

PROGRAMMING IN PYTHON
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2020 -2021 onwards)
SEMESTER –III

Subject Code	20MCA31	CIE Marks	50
Number of Lecture Hours/Week	04	SEE Marks	50
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			
<p>Course objectives: This course will enable students to</p> <ul style="list-style-type: none"> • Learn Syntax and Semantics and create Functions in Python. • To learn Handling Strings and Files in Python. • How to handle Lists, Dictionaries and Regular expressions in Python. • Implementation of Object Oriented Programming concepts in Python • To Learn Web Services and introduction to Network and Database Programming in Python. 			
Module I			Teaching Hours
<p>Introduction: Creativity and motivation, Computer hardware architecture, Understanding programming, Words and sentences, Conversing with Python, Terminology: interpreter and compiler, Writing a program, What is a program?, The building blocks of programs, What could possibly go wrong?:</p> <p>Variables, expressions, and statements: Values and types, Variables, Variable names and keywords, Statements, Operators and operands, Expressions, Order of operations, Modulus operator, String operations, Asking the user for input, Comments, Choosing mnemonic variable names, Debugging.</p> <p>Conditional execution: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Catching exceptions using try and except, Debugging.</p> <p>Functions: Function calls, Built-in functions, Type conversion functions, Random numbers, Math functions, Adding new functions, Definitions and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions, Why functions?, Debugging.</p>			10 Hours
Module II			
<p>Iteration: Updating variables, The while statement, Infinite loops, “Infinite loops” and break, Finishing iterations with continue, Definite loops using for, Loop patterns, Counting and summing loops, Maximum and minimum loops, Debugging.</p> <p>Strings: A string is a sequence, Getting the length of a string using len, Traversal through a string with a loop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, string methods, Parsing strings, Format operator, Debugging.</p> <p>Files: Persistence, Opening files, Text files and lines, Reading files, Searching through a file, Letting the user choose the file name, Using try, except, and open, Writing files, Debugging.</p>			10 Hours
Module III			
<p>Lists: A list is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Deleting elements, Lists and functions, Lists and strings, Parsing lines, Objects and values, Aliasing, List arguments, Debugging.</p> <p>Dictionaries: Dictionary as a set of counters, Dictionaries and files, Looping and dictionaries, Advanced text parsing, Debugging, Glossary.</p> <p>Tuples: Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, The most common words, Using tuples as keys in dictionaries, Sequences: strings, lists, and tuples - Oh My! , Debugging.</p> <p>Regular expressions: Character matching in regular expressions, Extracting data using regular expressions, Combining searching and extracting, Escape character, Summary, Bonus</p>			10 Hours

section for Unix / Linux users, Debugging.	
Module IV	
<p>Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Debugging.</p> <p>Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Debugging.</p> <p>Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example, The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Debugging, Interface and implementation.</p>	10 Hours
Module V	
<p>Networked programs: HyperText Transfer Protocol – HTTP, The World’s Simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, Parsing HTML and scraping the web, Parsing HTML using regular expressions, Parsing HTML using BeautifulSoup, Reading binary files using urllib.</p> <p>Using Web Services: eXtensible Markup Language - XML, Parsing XML, Looping through nodes, JavaScript Object Notation - JSON, Parsing JSON, Application Programming Interfaces, Google geocoding web service, Security and API usage.</p> <p>Using Databases and SQL: What is a database?, Database concepts, Database Browser for SQLite, Creating a database table, Structured Query Language summary, Spidering Twitter using a database, Basic data modeling, Programming with multiple tables, Constraints in database tables, Retrieve and/or insert a record, Storing the friend relationship, Three kinds of keys, Using JOIN to retrieve data</p>	10 Hours
Course Outcomes	
<p>The students should be able to:</p> <ul style="list-style-type: none"> • Examine Python syntax and semantics and be fluent in the use of Python flow control and functions. • Demonstrate proficiency in handling Strings and File Systems. • Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions. • Interpret the concepts of Object-Oriented Programming as used in Python. • Implement exemplary applications related to Network Programming, Web Services and Databases in Python 	
Question paper pattern:	
<p>The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.</p>	
Text Books:	
<ol style="list-style-type: none"> 1. Charles R. Severance, “Python for Everybody: Exploring Data In Python 3”, 1st Edition, Create Space Independent Publishing Platform, 2016. 2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2 nd Edition, Green Tea Press, 2015. 	
Reference Books:	
<ol style="list-style-type: none"> 1. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014 2. Mark Lutz, “Programming Python”, 4th Edition, O’Reilly Media, 2011. ISBN-13: 978-9350232873 3. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365 	

ADVANCES IN JAVA	
Choice Based Credit System (CBCS)	
(Effective from the academic year 2020-2021 onwards)	
Semester: III	CIE Marks: 50
Subject Code: 20MCA32	SEE Exam: 50
Contact Hours(L: T:P): 4:0:0	Exam Hours: 3
CREDITS 04	
Course Objectives:	
<ul style="list-style-type: none"> • To introduce the concepts of Advanced Java Programming. • To introduce the concepts and principles of Java programming language and to design and implement object oriented solutions to simple and complex problems. • To give students experience in Java programming and program development within an integrated development environment. 	
Module-1	Teaching hours
J2EE Overview: J2EE Multi-Tier Architecture, Enterprise Application Strategy, Clients, Sessions Management, Web Tier and JSP, Enterprise Java Beans Tier. J2EE Design Patterns: Pattern Concept, Pattern Catalog, Handle-Forward Pattern, Translator Pattern, Distributor Pattern, Broadcaster Pattern, Zero Sum Pattern, Status Flag Pattern, Sequencer Pattern, Behavior Separation Pattern.	10
Module-2	
JDBC: JDBC Concept, JDBC Driver Types, JDBC Packages, JDBC Process, Database Connection, Statement Objects, ResultSet, Transaction Processing, Metadata. Java Servlets: Servlets Basics, Advantages of using servlet, Servlet Lifecycle, Deployment Descriptor, Handling Client Data, HTTP Request Headers, HTTP Status Codes, HTTP Response Headers, Cookie Management, Session Tracking.	10
Module-3	
Java Server Pages: JSP Basics, JSP Tags, Variables, Objects and Methods Declaration in JSP, Control Statements, Loops, JSP Virtual Machine, Request String, Handling User Sessions, Handling Cookies, Session Objects. Enterprise Java Beans: EJB Container, EJB Classes and Interfaces, Deployment Descriptors, Session Java Bean, Entity Java Bean, Message-Driven Bean, JAR File.	10
Module-4	
JavaMail API: JavaMail Basics, Protocols, Exceptions, Sending and Retrieving Email Messages, Replying to Email Message, Forwarding an Email Message, Sending and Receiving Attachments, Email Folder Searching. Java IDL and CORBA: Object Request Brokerage Concept, IDL Interface, Client Side and Server Side Application, Running the Code. Java Remote Method Invocation: RMI Concept, Remote Interface, Passing Objects, RMI Process, Client Side and Server Side Application.	10
Module-5	
Java Message Service: Messaging Service, JMS Fundamentals, JMS Program Components, Messages, Message Selector. Security: Security Concepts, JVM Security, Security Management, Java API Security, Browser Security, Web Services Security. Java Naming and Directory Interface API: Naming and Directories, Java	10

Naming and Directory Interface, Naming Operations.	
<p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Understand J2EE multi-tier architecture and design patterns. 2. Build database applications using JDBC. 3. Apply the concept of Servlet and JSP to create web applications. 4. Develop enterprise applications using Java Beans concepts. 5. Understand JavaMail API, Java IDL, RMI, JMS, JNDI. 	
<p>Question paper pattern:</p> <p>The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module</p>	
<p>TextBooks</p> <ol style="list-style-type: none"> 1. Herbert Schildt, The Complete Reference J2EE, Tata McGraw Hill Edition 2002. 2. Java 6 Programming Black Book, Dreamtech press 2012. 	
<p>References</p> <ol style="list-style-type: none"> 1. Michel Siklora, EJB 3 Developer Guide, A Practical Guide For Developers And Architects to the Enterprise Java Beans Standard,Shroff Publishers and Distributers Private Limited July2008. 2. Marty Hall,Larry Brown Core Servlets and Java server pages. Vol 1: Core Technologies. 2nd Edition. 3. Andrew LeeRubinger, Bill Burke. Development Enterprise Java Components. Enterprise JavaBeans 3.1. O'reilly. 	

INTERNET OF THINGS [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2020 -2021 onwards)	
Semester: III	CIE Marks:50
Course Code:20MCA33	SEEMarks:50
Contact Hours (L:T:P): 4:0:0	Exam Hours:03
CREDITS-04	
Course Objectives: <ul style="list-style-type: none"> • Describe what IoT is and how it works today • Recognize the factors that contributed to the emergence of IoT • Design and program IoT devices • Use real IoT protocols for communication • Secure the elements of an IoT device 	
Module I	Teaching Hours
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack	10
Module II	
Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	10
Module III	
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment	10
Module IV	
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes. Cyber offenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	10
Module V	
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)	10

COURSE OUTCOMES:

CO1: Analyze the IoT architecture and design along with functional/compute stack and data management.

CO2: Understand the mechanism of IOT and IOT networking fundamentals.

CO3: Understanding the cyber security concepts.

CO4: Understanding the tools and methods used in Cyber security

Question paper pattern:

The question paper will have ten questions.

There will be 2 questions from each module.

Each question will have questions covering all the topics under a module.

The students will have to answer 5 full questions, selecting one full question from each module.

Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the 2. Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 9789386873743)
2. Srinivasa K G, "Internet of Things", CENGAGE Learning India, 2017
3. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013

Reference Books

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

RESEARCH METHODOLOGY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2020 -2021 onwards)
SEMESTER – III

Subject Code	20MCA341	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 03

Course Objectives: Research is a tool which helps the manager to identify, understand and solve management problems. Research improves the decision making ability of the manager. The objective of the subject is to create scientific attitude towards solving a management problem and impart knowledge about tools available for carrying out research with the evidence of statistical techniques.

Module 1

Teaching hours

Research Methodology

Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Methods, Criteria for Good research, Problems encountered in research.

10

Module 2

Research Process and Research Design

Steps in Research Process, Defining the research problem, Exploratory Research, Preparing research problem and Objectives, Developing research hypothesis, Meaning of Research Design, Need for research design, Research Design concepts, Classification of research design, Exploratory, Descriptive and Causal, Benefits of Research Design.

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Module 3

Measurement of Scaling and Sampling Design

Measurement of Scaling: Quantitative, Qualitative, Classification of Measure scales, Data Collection, Data Preparation.
 Census and Sampling Survey, Implications of Sampling Design, Steps in Sampling Design, Characteristics of Sampling Design, Criteria for good sampling design, Characteristics of Good sampling design, Different types of Sampling Design, Random sampling design.

10

Module 4	
Hypothesis Testing Qualities of a good Hypothesis –Framing Null Hypothesis & Alternative Hypothesis, Concept of Hypothesis Testing, Testing of Hypothesis, Large Sample Tests, Small Sample Tests, ANOVA (t- Test, F-Test and Chi-Square Test). .	10
Module 5	
Research Reports and Ethics in Research Types of Research Report, Short report, Long report, Components of research report, Prefatory information, Introduction, Methodology, findings, Conclusion and recommendation, appendices and bibliography, written presentation- Prewriting concern, Writing the draft, Presentation of research report – Initial Planning preparation, making the presentation. Review of legal, ethical, social and professional (LSEP) issues including data protection and standards. Ethical issues concerning research participants, researcher and sponsoring organization.	10
Course Outcomes	
Course Learning Outcome	
<ul style="list-style-type: none"> • Define research and describe the research process and research methods • Understand and apply basic research methods including research design, data analysis, and interpretation. 	
Question paper pattern:	
The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books:	
1. Research Methodology Methods And Techniques C.R. Kothari, New Age International Pub,2nd Ed 2. Gupta S.C & Kapoor V.K, <i>Fundamentals of Mathematical statistics</i> , Sultan chand & sons, 5009.	
Reference Books:	
1. Research Methodology Concepts And Cases Deepak Chawla, Neena Sondhi, Vikas Pub. 2. Business Research Methods By By William G.Zikmund, Thomson South-Western, CENGAGE Learning. 3. Statistical Methods – S.P.Gupta, Sultan Chand, NewDelhi 4. Christian W. Dawson: Projects in Computing and Information Systems (A Student’s Guide). Addison Wesley, 2005. Justin Zobel: Writing for Computer Science. Springer, 2004	

<p style="text-align: center;">SOFTWARE TESTING [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2020 -2021 onwards) SEMESTER – III</p>			
Subject Code	20MCA342	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03			
Course objectives: This course will enable students to			
<ul style="list-style-type: none"> • Explore the basics and goals of software testing. • Discuss various types of software testing and its techniques • List out various tools which can be used for automating the testing process • Introduce various software quality standards for establishing quality environment • Discuss various methods and evaluation procedures for improving the quality Models 			
Module I			Teaching Hours
Basics of Software Testing and Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudocode, The triangle problem, The NextDate function, The commission problem, The SATM (Simple Automatic Teller Machine) problem.			10 Hours
Module II			
Decision Table-Based Testing: Decision tables, Test cases for the triangle problem, Test cases for the NextDate function, Test cases for the commission problem, Guidelines and observations. Data Flow Testing: Definition-Use testing, Slice-based testing, Guidelines and observations. Levels of Testing: Traditional view of testing levels, Alternative lifecycle models, The SATM system, Separating integration and system testing. Integration Testing: A closer look at the SATM system, Decomposition-based, call graph-based, Path based integrations, Case study.			10 Hours
Module III			
System Testing: Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines, ASF (Atomic System Functions) testing example. Interaction Testing: Context of interaction, A taxonomy of interactions, Interaction, composition, and determinism, Client/Server Testing,.			10 Hours

<p>Issues in Object-Oriented Testing: Units for object oriented testing, Implications of composition and encapsulation, inheritance, and polymorphism, Levels of object-oriented testing, GUI testing, Dataflow testing for object oriented software, Examples. Class Testing: Methods as units, Classes as units.</p>	
<p>Module IV</p>	
<p>Object-Oriented Integration Testing: UML support for integration testing, MM-paths for object-oriented software, A framework for object-oriented dataflow integration testing. GUI Testing: The currency conversion program, Unit testing, Integration Testing and System testing for the currency conversion program. Object-Oriented System Testing: Currency converter UML description, UML-based system testing, Statechart-based system testing</p>	<p>10 Hours</p>
<p>Module V</p>	
<p>Exploratory Testing: context-driven school, Exploring exploratory testing, Exploring a familiar example, Exploratory and context-driven testing observations.</p> <p>Model-Based Testing: Testing based on models, Appropriate models, Use case-based testing, Commercial tool support for model-based testing. Test-Driven Development: Test-then code cycles, Automated test execution, Java and JUnit example, Remaining questions, Pros, cons, and open questions of TDD, Retrospective on MDD versus TDD.</p>	<p>10 Hours</p>
<p>Course Outcomes</p>	
<p>The students should be able to:</p> <ul style="list-style-type: none"> • Compare and pick out the right type of software testing process for any given real world problem • Carry out the software testing process in efficient way • Automate the testing process by using several testing tools • Establish a quality environment as specified in standards for developing quality software • Analyze and improve the quality procedures based on the past experience 	
<p>Question paper pattern:</p> <p>The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.</p>	
<p>Text Books:</p> <p>1. Paul C. Jorgensen: Software Testing, A Craftsman’s Approach, 3rd Edition, Auerbach Publications, 2013.</p>	
<p>Reference Books:</p> <p>1. Aditya P Mathur: Foundations of Software Testing, Pearson, 2008. 2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008.</p>	

SOFTWARE DEFINED NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2020 -2021 onwards)
SEMESTER – III

Subject Code	20MCA343	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03			
Course Outcomes: CO1: Apply the fundamentals of Software Defined Networks for the given problem CO2: Illustrate the basics of Software Defined Networks Operations and Data flow CO3: Apply different Software Defined Network Operations and Data Flow CO4: Analyze alternative definitions of Software Defined Networks CO5: Apply different Software Defined Network Operations in real world problem			
Module I			Teaching hours
Introduction to SDN Understanding the SDN, Understanding the SDN technology, Control Plane, Data Plane, Moving information between planes, separation of the control and data planes, Distributed control planes, Load Balancing, Creating the MPLS Overlay, Centralized control planes.			10
Module II			
Working of SDN Evaluation of Switches and Control planes, SDN Implications, Data centre Needs, Forerunner of SDN, Software Defines Networks is Born, Sustain SDN interoperability, Open source contribution, Fundamental Characteristics of SDN, SDN Operations, SDN Devices, SDN Controllers, SDN Applications, Alternate SDN methods.			10
Module III			
The Open Flow Specifications Open Flow Overview, Open Flow Basics, Open Flow 1.0 additions, Open Flow 1.1 additions, Open Flow 1.2 additions, Open Flow 1.3 additions, Open Flow limitations.			10
Module IV			
SDN via APIS, SDN via Hypervisor-Based Overlays, SDN via Opening up the device, Network function virtualization, Alternative Overlap and Ranking.			10
Module V			
Data centres definition, Data centres demand, tunnelling technologies for Data centres Path technologies in data centres, Ethernet fabrics in Data centres, SDN use case in Data centres.			10

<p>Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.</p>	
<p>Textbooks</p>	
<p>1. Software Defined Networking by Thomas D Nadeau and Ken Gray. 2. Software Define Networks, A Comprehensive Approach, Paul Goransson, Chuck Black. MK Publications.</p>	
<p>References 1. Software Defined Networking for Dummies brought you by cisco, Brian Underdahl and Gary Kinghorn.</p>	

STORAGE AREA NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2020 -2021 onwards)
SEMESTER –III

Subject Code	20MCA234	CIE Marks	50
Number of Lecture Hours/Week	03	SEE Marks	50
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03			
Course Objectives:			
This course will enable students to:			
<ul style="list-style-type: none"> • Define and contrast storage centric and server centric systems. • Define metrics used for Designing storage area networks. • Illustrate RAID concepts. • Demonstrate, how data centers maintain the data with the concepts of backup mainly remote mirroring concepts for both simple and complex systems. 			
Module I			Teaching Hours
Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.			10 Hours
Module II			
I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.			10 Hours

Module III	
Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.	10 Hours
Module IV	
SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.	10 Hours
Module V	
Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks,	10 Hours
Course Outcomes	
The students should be able to: <ul style="list-style-type: none"> • Identify the need for performance evaluation and the metrics used for it • Apply the techniques used for data maintenance. • Realize strong virtualization concepts • Develop techniques for evaluating policies for LUN masking, file systems 	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2013. 2. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011.	
Reference Books: 1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005. 2. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.	