2009.
2. Database Security, Castano, Second edition, Pearson Education.

#### **Reference Book:**

1. Database security by alfred basta, melissa zgola, CENGAGE learning

Course Code	Course Title				Core / Elective		
SPE 722 IT	Deep Learning				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Machine Learning	3	-	-	-	40	60	3

**Course Objectives:**

1. To understand the theoretical foundations, algorithms and methodologies of Neural Network
2. To design and develop an application using specific deep learning models
3. To provide practical knowledge in handling and analyzing real world applications.

**Course Outcomes:**

Upon completion of the course, the students will be able to

1. Understand and Apply different neural network algorithms for variety of problems.
2. Understanding the Deep learning architectures.
3. Identify and apply appropriate CNN and Transfer learning algorithms for variety of problems.
4. Understand and Apply different sequence to sequence models for variety of problems.
5. Apply auto-encoders in NLP, Speech applications

**UNIT-I**

**Introduction:** History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, And Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks.

**UNIT-II**

**Activation functions and parameters:** Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parametersv/s Hyper-parameters

**UNIT-III**

**Auto-encoders & Regularization:** Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization



## UNIT-IV

**Deep Learning Models:** Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Applications

## UNIT-V

**Sequence Modelling:** Introduction to Recurrent Neural Networks (RNN), Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, Bidirectional RNNs, BPTT for training RNN, Long Short-Term Memory (LSTM) Networks.

**Deep Learning Applications:** Image Processing, Natural Language Processing, Speech recognition, Video Analytics

### Textbook:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media,2017
3. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to understanding deep neural networks” Apress, 2018.

### Reference Books:

1. Bengio, Yoshua. “Learning deep architectures for AI.” Foundations and trends in Machine Learning 2.1, Now Publishers, 2009
2. Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.
3. NPTEL : <https://nptel.ac.in/courses/106/106/106106184/>
4. COURSEERA: <https://www.coursera.org/specializations/deep-learning>
5. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

Course Code	Course Title				Core / Elective		
SPE 723 IT	Data mining & Data ware housing				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Database Management and Systems	3	-	-	-	40	60	3

**Course Objectives:**

1. To understand the principles of Data warehousing and Data Mining.
2. To be familiar with the Data warehouse architecture and its Implementation.
3. To understand the various Data preprocessing Methods and perform classification and prediction of data.

**Course Outcomes:**

Upon completion of the course, the students will be able to

1. Design a data warehouse or data mart to present information needed by the clients.
2. Design and implement a quality data warehouse or data mart effectively and administer the data resources in such a way that it will truly meet management's requirements.
3. Evaluate standards and new technologies to determine their potential impact on your information resource for a large complex data warehouse/data mart.
4. Use data mining tools for projects and to build reliable products as per demand.
5. Technical know-how of the Data Mining principles and techniques for real time applications.

**UNIT-1**

**Data Warehousing and Business Analysis:** - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

**UNIT-II**

**Data Mining:** - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.  
**Association Rule Mining:** - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

## UNIT-III

**Classification and Prediction:** - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

## UNIT-IV

**Cluster Analysis:** - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

## UNIT-V

### **Mining Object, Spatial, Multimedia, Text and Web Data:**

Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

### **Text Books**

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2011.

### **Reference Books**

- Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
- K.P. Soman, Shyam Diwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
- G. K. Gupta “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006.
- Pang-Ning Tan, Michael Steinbach and Vipin Kumar “Introduction to Data Mining”, Pearson Education, 2007.

Course Code	Course Title					Core / Elective	
SPE 724 IT	Cloud Computing					Core	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Distributed Systems	3	-	-	-	40	60	3

**Course Objectives:**

1. To introduce the concept of Virtualization and cloud computing
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios
3. To enable students exploring some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

**Course Outcomes:**

Upon completion of the course, the students will be able to

1. An ability to create VM, migrate and provide QOS to the committed users
2. Analyze, identify, and select suitable type of virtualization
3. Appreciate the requirements of various service paradigms in Cloud Computing
4. An ability to use techniques, skills in secured cloud environment
5. Design, implement and evaluate a cloud-based system, process, component, or program to meet desired needs

**UNIT-I**

**Introduction:** Overview of Computing Paradigm, Cloud Computing- Types of cloud Deployment models - Private, Public, Hybrid, Agency Clouds - Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Anything as a Service (XaaS)

**Virtualization:** Types - Implementation Levels –Structures-Tools, CPU, Memory, I/O Devices, Virtual Clusters and Resource management – Virtualization for Data-center Automation

**UNIT-II**

**Virtualization Techniques:** Virtual Machine Basics – Taxonomy of Virtual machines - Server Virtualization – Physical and Logical Partitioning - Types of Server Virtualization, VM Provisioning and Manageability-Virtual Machine Migration Service-Distributed Management of Virtual Machines-Scheduling Techniques

### UNIT-III

**Cloud Platforms in Industry:** Cloud Environments - Case study: One cloud service provider per service model (e.g., Amazon EC2, Google App Engine, Sales Force, Azure, Open-Source tools) - Cloud application development using third party APIs, Working with EC2 API – Google App Engine API -Facebook API, Twitter API, HDFS, Map Reduce Programming Model.

### UNIT-IV

**Security Overview:** Cloud Security Challenges and Risks – Software-as-a- Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security –Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic Security.

### UNIT-V

**Legal issues & Metrics:** SLA Model-Types of SLA - SLA management. Legal issues in cloud computing, Selected Business Use Cases- The ERP Hosting Use Case Scenario- The Enterprise IT Use Case Scenario - The Service Aggregator Use Case Scenario- The eGovernment Use Case Scenario. - Performance metrics: Consistency, Availability and Partitioning (CAP theorem).

Advanced concepts in cloud : Scientific cloud applications - Energy efficiency in clouds- Market-based management of clouds - Federated clouds/InterCloud - Third-party cloud services – Mobile Cloud Computing

#### **Text Books:**

1. RajkumarBuyya, ChirstianVecchiola, S.ThamaraiSelvi, “Mastering Cloud Computing” , Tata McGraw Hill,2017
2. Sehgal, Naresh, Bhatt, Pramod Chandra P., Acken, John M, “Cloud Computing with Security Concepts and Practices, Springer International Publishing”, 978-3-030-24612-9,2020
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers,2013

#### **Reference Books:**

1. RajkumarBuyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2013
2. Tim Mather, SubraKumaraswamy, and ShahedLatif, “ Cloud Security andPrivacy”,Oreilly,2009
3. Ronald L. Krutz, Russell Dean Vines, “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley-India, 2010

Course Code	Course Title					Core / Elective	
SPE 725 IT	PHP					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Distributed Systems	3	-	-	-	40	60	3

**Course Objectives:**

1. To provide fundamental concepts of server-side script programming and client-side script programming using JavaScript and PHP respectively.
2. To provide server-side and client-side script programming
3. To provide script programming along with database connectivity.

**Course Outcomes:**

Upon completion of the course, the students will be able to

1. Acquire skills in client-side scripting.
2. To gain knowledge on server-side scripting with Database Connectivity.
3. To design better and fast webpages using AJAX.
4. Able to develop more effective and efficient web-based application packages using WordPress.
5. To design simple and productive to build web applications using Ruby.

## UNIT-I

**Client Side Scripting: JavaScript:** Introduction, Need of Client Side Scripting Language, Formatting and Coding Conventions, JavaScript Files, Comments, Embedding JavaScript in HTML, Using Script Tag, NoScript Tag, Operators, Control Structures, Array and For Each Loop, Defining and Invoking Functions, Built in Objects, Date Objects, Interacting With The Browser, Windows & Frames, Document Object Model, Event Handling, Forms, Cookies, Handling Regular Expression, Client Side Validations.

## UNIT-II

**Server Side Scripting with Database Connectivity: PHP:**Introduction to Server Side Scripting Language, PHP introduction. Basic PHP Syntax, Comments in PHP, Variables, PHP Operators, Control Structures(If else, switch, all loops), Arrays, For Each Loop, Functions, Form Handling, PHP \$\_GET, PHP \$\_POST, PHP \$\_REQUEST, PHP date () Function, PHP include File, File Handling, File Uploading, PHP Sessions, Sending Emails, PHP Cookies.

**Advanced Server Side Scripting : Object Oriented Programmng in PHP:**Classes and Objects, Defining and Using properties and methods, Constructors and Destructors, Method Overriding, Encapsulation, Inheritance, Polymorphism, Static Members, Exception Handling

## UNIT-III

**AJAX(Asynchronons JavaScript and XML):**Using PHP, Using PHP +MySQL

**jQuery:**Playing With Elements, Hiding and Unhiding Images. JQuery UI

**JOOMLA:**Introduction To CMS, Installation, Handling Joomla Back End.. Customization In Joomla, Introduction To Extensions, Installation and Uses Of Extensions in Joomla, Template Development In Joomla, Artiseer(IDE), Module Development In Joomla, Component Development In Joomla, Introduction To MVC(Model, View and Controller)

## UNIT-IV

**WordPress Administrator Level:**Theme Integration, Creating pages, Managing Posts, Managing Widgets

## UNIT-V

**Introduction:** Ruby, Rails, the structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and webservices RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling Extending Ruby: Ruby Objects in C, the Jukebox extension, Memory allocation, Ruby Type System, Embedding Ruby to Other Languages, Embedding a Ruby Interpreter

### Text Books

1. Harvey M. Deitel, Paul J. Deitel & Abbey Deitel, “Internet and World Wide Web: How to Program”, 5th Edition, Pearson Education, 2012, ISBN: 9780273764021
2. Robin Nixon, “Learning PHP, MySQL, JavaScript and CSS”, 2<sup>nd</sup> Edition, O’ Reilly Media, 2012, ISBN 978-44-9319267

**Reference Books:**

1. Da Flanagan. "JavaScript; The Definitive Guide", O' Reilly Media, 2011. ISBN. 139780596505524
2. David Sawyer McFarland, "JavaScript & jQuery; The Missing Manual" 2nd Edition, Pogue Press, 2011, ISBN: 978-1449399023
3. Luke Welling & Laura Thomson, "PHP and MySQL Web Development", 5th Edition, Developer's Library, 2014, ISBN: 978-0321833891



Course Code	Course Title					Core / Elective	
SPE 731 IT	IOT Security					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
IOT	3	-	-	-	40	60	3

**Course Objectives:**

1. Reduce hacks and breaches.
2. Gain early compliance with relevant standards.
3. Increase IOT security and business agility.

**Course Outcomes:**

Upon completion of the course, the students will be able to

1. Understand the Security requirements in IOT.
2. Understand the cryptographic fundamentals for IOT
3. understand the authentication credentials and access control
4. Understand the various types Trust models.
5. Understand the Cloud Security for IOT.

**UNIT-I**

**Introduction: Securing the Internet of things:** Security Requirements in IOT Architecture-Security in Enabling Technologies-Security Concerns in IOT Applications. Security Architecture in the Internet of Things - Security Requirements in IOT-Insufficient Authentication/Authorization-Insecure Access Control-Threats to Access Control, Privacy, and Availability- Attacks Specific to IOT. Vulnerabilities –Secrecy and Secret-Key Capacity -Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

**UNIT-II**

**Cryptographic Fundamentals for IOT :** Cryptographic primitives and its role in IOT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IOT messaging and communication protocols – IOT Node Authentication

**UNIT-III**

**Identity & Access Management Solutions for IOT:** Identity lifecycle – authentication credentials – IOT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control.

## **UNIT-IV**

**Privacy Preservation and Trust Models for IOT :** Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IOT – self-organizing Things - Preventing unauthorized access.

## **UNIT-V**

**Cloud Security for IOT :**Cloud services and IOT – offerings related to IOT from cloud service providers – Cloud IOT security controls – An enterprise IOT cloud security architecture – New directions.in cloud enabled IOT computing.

### **Textbooks:**

1. Fei HU, “Security and Privacy in Internet of Things (IOTs): Models, Algorithms, and Implementations”, CRC Press,2016
2. Russell, Brian and Drew Van Duren, “Practical Internet of Things Security”, Packet Publishing, 2016.
3. Ollie Whitehouse, “Security of Things: An Implementers’ Guide to Cyber-Security for Internet of Things Devices and Beyond”, NCC Group, 2014

### **References:**

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Securing the Internet of Things Elsevier
3. Security and Privacy in Internet of Things (IOTs): Models, Algorithms, and Implementation

Course Code	Course Title				Core / Elective		
SPE 732 IT	Big Data Analytics				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Database Management System	3	-	-	-	40	60	3

**Course Objectives:**

1. Understand the Big Data Platform and its Use cases
2. Provide an overview of Apache Hadoop, HDFS and Map Reduce
3. Provide hands on Hadoop Eco System and Apply analytics on Structured, Unstructured Data.

**Course Outcomes:**

The students will be able to:

1. Identify Big Data and its Business Implications.
2. Understand the components of Hadoop and Hadoop Eco-System
3. Access and Process Data on Distributed File System
4. Develop Big Data Solutions using Hadoop Eco System
5. Analyze Infosphere Big Insights Big Data Recommendations.

**UNIT-I**

**Introduction to Big Data and Hadoop:** Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

**UNIT-II**

**HDFS(Hadoop Distributed File System) :** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

### UNIT-III

#### Map Reduce

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

### UNIT-IV

**Hadoop Eco System: Pig:** Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

**Hive:** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

**HBase:** Basics, Concepts, Clients, Example, Hbase Versus RDBMS.

**Big SQL:** Introduction

### UNIT-V

**Spark Framework:** Overview of Spark, Hadoop vs Spark, Cluster Design, Cluster Management, performance, Application Programming interface (API): Spark Context, Resilient Distributed Datasets, Creating RDD, RDD Operations, Saving RDD, Lazy Operation, Spark Jobs

**Data Analysis with Spark Shell:** Writing Spark Application, Spark Programming in Scala, Python, R, Analyzing big data with twitter ,Big data for E-Commerce Big data for blogs, Review of Basic Data Analytic Methods using R.

#### Textbooks:

1. Tom White, “Hadoop: The Definitive Guide”, O’Reilly, 4th Edition, 2015.
2. Garrett Grolemond, “Hands-On Programming with R” , O'Reilly Media, Inc, 2014.
3. Mohammed Guller, Big Data Analytics with Spark, Apress, 2015.
4. Chuck Lam, “Hadoop in Action”, Manning Publications, 2010.

#### Reference Books:

1. Frank Pane, “Hands On Data Science and Python Machine Learning”, Packt Publishers, 2017.
2. Nick Pentreath, Machine Learning with Spark, Packt Publishing, 2015
3. Seema Acharya, SubhashiniChellapan, “Big Data and Analytics”, Wiley, 2015.

Course Code	Course Title	Core / Elective
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<b>SPE 733 IT</b>	<b>Data Science Using R</b>					<b>Elective</b>	
<b>Prerequisite</b>	<b>Contact hours per week</b>				<b>CIE</b>	<b>SEE</b>	<b>Credits</b>
	<b>L</b>	<b>T</b>	<b>D</b>	<b>P</b>			
<b>Probability &amp; Statistics</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>40</b>	<b>60</b>	<b>3</b>

**Course Objectives:**

- 1.To learn basics of R Programming environment: R language
2. To learn various statistical concepts like linear and logistic regression
3. To learn Decision tree induction

**Course Outcomes:**

The students will be able to:

1. Identify and execute basic syntax and programs in R.
2. Perform the Matrix operations using R built in functions and apply non numeric values in vectors
3. Create the list and data frames and exploit the graph using ggplot2.
4. Perform exploratory analysis on the datasets and understand the various distribution and sampling
5. Apply statistical inference for Regression.

**UNIT-I**

**Introduction:** Introduction to Data Science, Need of Data Science, Data science process, Life Cycle of Data Science, Data science toolkit, Big Data and Data Science hype – and getting past the hype - Datafication - Current landscape of perspectives

**Types of Data:** Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes.

**UNIT-II**

**Basic Statistical Descriptions of Data:** Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Statistical Hypothesis Testing, Confidence Intervals, P hacking, ANOVA.

**UNIT-III**

**Data Pre-Processing:** Data Pre-Processing Overview, Data Cleaning: Missing values, dealing with noisy data, Spread, outliers Data. Transformation Discretization: Transformation strategies overview, transformation by normalization, discretization by binning, feature selection and feature engineering.

#### **UNIT-IV**

Data Visualization: Introduction, Types of Visualization, Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations. Data Encoding, Visual Encoding, Redundant Encoding, Color Encoding

#### **UNIT-V**

**Vectors:** Creating and Naming Vectors, Vector Arithmetic, Vector sub setting,

**Matrices:** Creating and Naming Matrices, Matrix Sub setting, Arrays, Class.

**Factors and Data Frames:** Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, sub setting of Data Frames, Extending Data Frames, Sorting Data Frames.

**Lists:** Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting Lists to Vectors

#### **Textbooks:**

1. Kennedy R.Behrman, “Foundation python for data science”, Addison – Wesley, 2021
2. Vijay Kotu and Bala Deshpande, “Data Science concepts and practice”, Morgan Kaufmann Publishers, 2<sup>nd</sup> edition, 2018.
3. Doing Data Science, Straight Talk from the Frontline. Cathy O’Neil and Rachel Schutt, O’Reilly, 2014
4. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd Ed. The Morgan Kaufmann Series in Data Management Systems.

#### **Reference Books:**

1. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi, 2018.
2. Peter Bruce, Andrew Bruce & Peter Gedeck, “Practical Statistics for Data Scientists”, 2<sup>nd</sup> edition, 2020.
3. Seema Acharya, “Data Analytics using R”, 1<sup>st</sup> edition, McGraw Hill Publication.2018.
4. Brain S. Everitt, “A Handbook of Statistical Analysis Using R”, Second Edition, 4 LLC, 2014.
5. Dalgaard, Peter, “Introductory statistics with R”, Springer Science & Business Media, 2008.
6. Paul Teetor, “R Cookbook”, O’Reilly, 2011

Course Code	Course Title				Core / Elective		
SPE 734 IT	VLSI Design				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Digital Electronics	3	-	-	-	40	60	3

**Course Objectives:**

This course will provide an opportunity to the students to learn about various topics of VLSI such as MOSFET fabrication, its physics, and analysis as well as design of digital circuits using MOSFET device.

**Course Outcomes:**

The students will be able to:

1. Describe working of MOSFET and develop its mathematical model
2. Analyze, design, and simulate various static and dynamic CMOS circuits
3. Prepare layout of MOSFET based circuits
4. Understand CMOS latch-up, clocking strategy, and testing principles
5. Write programs in VHDL/ Verilog for digital circuits and realize them on FPGA/CPLD

**UNIT-I**

**Introduction:** Overview of VLSI design methodology, VLSI design flow, Design hierarchy, Concept of regularity, Modularity, and Locality, VLSI design style, Design quality, package technology, introduction to FPGA and CPLD, computer aided design technology.

Fabrication of MOSFET : Introduction, Fabrication Process flow: Basic steps, C-MOS n-WellProcess, Layout Design rules, full custom mask layout design.

**UNIT-II**

**3 MOS Transistor:** The Metal Oxide Semiconductor (MOS) structure, The MOS System under external bias, Structure and Operation of MOS transistor, MOSFET Current-Voltage characteristics, MOSFET scaling and small-geometry effects, MOSFET capacitances

**MOS Inverters** - Static Characteristics: Introduction, Resistive load Inverter, Inverter with n-type MOSFET load (Enhancement and Depletion type MOSFET load), CMOS Inverter

### UNIT-III

**MOS Inverters Switching characteristics and Interconnect Effects:** Introduction, Delay-time definitions, Calculation of Delay times, Inverter design with delay constraints, Estimation of Interconnect Parasitic, Calculation of interconnect delay, Switching Power Dissipation of CMOS Inverters Combinational MOS Logic Circuits: Introduction, MOS logic circuits with Depletion nMOS Loads, CMOS logic circuits, Complex logic circuits, CMOS Transmission Gates (TGs)

### UNIT-IV

**Sequential MOS Logic Circuits:** Introduction, Behavior of Bistable elements, The SR latch circuit, Clocked latch and Flip-flop circuit, CMOS D-latch and Edge-triggered flip-flop

**Dynamic Logic Circuits:** Introduction, Basic Principles of pass transistor circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, CMOS Dynamic Circuit Techniques, High-performance Dynamic CMOS circuits

### UNIT-V

Chip I/P and O/P Circuits: On chip Clock Generation and Distribution, Latch –Up and its Prevention

Design for testability: Introduction, Fault types and models, Controllability and observability, AdHoc Testable design techniques, Scan –based techniques, built-in SelfTest (BIST) techniques, current monitoring IDDQ test

FinFET Device: Introduction (Need of FinFET device), structure, Comparison between FinFET and Planar MOSFET (gm, gds, leakage current, DIBL, Subthreshold Slope)

#### Text Books:

1. Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson , 2017 (UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, Digital Integrated Circuits:A Design perspective, Second Edition , Pearson , 2016.(UNIT III,IV)

#### Reference Books:

1. CMOS Digital Integrated circuits – Analysis and Design by Sung – Mo Kang, Yusuf Leblebici, TATA McGraw-Hill Pub. Company Ltd.
2. Basic VLSI Design By Pucknell and Eshraghian, PHI,3rd ed.
3. Introduction to VLSI Systems by Mead C and Conway, Addison Wesley
4. Introduction to VLSI Circuits & Systems – John P. Uyemura
5. Fundamentals of Digital Logic Design with VHDL, Brown and Vranesic



Course Code	Course Title				Core / Elective		
SPE 735 IT	Agile Software Development				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-	-	40	60	3

**Course Objectives:**

1. To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
2. To provide a good understanding of software design and a set of software technologies and APIs.
3. To do a detailed examination and demonstration of Agile development and testing techniques.

**Course Outcomes:**

The students will be able to:

1. Realize the importance of interacting with business stakeholders in determining the requirements for a software system
2. Perform iterative software development processes: how to plan them, how to execute them.
3. Point out the impact of social aspects on software development success.
4. Develop techniques and tools for improving team collaboration and software quality.
5. Perform Software process improvement as an ongoing task for development teams.

**UNIT-I**

**Agile Methodology:** Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

**UNIT-II**

**Agile Processes:Lean Production** - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

**UNIT-III**

**Agility & Knowledge Management: Agile Information Systems** – Agile Decision Making - Earl\_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement,

Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

#### **UNIT-IV**

**Agility& Requirements Engineering:** Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

#### **UNIT-V**

**Agility& Quality Assurance:** Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

#### **Text Books:**

1. David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

#### **References:**

1. Craig Larman, —Agile and Iterative Development: A Manager's Guidel, Addison-Wesley, 2004.
2. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

Course Code	Course Title				Core / Elective		
SPE 741 IT	Computer Forensics				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Operating Systems	3	-	-	-	40	60	3

**Course Objectives:**

1. To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
2. To understand how to examine digital evidences such as the data acquisition, identification analysis.
- 3, To be well-trained as next-generation computer crime investigators.

**Course Outcomes:**

The students will be able to:

1. Understand the basic terminology of Computer forensics
2. Understand the basics of computer forensics
3. Apply a number of different computer forensic tools to a given scenario
4. Analyze and validate digital evidence data
5. Analyze acquisition methods for digital evidence related to system security

**UNIT-I**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns, and private issues.

**UNIT-II**

**Understanding Computing Investigations** – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

**UNIT-III**

**Data acquisition-** understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

## **UNIT-IV**

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

## **UNIT-V**

**Current computer forensics tools-** software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

### **Text Books:**

1. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

### **Reference Books:**

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

Course Code	Course Title				Core / Elective		
SPE 742 IT	Semantic Web				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Database Systems & Web Application Development	3	-	-	-	40	60	3

**Course Objectives:**

1. Explain the fundamentals of Semantic Web technologies.
2. Implementation of semantic web applications and the architectures of social networking.
3. Social network performance analysis

**Course Outcomes:**

The students will be able to:

1. Able to gain knowledge on intelligent web applications
2. Demonstrate the semantic web technologies like RDF Ontology and others
3. Learn the various semantic web applications
4. Identify the architectures and challenges in building social networks
5. Analyze the performance of social networks using electronic sources

**UNIT-I**

Web Intelligence Thinking and Intelligent Web Applications, The Information Age ,The world Wide Web, Limitations of Today’s Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

**UNIT-II**

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

**UNIT-III**

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology development tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

## **UNIT-IV**

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

## **UNIT-V**

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

### **Text Books:**

1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.
2. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

### **Reference Books:**

1. Semantic Web Technologies, Trends and Research in Ontology Based Systems.
2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group).
3. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor, O'Reilly.

Course Code	Course Title					Core / Elective	
SPE 743 IT	Data Science & Visualization					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Mathematics and Statistics	3	-	-	-	40	60	3

**Course Objectives:**

1. Data Science and Visualization delivers a simplified, unified, and integrated view of trusted business data in real time.
2. Understand and view data sources in an agnostic manner
3. Introduce the fundamental concepts in Data Science, visualization, exploration and find insights from data using R.

**Course Outcomes:**

The students will be able to:

1. Demonstrate the understanding of data, analytics, and visualization importance for explaining the insights and data driven decision making.
2. Understand and apply the tools from R & Python for data collection, cleaning, and pre-processing.
3. Understand and apply the visualization tools from R & Python for various data. Infer insights from visualization.
3. Apply concepts from Exploratory data analysis tools to check assumptions, hypothesis, trends in data.
4. Understand business scenarios, data requirements and Apply visualization techniques to create effective data storytelling to drive change

**UNIT-I**

**Data Definitions:** Elements, Variables, and Data categorization, NOIR classification, Levels of Measurement, Data analytics.

**Analytics with Data visualization:** introduction, exploration, explanation, insight visualization, insight to action, Data driven decision making, Data storytelling – Psychology, anatomy, narrative, visuals structure.

**UNIT-II**

**Introduction to R:** Install R studio, R markdown, data structures: Vector, list, matrix, data frame, factors. Data import/export: read/write csv files, excel files, loading datasets.

**Descriptive stats:** Central tendency, dispersion measurements.

**Data Pre-processing:** Tabularizing, cleaning, imputation, scaling, normalizing, selection, filtering, sort, aggregate, joining with Tidyverse, dplyr R libraries.

### UNIT-III

**Visualizations in R:** Intro to ggplot2, Basic visualization – Histogram, Bar / Line Chart, Box plot, Scatter plot. Advanced Visualization: Heat Map, Mosaic Map, Map Visualization, 3D Graphs, Correlogram.

**Visualization using Seaborn:** – Histogram, Bar / Line Chart, Box plot, Scatter plot, Heat Map, 3D Graphs.

### UNIT-IV

**Hypothesis testing:** z-test, t-test, Chi-square test.

**Exploratory Data Analysis:** univariate, bivariate, multivariate analysis using descriptive and visualization to check assumptions, hypothesis, anomalies and discover trends and patterns in the data.

**Interactive Dashboards:** Interactive dash boards with shiny library. Intro to Tableau, PowerBI.

### UNIT-V

**Business case studies:** in health, finance, transport, food, and supply chain: Understanding business scenarios, Feature engineering and visualization, creating your own data story, exploration, insight to action, driving change.

#### Text books

1. Effective Data Storytelling: How to Drive Change with Data, Narrative, and Visuals by Brent Dykes.
2. The Big Book of Dashboards. Visualize Your Data Using Real-World Business Scenarios by Steve Wexler, Jeffrey Shaffer, and Andy Cotgreave.
3. Data visualizations in R

#### Reference Books:

1. Comprehensive Guide to Data Visualization in R
2. <https://www.datacamp.com/>
3. <https://seaborn.pydata.org/>
4. <https://www.r-project.org/>
5. <https://www.ibm.com/in-en/cloud/learn/exploratory-data-analysis>



SPE 744 IT	Block chain Technology				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Knowledge of security and applied cryptography	3	-	-	-	40	60	3

**Course Objectives:**

1. To introduce block chain technology and cryptocurrency
2. To provide conceptual understanding of how blockchain technology can be used to innovate and improve business processes.
3. Blockchain technology helps to allow digital information to be recorded and distributed, but not edited.

**Course Outcomes:**

The students will be able to:

1. Acquire the basic concepts and uses of blockchain with different applications/Systems.
2. Understand the Extensibility of Blockchain Concepts.
3. Understand and analyze Blockchain Science.
4. Understand Technical challenges, Business model challenges.
5. Learn about research advances related to one of the most popular technological areas today.

**UNIT-I**

Introduction: Blockchain or distributed trust, Protocols, currency, cryptocurrency, How a cryptocurrency works, crowdfunding.

**UNIT-II**

Extensibility of blockchain concepts, Digital identity verification, Block chain Neutrality, Digital art, Blockchain Environment.

**UNIT-III**

Blockchain Science: Gridcoin, Floding coin, Blockchain Genomics, Bitcoin MOOCs

## **UNIT-IV**

Currency, Token, Tokenizing, Campuscoin, Coindrop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency.

## **UNIT-V**

Technical challenges, Business model challenges, Scandals and Public perception , Government Regulations.

### **Text Book:**

1. Melanie Swan, Blockchain Blueprint for Economy, O'reilly.

### **Reference Books:**

1. Building Blockchain Apps, Michael Juntao Yuan, Pearson Education.
2. Daniel Drescher, Block Basics: A Non-Technical Introduction in 25 steps 1<sup>st</sup> Edition
3. Bradley Lakeman, Blockchain Revolution: Understanding the crypto Economy of the Future. A Non-Technical Guide to the Basic of Cryptocurrency Trading and investing.

### **E BOOKS**

1. <https://www.velmie.com/practical-blockchain-study>

### **MOOC**

1. <https://www.udemy.com/course/build-your-blockchain-az/>

Course Code	Course Title				Core / Elective		
SPE 745 IT	Software Quality Assurance and Testing				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering and UML	3	-	-	-	40	60	3

**Course Objectives:**

1. Study fundamental concepts of software testing and its application with different testing strategies, methods, and tools.

**Course Outcomes:**

The students will be able to:

1. Understand importance of testing techniques in software quality management and assurance
2. Identify various types of software risks and its impact on different software application.
3. Create test case scenarios for different application software's using various testing techniques.
4. Apply different testing methodologies used in industries for software testing.
5. Able to execute test cases and prepare reports and test summary.

**UNIT-I**

**Introduction:** Software Testing, Importance of testing, Roles and Responsibilities, Testing Principles, Attributes of Good Test, V-Model, Test Case Generation, SDLC Vs STLC, Software Testing Life Cycle-in detail.

**Types of Testing: Testing Strategies:** Unit Testing, Integration Testing, System Testing, Smoke, Regression Testing, Acceptance Testing. Clean Room Software Engineering. Functional/Non-Functional Testing.

**Testing Tools, Categorization of testing methods:** Manual Testing, Automation Testing and Automated Testing Vs. Manual Testing.

**UNIT-II**

**Non Functional Testing:** Performance Test, Memory Test , Scalability Test, Compatibility Test, Security Test, Cookies Test, Session Test, Recovery Test, Installation Test, Ad-hoc Test, Risk Based Test, Compliance Test. McCall's Quality Factors, FURPS.

### UNIT-III

**Software Testing Methodologies:** Validation & Verification, White/Glass Box Testing, Black Box Testing, Grey Box Testing, Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing, Boundary Value Analysis, Equivalence Class Partition, State Based Testing, Cause Effective Graph, Decision Table, Use Case Testing, Exploratory testing and Testing Metrics, Testing GUI

### UNIT-IV

**Software Testing Life Cycle:** Requirements Analysis/Design, Traceability Matrix, Test Planning, Objective, Scope of Testing, Schedule, Approach, Roles & Responsibilities, Assumptions, Risks & Mitigations, Entry & Exit Criteria, Test Automation, Deliverables.

**Test Cases Design:** Write Test cases, Review Test cases, Test Cases Template, Types of Test Cases, Difference between Test Scenarios and Test Cases. Test Environment setup, Understand the SRS, Hardware and software requirements, Test Data.

### UNIT-V

**Test Execution:** Execute test cases, Error/Defect Detecting and Reporting, DRE(Defect Removal Efficiency), Object ,Types of Bugs , Art of Debugging,. Debugging Approaches, Reporting the Bugs, Severity and priority, Test Closure, Criteria for test closure, Test summary report.

**Test Metrics:** Test Measurements, Test Metrics, Metric Life Cycle, Types of Manual Test Metrics.

#### **Text Books:**

1. William E. Lewis, Software Testing and Continuous Quality Improvement, CRC Press, 3rd edition, 2016
- 2.M. G. Limaye, Software Testing: Principles, Techniques and Tools, TMH, 2017
3. Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black, Foundations of Software Testing, Cengage Learning
4. Paul C. Jorgenson, Software Testing: A Craftsman's Approach, CRC Press, 4th Edition, 2017.

#### **References:**

1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill International Editions
2. Ian Sommerville, Software engineering, Pearson education Asia
3. Software Testing Techniques, 2nd edition, Boris Beizer, 1990
4. Software Testing: Principles and Practices by Srinivasan Desikan
5. Software Testing and Quality Assurance: Theory and Practice by Kshirasagar Naik and Priyadarshi Tripathy

6. Software Quality Approaches: Testing, Verification, and Validation: Software Best Practice by Michael Haug and Eric W Olsen

Course Code	Course Title					Core / Elective	
SPC 711 IT	IOT Lab					Core	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Embedded Systems		-	-	2	40	60	2

**Course Objectives:**

- 1.To become familiar with the different blocks of an IoT ecosystem.
- 2.To understand the working principles of Actuators
- 3.To be familiar with IoT devices like sensors microcontrollers, Raspberry Pi, etc.

**Course Outcomes**

The students will be able to:

- 1.Use microcontroller-based embedded platforms in IoT
- 2.Interface wireless peripherals for the exchange of data.
- 3.Make use of the Cloud platform to upload and analyze any sensor data
- 4.Use of Devices, Gateways, and Data Management in IoT.
- 5.Apply the knowledge and skills acquired during the course to build and test a complete IoT system involving prototyping, programming, and data analysis.

**List of Experiments:**

1. Introduction to Arduino platform and programming.
2. Interfacing Arduino to Zigbee module.
3. Interfacing Arduino to Blue tooth Module/ GSM Module
4. Sensor / Actuator interfacing using ESP32 or Raspberry Pi
5. Introduction to Raspberry PI platform and Python programming.
6. Communicate between Arduino and Raspberry PI using any wireless medium.
7. Set up a cloud platform to upload the data from the Raspberry Pi
8. Design a Mobile App for a simple user interface
9. Case study 1: Smart Street Light management system

10. Case study 2: Soil State Monitoring System
11. Case study 3: Internet-enabled home safety and security system.

**Text Books:**

- 1) Embedded Controllers using C and Arduino/2E by James M. Fiore
- 2) Simon Monk, “Programming the Raspberry Pi™ Getting Started with Python”,  
McGraw-Hill Publications.

**Suggested Weblinks:**

1. <https://microcontrollerslab.com/hc-05-bluetooth-module-interfacing-arduino/>
2. <https://www.electronicshub.org/interfacing-ir-sensor-with-raspberry-pi/>
3. <https://www.arduino.cc/en/Tutorial/HomePage>,
4. <https://www.w3schools.com/python/>and <https://pythonprogramming.net/introductionraspberrypi-tutorials/>

Course Code	Course Title				Core / Elective		
SPC 712 IT	Deep Learning Lab				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Machine Learning		-	-	2	40	60	1

**Course Objectives:**

1. To carry out fundamental and applied research using deep learning mechanisms
2. To identify innovative tools usage Deep Learning

**Course Outcomes**

The students will be able to:

1. Able to train a model using deep learning
2. Understand Convolution Neural Networks
3. Understand Sentiment Analysis in network graph using RNN
4. Learn about Deep learning model by tuning hyper parameters
5. Gain knowledge in Image generation using GAN

**List of Indicative Experiments:**

1. Implementation of different activation functions to train Neural Network
2. Implementation of different Learning Rules.
3. Implementation of Perceptron Networks.
4. Pattern matching using different rules.
5. Train a Deep learning model to classify a given image using pre trained model
6. Object detection using Convolution Neural Network
7. Recommendation system from sales data using Deep Learning
8. Improve the Deep learning model by tuning hyper parameters
9. Perform Sentiment Analysis in network graph using RNN
10. project related to Image generation using GAN
11. Project related to application of deep learning in healthcare.



12. Project related to application of deep learning in business analysis.

13. Project related to application of deep learning in Time Series Analysis & Forecasting

Course Code	Course Title					Core / Elective	
SPE712IT	Cloud Computing Lab					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Python /Java		-	-	2	40	60	1

**Course Objectives:**

1. To develop web applications in cloud
2. To learn the design and development process involved in creating a cloud based application
3. To learn to implement and use parallel programming using Hadoop

**Course Outcomes**

On completion of this course, the students will be able to:

1. Configure various virtualization tools such as Virtual Box, VMware workstation.
2. Design and deploy a web application in a PaaS environment.
3. Learn how to simulate a cloud environment to implement new schedulers.
4. Install and use a generic cloud environment that can be used as a private cloud.
5. Manipulate large data sets in a parallel environment

**List of Experiments:**

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Test ping command to test the communication between the guest OS and Host OS
4. Install Google App Engine. Create hello world app and other simple web applications using python/java.
5. Use GAE launcher to launch the web applications.
6. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
7. Find a procedure to transfer the files from one virtual machine to another virtual machine.
8. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
9. Install Hadoop single node cluster and run simple applications like wordcount.
10. Develop hadoop application to process given data and produce results such as finding the year of maximum usage, year of minimum usage.

Course Code	Course Title					Core / Elective	
SPE713IT	Big Data Analytics Lab					Elective	
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
Database Systems		-	-	2	40	60	1

**Course Objectives:**

To understand the basic programming constructs of R and understand the use of R in Big Data analytics.

1. To solve Big data problems using Map Reduce Technique in R, HADOOP.
2. To develop Pig scripts for analyzing large un-structured and semi-structured data.
3. To develop program for Query processing using Hive and to perform analytics on Big data streams using Hadoop Streaming API.

**Course Outcomes**

The students will be able to:

1. Solve Big Data problems using R and HADOOP.
2. Understand setting up of Pig and solve Big Data problems.
3. Understand setting up of Hive and perform query processing.
4. Apply Hadoop Streaming API for Big Data problems.
5. Apply Sqoop for data loading into HDFS

**List of Experiments:**

1. Perform descriptive and predictive analytics using “R programming”
2. MapReduce application for word counting on R HADOOP after successful installation of three R packages(rhdfs, rmr, and rhbase)
3. Understand data pipeline using Pig Interactive Shell Commands after successful “Pig” installation
4. Develop Pig Scripts and call UDF’s to accomplish functionalities to meet the problem objectives
5. Embedding PIG Latin in Python
6. Log analysis using “Pig” on semi structured data
7. Perform query processing on data warehousing after successful installation of “Hive”
8. Perform adhoc query on HDFS data using Hive Query Language (HQL)

9. Accomplish MapReduce Job by using Hadoop Streaming API
10. Perform various HDFS commands
11. Loading data into HDFS using Sqoop

Course Code	Course Title				Core / Elective		
SPE7143T	Data Science using R Lab				Elective		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
		-	-	2			1

**Course Objectives:**

**The course should enable the students to:**

1. understand the data science basics.
2. Understand the R Programming Language.
3. Exposure on Solving of data science problems.

**Course Outcomes:**

The students will be able to:

1. Understand and explain the main steps in a data science project.
2. Be able to apply wisely different data manipulation solutions.
3. Describe key concepts of data summarization and visualization and how to apply them in R.
4. Describe the problem of model evaluation and selection and be able to apply adequate methods to select a model for a concrete data set.
5. Understand and describe the basic foundations of several key descriptive modelling methods like clustering, outlier detection and association rules.

**List of Experiments:**

**1. Basic R Programming**

- i. Develop the R program for Basic Mathematical computation –Square, Square root, exponential etc.
- ii. Create an object X that stores the value then overwrite the object in by itself divided by Y. Print the result to the console.
- iii. Create and store a sequence of values from x to y that progresses in steps of 0.3
- iv. Extract the first and last elements of already created vector from, storing them as a new object.
- v. Create and store a three-dimensional array with six layers of a 4 X 2 matrix, filled with a decreasing sequence of values between 4.8 and 0.1 of the appropriate length
- vi. Create a factor with levels of confidence as follows: Low for percentages [0,30]; Moderate for percentages (30,70); and High for percentages (70,100].

**2. Reading and Writing Different Types of Datasets**

- i. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
- ii. Reading Excel data sheet.
- iii. Reading XML dataset.
- iv. Reading data from database.

### **3. Descriptive Statistics**

- i. Write a program to calculate, that measures the central tendency and dispersion of data.
- ii. Write a program to find basic descriptive statistics using summary, str, quartile function on mt cars dataset.
- iii. Write a program to find subset of dataset by using subset (), aggregate () functions on iris dataset.

### **4. Perform data preprocessing operations.**

- i. Noise Removal
- ii. Filling Missing Values
- iii. Outlier Detection

### **5. Perform Data Transformation Operations**

- i. Min max normalization
- ii. Z-score normalization

### **6. Inferential Statistics**

Write a program to find F Test, T Test for the given dataset.

### **7. Correlation and Covariance**

- i. Find the correlation matrix.
- ii. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
- iii. Analysis of covariance.

### **8. Visualizations**

- i. Find the data distributions using box and scatter plot.
  - ii. Find the outliers using plot.
  - iii. Plot the histogram, bar chart and pie chart on sample data.
9. Write a program to build a linear regression model, check the model on test data and predict the result.
10. Find the outliers in the Housing Price dataset
11. For a given dataset, display a chosen feature using different mean values
12. Display the confidence interval of a chosen feature based on a sample

Course Code	Course Title				Core / Elective		
SPW711IT	PROJECT WORK-I				internship		
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	6	50	-	3

**Course Objectives:**

1. To enhance practical and professional skills and To familiarize tools and techniques of systematic Literature survey and documentation
2. To expose the students to industry practices and team work
3. To encourage students to work with innovative and entrepreneurial ideas

**Course Outcomes:**

At the end of this course, the students will

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

*The department will appoint a project coordinator who will coordinate the following:*

- Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.