M.TECH - FULL TIME - CLOUD COMPUTING
CURRICULUM & SYLLABUS
2015 - 2016

FACULTY OF ENGINEERING AND TECHNOLOGY
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
SRM NAGAR, KATTANKULATHUR – 603 203

COURSE CODE	COURSE NAME	L	T	P	C
I and II Semester					
CC2001	Web Application Development	3	0	2	4
CC2002	Cloud Architectures	3	0	2	4
CC2003	Cloud Storage Infrastructures	3	0	2	4
CC2004	Data Center Networking	3	0	2	4
CC2005	Cloud Security	3	0	2	4
CC2006	Managing Virtual Environments	3	0	2	4
CAC2001	Career Advancement Course For Engineers - I	1	0	1	1
CAC2002	Career Advancement Course For Engineers - II	1	0	1	1
	TOTAL	**20**	**0**	**14**	**26**
Total Contact Hours: 34					
III Semester					
CC2047	Seminar	0	0	1	1
CC2049	Project Phase-I	0	0	12	6
CAC2003	Career Advancement Course For Engineers - III	1	0	1	1
	TOTAL	**1**	**0**	**14**	**8**
Total Contact Hours: 15					
IV Semester					
CC2050	Project Phase-II	0	0	32	16
Supportive Course					
CC2011	Data Analysis using Multivariate Techniques and Forecasting Methods	3	0	0	3
Inter Disciplinary Elective					
	One course to be taken in Semester I or II or III	3	0	0	3
Program Electives					
	6 courses of 3 credits each to be taken in Semesters I -III	-	-	-	18
	TOTAL CREDITS	**74**			

Total Number of credits to be earned for M.TECH degree: 74

L: Lecture Hours per week

T: Tutorial Hours per week
P: Practical Hours per week
C: Credit

PROGRAM ELECTIVES

Course Code	Course Name	L	T	P	C
CC2101	Design & Development of Cloud Applications	2	0	2	3
CC2102	Application Development Frameworks	2	0	2	3
CC2103	Scripting for System Administrators	2	0	2	3
CC2104	Data Warehousing and Mining	3	0	0	3
CC2105	Converged Networks	3	0	0	3
CC2106	Network Security	3	0	0	3
CC2107	Enterprise Storage Systems	3	0	0	3
CC2108	Object Oriented Software Engineering	2	0	2	3
CC2109	Data Center Virtualization	3	0	0	3
CC2110	Cloud Application Development	2	0	2	3
CC2111	Cloud Strategy Planning & Management	3	0	0	3
CC2112	Data Science & Big Data Analytics	2	0	2	3

NOTE:
Students have to register for the courses as per the following guidelines:

Sl. No	Category	Credits				
		I Semester	II Semester	III Semester	IV Semester	Category Total
1.	Core courses	12 (3courses)	12 (3courses)	---	---	24
2.	Program Elective courses	18 (in I to III semesters)		---	18	
3.	Interdisciplinary elective courses(any one program elective from other programs)	3 (One course to be taken in Semester I or II or III)			3	
4.	Supportive courses - mandatory	3 (One course to be taken in Semester I or II or III)		---	3	
5.	Seminar	---	---	1	---	1
6.	Career Advancement Courses	1	1	1	--	3
7.	Project work	---	---	06	16	22

	Total	74

	WEB APPLICATION DEVELOPMENT	L	T	P	C
CC2001	Total Contact Hours - 75	**3**	**0**	**2**	**4**
	Prerequisite				
	Knowledge in JAVA programming is preferred				

PURPOSE

Internet is part and parcel of everybody's life today. Programming in web is every essential for any IT professional .The subject provides knowledge to learn and implement the various web programming technologies of current trend today.

INSTRUCTIONAL OBJECTIVES

1.	Understand the current technologies in Internet world
2.	Implement client side programming using java script ,CSS
3.	Learn and implement advanced and current technologies like AJAX, JQuery
4.	Understand the socket programming in Java
5.	Learn and implement java server side programming
6.	Learn and implement web services
7.	Learn various web development frame works

UNIT I - INTRODUCTION TO INTERNET WEB TECHNOLOGIES   (12 Hours)

Internet technology and Internet standards-evolution of web technology-web2.0 an overview –HTML tags –new tags in HTML 5 –XML technologies-DTD-Schema-parsers-XHTML-CSS-javascript-data types-control structures-functions –objects - mobile web.

UNIT II - ADVANCED DYNAMIC WEB CLIENT SIDE PROGRAMMING (9 HOURS)

AJAX-xmlHttpRequest object-AJAX applications-AJAX frame work -java script libraries -JQuery-basics –animation-overview on Yahoo UI, Google web toolkit libraries-Applets-overview on javaFX applets.

UNIT III - JAVA NETWORK PROGRAMMING (6 Hours)

Java I/O streaming-files-lookup Internet address-socket programming-UDP sockets-Multicast sockets-client/server programs-secure sockets-javaMail API

UNIT IV - DYNAMIC WEB SERVER SIDE PROGRAMMING (9 Hours)

Web servers and java web containers-servlets -lifecycle-content handling-cookies-session tracking-filters-Java server pages-expressions-and declarations-directives-JSP and java beans-include and forward directives-custom tag libraries-JSTL-new features in servlet3.1 and JSP2.5

UNIT V - ADVANCED SERVER SIDE PROGRAMMING (9 Hours)

Web services-SOAP protocol-UDDI-WSDL-creating publishing and describing web services-JDBC database connectivity-drivers-connections-rowset interface-prepared statements-three tier applications; Web application frameworks-MVC (model view controller) frame work-struts- JSF(Java server faces)-Java EE design pattern an overview.

PRACTICAL - (30 Hours)

REFERENCES

1. Paul J. Deitel, Harvey Deitel, Abbey Deitel, "*Internet and World Wide Web How to Program*", Edition 5, ISBN 0132151006, 9780132151009, 2011.
2. Chris Bates, "*Web Programming – Building Intranet applications*", Wiley Publications, 3rd Edition, 2009.
3. Jeffrey C. Jackson, "*Web Technologies A computer Science Perspective*", Pearson, 2011.
4. Eilliote, Rusty Harold, "*Java Network Programming*", 3/e, O'Reilly Media, Inc, 2004.
5. "*Java server programming java JavaEE5 Black Book*", Kogent Solutions Inc, Dreamtech Press, 2012.
6. AJAX, "*black book*", new edition, Kogent Solutions Inc, Dreamtech Press, 2008.

	CLOUD ARCHITECTURES	L	T	P	C
CC2002	Total Contact Hours - 75	3	0	2	4
	Pre-requisites				
	Nil				

PURPOSE
This module gives students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization.

INSTRUCTIONAL OBJECTIVES

1.	Analyze the components of cloud computing showing how business agility in an organization can be created
2.	Evaluate the deployment of web services from cloud architecture
3.	Critique the consistency of services deployed from a cloud architecture
4.	Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
5.	Critically analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications

UNIT I - CLOUD COMPUTING FUNDAMENTALS   (8 Hours)

Cloud Computing definition, private, public and hybrid cloud. Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

UNIT II - CLOUD APPLICATIONS   (6 Hours)

Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

UNIT III - MANAGEMENT OF CLOUD SERVICES   (12 Hours)

Reliability, availability and security of services deployed from the cloud. Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics : Cloud Computing infrastructures available for implementing cloud based services. Economics of choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

UNIT IV - APPLICATION DEVELOPMENT   (10 Hours)

Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT V - CLOUD IT MODEL   (9 Hours)

Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO)

                                        PRACTICAL - (30 Hours)

REFERENCES

1. Gautam Shroff, "*Enterprise Cloud Computing Technology Architecture Applications*", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

2. Toby Velte, Anthony Velte, Robert Elsenpeter, "*Cloud Computing, A Practical Approach*" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
3. Dimitris N. Chorafas, "*Cloud Computing Strategies*" CRC Press; 1 edition [ISBN: 1439834539],2010.

	CLOUD STORAGE INFRASTRUCTURES	L	T	P	C
CC2003	Total Contact Hours - 75	**3**	**0**	**2**	**4**
	Pre-requisites				
	Nil				

PURPOSE
This course provides a comprehensive view of storage and networking infrastructures for highly virtualized cloud ready deployments. The course discusses the concepts and features related to Virtualized datacenter and cloud, Information storage security and design, storage network design and cloud optimized storage.

INSTRUCTIONAL OBJECTIVES	
1.	Critically appraise the opportunities and challenges of information management in complex business environments
2.	Evaluate information storage management design in a cloud environment and how it relates to the business objectives of an organization
3.	Analyze the role technology plays in the design of a storage solution in a cloud architecture
4.	Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud
5.	Analyze how best to provide reliable access to information both locally and remotely using storage technologies

UNIT I - VIRTUALIZED DATA CENTER ARCHITECTURE   (9 Hours)

Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures.

UNIT II - INFORMATION STORAGE SECURITY & DESIGN　　　　(9 Hours)

Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM.

UNIT III - STORAGE NETWORK DESIGN　　　　(12 Hours)

Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations.

UNIT IV - OPTIMIZATION OF CLOUD STORAGE　　　　(6 Hours)

Global storage management locations, scalability, operational efficiency. Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attitudes; file systems or object storage.

UNIT V - INFORMATION AVAILABILITY DESIGN　　　　(9 Hours)

Designing backup/recovery solutions to guarantee data availability in a virtualized environment. Design a replication solution, local remote and advanced. Investigate Replication in NAS and SAN environments. Data archiving solutions; analyzing compliance and archiving design considerations.

PRACTICAL - (30 Hours)

REFERENCES

1. Greg Schulz, "*Cloud and Virtual Data Storage Networking*", Auerbach Publications [ISBN: 978-1439851739], 2011.
2. Marty Poniatowski, "*Foundations of Green IT*" Prentice Hall; 1 edition [ISBN: 978-0137043750], 2009.
3. EMC, "*Information Storage and Management*" Wiley; 2 edition [ISBN: 978-0470294215],2012.
4. Volker Herminghaus, Albrecht Scriba, *"Storage Management in Data Centers"* Springer; editioN [ISBN: 978-3540850229]. 2009.
5. Klaus Schmidt, "*High Availability and Disaster Recovery*" Springer; edition [ISBN: 978-3540244608], 2006.

CC2004	DATA CENTER NETWORKING	L	T	P	C
	Total Contact Hours - 75	3	0	2	4

Pre-requisites				
Nil				

PURPOSE

This course provides an insight to the students on design guidance, configuration examples and best practices with respect to data center networking. This course also deals with current data center architectures, new technologies adopted to create modern data center architecture, and merits and demerits of the same. This course examines these new technologies and demonstrates how consolidation can be realized using a unified network approach

INSTRUCTIONAL OBJECTIVES

1.	Critically discuss data centre networking technologies and protocols
2.	Evaluate key concepts in modern Layer 2 & Layer 3 data centre networks
3.	Research a topic related to networking technologies in modern data centers
4.	Design, build and configure complex routed and switched networks
5.	Justify the implementation of networking solutions in a virtualized environment

UNIT I - EVOLUTION OF DATA CENTRE DESIGN   (6 Hours)

Design for flexibility, scalability, environmental control, electrical power, flooring, fire protection, security, network infrastructure. Energy use and greenhouse gas emissions. Requirements for modern data centers, high availability and Service Orientated Infrastructures (SOI). Modern data centre use case studies.

UNIT II - DATA CENTRE ARCHITECTURES   (7 Hours)

Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), scale up vs scale up, solutions that reduce power and cabling. Data Centre standards; TIA/EIA-942. Structured cabling standards, fibre and copper cabling characteristics, cable management, bandwidth requirements, I/O connectivity.

UNIT III - SERVER ARCHITECTURES   (8 Hours)

Stand-alone, blades, stateless, clustering, scaling, optimization, virtualization. Limitation of traditional server deployments; modern solutions. Applications; database, finance etc. Redundant Layer 2 and Layer 3 designs. Case studies.

UNIT IV - LAYER 2 NETWORKS   (12 Hours)

Ethernet; IEEE 802.3ba; 40 Gbps and 100 Gbps Ethernet. IEEE 802.1D Spanning Tree Protocol (STP), RSTP, PVST, MSTP. TRILL (Transparent Interconnection of Lots of Links), RBridges, IEEE 802.1Qbg Edge Virtual Bridging, 802.1Qbh Bridge Port Extension. Fibre Channel over Ethernet (FCoE) vs Internet Small Computer System Interface (iSCSI). Data Center Bridging (DCB); priority-based flow control, congestion notification, enhanced transmission selection, Data Center Bridging Exchange (DCBX). Layer 2 Multicasting; Case studies.

UNIT V - LAYER 3 AND BEYOND   (12 Hours)

Layer 3 Data Centre technologies, network virtualization. Protocols; IPv4, IPv6, MPLS, OSPF, IS-IS, BGP. OTV, VPLS layer 2 extension protocols. Locator Identifier Separation Protocol (LISP). Layer 3 Multicasting. Data centre application services. Data centre networking use case studies and the enabling technologies and protocols in the modern data centre.

PRACTICAL - (30 Hours)

REFERENCES
1. SilvanoGai, Claudio DeSanti,"*I/O Consolidation in the Data Center*" Cisco Press; 1 edition [ISBN: 9781587058882]. 2009.
2. Kevin Corbin, Ron Fuller, David Jansen, "*NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures*" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.
3. SilvanoGai, TommiSalli, Roger Andersson, "*Cisco Unified Computing System*" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010.
4. Nash Darukhanawalla, Patrice Bellagamba, "*Interconnecting Data Centers Using VPLS*" Cisco Press; 1 edition, [ISBN: 9781587059926], 2009.
5. Robert W. Kembel, Roger Cummings (Introduction), "*The Fibre Channel Consultant*" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 1998.
6. Robert W Kembal"*Fiber Channel Switched Fabric*" Northwest Learning Associates, inc. [ISBN: 0931836719], 2009.
7. John L. Hufferd, "*ISCSI*", Addison-Wesley Boston [ISBN: 978-0201784190], 2003.

CC2005	CLOUD SECURITY	L	T	P	C
	Total Contact Hours - 75	3	0	2	4
	Pre-requisite				
	Nil				

PURPOSE

The course on cloud security introduces the basic concepts of security systems and cryptographic protocols, which are widely used in the design of cloud security. The issues related multi tenancy operation, virtualized infrastructure security and methods to improve virtualization security are also dealt with in this course

INSTRUCTIONAL OBJECTIVES

1.	Compare modern security concepts as they are applied to cloud computing
2.	Assess the security of virtual systems
3.	Evaluate the security issues related to multi-tenancy
4.	Appraise compliance issues that arise from cloud computing

UNIT I - SECURITY CONCEPTS   **(10 Hours)**

Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

UNIT II - MULTI-TENANCY ISSUES (9 Hours)
Isolation of users/VMs from each other. How the cloud provider can provide this; Virtualization System Security Issues- e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery; Virtualization System Vulnerabilities- Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).

UNIT III - VIRTUALIZATION SYSTEM-SPECIFIC ATTACKS (7 Hours)
Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking.

UNIT IV - TECHNOLOGIES FOR VIRTUALIZATION-BASED SECURITY ENHANCEMENT (9 Hours)
IBM security virtual server protection, virtualization-based sandboxing; Storage Security- HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

UNIT V - LEGAL AND COMPLIANCE ISSUES (10 Hours)
Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

PRACTICAL - (30 Hours)

REFERENCES
1. Tim Mather, Subra Kumaraswamy, ShahedLatif, "*Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.
2. Ronald L. Krutz, Russell Dean Vines, "*Cloud Security*" [ISBN: 0470589876], 2010.
3. John Rittinghouse, James Ransome, "*Cloud Computing*" CRC Press; 1 edition [ISBN: 1439806802], 2009.
4. J.R. ("Vic") Winkler, "*Securing the Cloud*" Syngress [ISBN: 1597495921] 2011.

5. Cloud Security Alliance, "*Security Guidance for Critical Areas of Focus in Cloud Computing"* 2009.
6. Vmware "*VMware Security Hardening Guide"* White Paper, June 2011 .
7. Cloud Security Alliance 2010, "*Top Threats to Cloud Computing"* Microsoft 2013.
8. Timothy Grance; Wayne Jansen;NIST "*Guidelines on Security and Privacy in Public Cloud Computing",* 2011.
9. Evelyn Brown NIST "*Guide to Security for Full Virtualization Technologies",* 2011.
10. Peter Mell, Timothy Grance, NIST "*The NIST Definition of Cloud Computing "* 2011.
11. William Hau, Rudolph Araujo et al "*How Virtualization Affects PCI DSS",* www.foundstone.com.
12. Chenxi Wang "*Compliance with Clouds: Caveat Emptor",* www.forrester.com/2010.

CC2006	MANAGING VIRTUAL ENVIRONMENTS	L	T	P	C
	Total Contact Hours - 75	3	0	2	4
	Pre-requisite				
	Nil				

PURPOSE

This course deals with management of complex virtual environments, analysis of key performance factors of virtualized systems, principal issues in troubleshooting virtual environments, evaluation of small scale virtual environment developed in the lab. This course will equip students with the in-depth knowledge and techniques used to efficiently optimize and effectively trouble-shoot virtual infrastructures

	INSTRUCTIONAL OBJECTIVES
1.	Discuss and evaluate the management of complex virtual environments.
2.	Critically analyze key performance factors in virtualized systems.
3.	Identify and formulate judgements for management requirements relating to the configuration and performance of virtual environments.
4.	Identify and analyze the principal issues in troubleshooting virtual environments.
5.	Performance evaluations and critical evaluations of a small scale virtual environment developed in the lab.

UNIT I - PERFORMANCE MANAGEMENT IN A VIRTUAL ENVIRONMENT

(9 Hours)

Management techniques, methodology and key performance metrics used to identifying CPU, memory, network, virtual machine and application performance bottlenecks in a virtualized environment.

UNIT II - CONFIGURATION AND CHANGE MANAGEMENT   (7 Hours)

Configuration and change management goals and guidelines, tools and technologies in virtualized environments.

UNIT III - SECURE VIRTUAL NETWORKING   (9 Hours)

Configuration and change management goals and guidelines, tools and technologies in virtualized environments; Virtual network security architecture, network segmentation and traffic isolation to secure a virtual network configuration.

UNIT IV - PROTECTING THE MANAGEMENT ENVIRONMENT   (10 Hours)

Server authentication, authorization, and accounting, SSL certificates, server hardening; Protecting the host system: security architecture, controlling access to storage, hardening hosts, Hardening virtual machines; Virtual machine security architecture, security parameters; Protecting the host and virtual machine systems using server authentication, authorization, and accounting techniques.

UNIT V - TROUBLESHOOTING VIRTUAL ENVIRONMENTS   (10 Hours)

Interpreting host, network, storage, cluster and virtual machine log files. Network troubleshooting, traffic sniffing, storage access problems, iSCSI authentication and digests. Virtual machine migration, cluster errors with shares, pools, and limits; Command line interfaces and syntax, interpreting host, network, storage, cluster, virtual machine log files and network traces.

PRACTICAL - (30 Hours)

REFERENCES

1. Massimo Cafaro (Editor), Giovanni Aloisio (Editor), "*Grids, Clouds and Virtualization"* Springer; edition [ISBN: 978-0857290489] 2011.

2. Chris Wolf and Erick M. Halter, "*Virtualization"* A press; 1 edition [ISBN: 978-1590594957] 2005.

3. Gaurav Somani, "*Scheduling and Isolation in Virtualization"*, VDM Verlag Dr. Müller [ISBN: 978-3639295139], **Muller** Publishers, Germany, Sept. 2010

4. LatifaBoursas (Editor), Mark Carlson (Editor), Wolfgang Hommel (Editor), Michelle Sibilla (Editor), KesWold (Editor), "*Systems and Virtualization Management: Standards and New Technologies"* [ISBN: 978-3540887072], October 14, 2008

5. Edward L. Haletky, "*VMware ESX Server in the enterprise"* [ISBN: 978-0132302074]. Prentice Hall; 1 edition 29 Dec 2007.

6. Edward Haletky, "*VMware ESX and ESXi in the Enterprise - Planning Deployment of Virtualization Servers"* [ISBN: 978-0137058976]., Prentice Hall; 2 edition February 18, 2011.

CC2047	SEMINAR	L	T	P	C
		0	0	1	1

PURPOSE

Seminar is one of the important components for the engineering graduates to exhibit and expose their knowledge in their field of interest. It also gives a platform for the students to innovate and express their ideas in front of future engineering graduates and professionals

NSTRUCTIONAL OBJECTIVES

1.	To make a student study and present a seminar on a topic of current relevance in Information Technology or related fields.
2.	Enhancing the debating capability of the student while presenting a seminar on a technical topic
3.	Training a student to face the audience and freely express and present his ideas without any fear and nervousness, thus creating self-confidence and courage which are essentially needed for anEngineer.

GUIDELINES
1. Each student is expected to give a seminar on a topic of current relevance in IT/Related field with in a semester.
2. Students have to refer published papers from standard journals.
3. The seminar report must not be the reproduction of the original papers but it can be used as reference.

ASSESMENT:

The students are expected to give at least two presentations on their topics of interest which will be assessed by a committee constituted for this purpose. This course is mandatory and a student has to pass the course to become eligible for the award of degree. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations

		L	T	P	C

CC2049	**PROJECT WORK PHASE I** (III semester)	0	0	12	6
CC2050	**PROJECT WORK PHASE II** (IV semester)	0	0	32	16

PURPOSE

To undertake research in an area related to the program of study

INSTRUCTIONAL OBJECTIVE

The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.

M.Tech projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. The method of assessment for both Phase I and Phase II is shown in the following table:

Assessment	Tool	Weightage
In- semester	I review	10%
	II review	15%
	III review	35%
End semester	Final viva voce examination	40%

Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.

SUPPORTIVE COURSE

CC2011	**DATA ANALYSIS USING MULTIVARIATE TECHNIQUES AND FORECASTING METHODS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to introduce the students into the field of Multivariate Techniques and Forecasting Methods for analyzing large volumes of data and to take decisions based on inference drawn.

INSTRUCTIONAL OBJECTIVES

1. Data characteristics and form of Distribution of the Data Structures
2. Understanding the usage of multivariate techniques and forecasting methods for the problem under the consideration
3. For drawing valid inferences and to plan for future investigations

UNIT I - MULTIVARIATE ANALYSIS   (5 Hours)
Meaning of Multivariate Analysis, Measurements Scales: Metric measurement scales and Non-metric measurement scales, Classification of multivariate techniques (Dependence Techniques and Inter-dependence Techniques), Applications of Multivariate Techniques in different disciplines.

UNIT II - FACTOR ANALYSIS   (10 Hours)
Meanings, Objectives and Assumptions, Designing a factor analysis, Deriving factors and assessing overall factors, Interpreting the factors and validation of factor analysis.

UNIT III - CLUSTER ANALYSIS   (10 Hours)
Objectives and Assumptions, Research design in cluster analysis, Deriving clusters and assessing overall fit (Hierarchical methods, Non Hierarchical Methods and Combinations), Interpretation of clusters and validation of profiling of the clusters.

UNIT IV - FORECASTING TECHNIQUES   (10 Hours)
Basics of forecasting: Basic steps in forecasting task. The forecasting scenario: Averaging methods, Exponential smoothing methods, Holt's linear method, Holt-Winters trend and Seasonality method.

UNIT V - TIME SERIES ANALYSIS   (10 Hours)

Box-Jenkins Methodology for ARIMA models: Examining correlation and stationarity of time series data, ARIMA models for time series data (An Auto-regressive model of order one and a Moving Average Model of order one).

REFERENCES

1. Joseph F.Hair, William C.Black, Barry J.Babin, Rolph E.Anderson and Ronald L.Tatham (2006). "*Multivariate Data Analysis*, *6th Edition*", Pearson Education, Inc., (Chapters 1, 3 and 8), 2009.
2. Spyros Makridakis, Steven C.Wheelwright and Rob J. Hyndman. "*Forecasting methods and Applications, Third Edition*", John Wiley & Sons Inc., New York (Chapters 1, 4 and 7), 2005.

	INTERDISCIPLINARY ELECTIVE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
Students to choose one Elective course from the list of Post Graduate courses specified under the Faculty of Engineering and Technology other than courses under M.Tech (Cloud Computing) curriculum either in I, II or III semester					

PROGRAM ELECTIVES

	DESIGN & DEVELOPMENT OF CLOUD APPLICATIONS	L	T	P	C
CC2101	Total Contact Hours - 60	2	0	2	3
	Pre-requisite				
	Web Application Development				

PURPOSE

This module is focused on developing web and mobile applications in the cloud. By the end of this module the student will have a detailed overview of the design and development process involved in creating a cloud based application.

INSTRUCTIONAL OBJECTIVES

1.	Design and develop elegant and flexible cloud software solutions.
2.	Evaluate the security issues related to the development of cloud applications.
3.	Manage and deploy a cloud based application.
4.	Research and critique a topic related to Software development in the cloud.
5.	Analyze a real world problem and develop a cloud based software solution.

UNIT I - DESIGNING CLOUD BASED APPLICATIONS   (5 Hours)

Role of business analyst, requirements gathering, UML, use of state diagrams, wire frame prototypes, use of design tools such as Balsamiq. Selecting front end technologies and standards, Impact of growth in mobile computing on functional design and technology decisions.

UNIT II - CLOUD APPLICATION DEVELOPMENT   (7 Hours)

Technical architecture considerations – concurrency, speed and unpredictable loads. Agile development, team composition (including roles/responsibilities), working with changing requirements and aggressive schedules. Understanding Model View Controller (MVC).

Advanced understanding of "views", location, and the presentation layer: Advanced Ajax and JQuery. Presenting to different browsers and devices. Localization and internationalization; Understanding client location and device type. Mobile application development – Android, iOS, WP, RIM, Symbian.

UNIT III - STORING OBJECTS IN THE CLOUD   (5 Hours)

Session management. Advanced database techniques using MySQL and SQL Server, blob storage, table storage.

Working with Third Party APIs:

Overview of interconnectivity in cloud ecosystems. Working with Twitter API, Flickr API, Google Maps API. Advanced use of JSON and REST.

UNIT IV - CLOUD APPLICATIONS AND SECURITY ISSUES   (6 Hours)

Understanding cloud based security issues and threats (SQL query injections, common hacking efforts), SSL, encrypted query strings, using encryption in the database. Authentication and identity. Use of oAuth. OpenID; Understanding QA and Support: Common support issues with cloud apps: user names and passwords, automated emails and spam, browser variants and configurations. Role of developers in QA cycle. QA techniques and technologies. Use of support forums, trouble ticketing.

UNIT V - USE CASES   (7 Hours)

Design, develop and deploy an advanced cloud app using framework and platform of choice to demonstrate an understanding of database, presentation and logic. Application should demonstrate integration with third party API, sensitivity to geography of user (language, currency, time and date format), authentication of user, security, and awareness of client device/browser.

Case Studies: Salesforce, Basecamp, Xero.com, Dropbox.

PRACTICAL - (30 Hours)

REFERENCES

1. Jim Webber, Savas Parastatidis, Ian Robinson, *"REST in Practice"* O'Reilly Media; 1 edition, [ISBN: 978-0596805821] 2010.
2. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, MatiasWoloski, *"Developing Applications for the Cloud on the Microsoft Windows Azure Platform"* Microsoft Press; 1 edition, [ISBN: 9780735656062] 2010.
3. Dan Wellman, *"jQuery UI 1.6"* Packt Publishing [ISBN: 9781847195128] 2009.
4. Peter Lubbers, Brian Albers, Frank Salem, Ric Smith, *"Pro HTML5 Programming"* A press, [ISBN: 9781430227908] 2010.
5. Lee Babin, *"Beginning Ajax with PHP"* A press; 1 edition, [ISBN: 9781590596678] 2006.
6. Richard York, *"Beginning JavaScript and CSS development with jQuery"*, Wiley Pub. Indianapolis, IN [ISBN: 9780470227794] 2009.
7. Edward Benson, *"The art of Rails"*, Wiley Pub. Indianapolis, IN [ISBN: 9780470189481] 2008.

	APPLICATION DEVELOPMENT FRAMEWORKS	L	T	P	C
CC2102	Total Contact Hours - 60	**2**	**0**	**2**	**3**
	Pre-requisite				

	Web Application Development Cloud Storage Infrastructures				

PURPOSE

This module has two distinct sections. In the first section students will learn about building applications using a popular application development framework. After the first section is completed the module will focus on one of the following areas: Enterprise Integration or Rich Web Applications.

INSTRUCTIONAL OBJECTIVES

1.	Identify the key aspects of developing applications using a framework.
2.	Write code to integrate frameworks to access relational databases
3.	Evaluate framework technologies for remote communication.
4.	Option 1 - Enterprise Integration: Design and build concurrent applications and schedule tasks using an application framework. Assess the integration of serialization and remoting to call remote applications.
5.	Option 2 - Rich Web Applications: Integrate an application framework to implement stateful interactions. Compare rapid productivity tools such as Grails and Roo, etc.

UNIT I - SPRING FRAMEWORK   **(6 Hours)**
Overview of Java frameworks, introduction to Spring. Using Spring to configure an application, the bean life-cycle, simplifying application configuration, annotation-based dependency injection, testing a Spring-based application.

UNIT II- EFFECTIVE MIDDLE-TIER ARCHITECTURE   **(6 Hours)**
Adding behavior to an application using aspects, data access with Spring, simplifying JDBC-based data access, driving database transactions in a Spring environment.

UNIT III - IMPLEMENTING ENTERPRISE INFORMATION CONNECTIVITY
                                                                                          (6 Hours)
Object-to-relational mapping (ORM), Hibernate in a Spring environment, effective web application architecture, Spring MVC, RESTful web services with Spring MVC.

UNIT IV - INTEGRATION WITH ENTERPRISE SERVICES   **(4 Hours)**
Securing web applications, emoting framework, simplifying message applications with Spring JMS, adding manageability to an application with Spring JMX.

UNIT V - ENTERPRISE INTEGRATION   **(8 Hours)**
Integration Foundations Essential concurrency, tasks and scheduling, serialisation and remoting. Working with Web Services Advanced XML, SOAP web services, RESTful web services, web service security. Messaging and Transactions

Messaging, working with JMS, transactional JMS, distributed transaction management. Spring Batch and Integration Spring batch, advanced Spring integration, Service-Oriented Architecture (SOA)

(OR)

Rich Web Applications: Spring Web MVC Spring MVC annotation-based programming model, Page composition with layout technologies such as Tiles, Rendering multiple content types, Handling exceptions, Processing form pages, Internationalization and personalization. Spring Web Flow Spring web flow, authoring flow definitions, view states, events and transitions, adding flow behaviour. Working with scoped data, using the web flow integration with JSF. Spring Security Securing a web application with Spring security. Integration With Client Technologies Modern Web UI, progressive enhancement, accessibility, web design. Working with HTML, CSS and JavaScript, Using a JavaScript framework (Dojo) for DOM scripting and UI widgets, integrating Flex clients with Spring applications. Rapid Application Development Using Grails & Spring Roo

PRACTICAL - (30 Hours)

REFERENCES

1. Rod Johnson.[et al.] "*Professional Java development with the Spring Framework*", Wiley Pub. Indianapolis, IN [ISBN: 978-0764574832], 2005.
2. Mark Fisher, "*Spring Integration in Action*", 1st Ed., Manning Publications [ISBN: 978-1935182436], 2011.
3. Craig Walls, Ryan Breidenbach, "*Spring in Action*" Manning Publications; 2 edition [ISBN: 978-1933988139], 2007.
4. Paul Fisher, Solomon Duskis, "*Spring Persistence with Hibernate*" A press; 1 edition (February 17, [ISBN: 978-1430226321] 2009.
5. Website: "*Spring Source*".
   http://www.springsource.com/.
6. Website: "*Sun – Oracle*".
   http://www.oracle.com/us/technologies/java/index.html.
7. Website: "*IBM*".
   http://www.ibm.com/developerworks/java/.

CC2103	SCRIPTING FOR SYSTEM ADMINISTRATORS	L	T	P	C
	Total Contact Hours - 60	2	0	2	3
	Pre-requisite				
	Nil				

PURPOSE

This module will address the scripting skills that System administrators need to help them with their daily tasks.

INSTRUCTIONAL OBJECTIVES

1.	Assess system administration tasks and design scripts to automate these tasks.

2.	Solve system administration problems using a shell interface.
3.	Design complex scripts in a scripting language such as Perl, Python or Ruby.
4.	Develop scripts to a high level in Powershell

UNIT I - **POWERSHELL** (6 Hours)

Shell and Powershell Scripting: Shell syntax, sed, awk, grep, diff, join, etc.

UNIT II - cmdlets (6 Hours)

Unix and Windows CLI. cmdlets, wmic.

UNIT III - TROUBLESHOOTING (6 Hours)

Managing processes, services, events and network connections; Troubleshooting.

UNIT IV - APPLICATIONS OF SCRIPTING (6 Hours)

Scripting in a high-level Language: Language syntax, Applications of scripting e.g. querying SNMP devices, running external processes, managing user accounts, monitoring file systems & processes,

UNIT V – USING LDAP AND AD (6 Hours)

Working with LDAP and AD, analyze log files, administer network names and configuration services, maintain, monitor and map network services, processes, package management, statistics gathering and reporting. Using scripting to automate tedious and repetitive tasks.

PRACTICAL - (30 Hours)

REFERENCES
1. Hal Rottenberg, "*Managing VMware Infrastructure with Windows PowerShell TFM*", Sapien Press [ISBN: 0-9821314-0-2]2009.
2. Justin Seitz, "*Gray Hat Python*", NO STARCH PRESS [ISBN: 1593271921], 2009.
3. RytisSileika, "*Pro Python System Administration*" A press; 1 edition [ISBN: 978-1-4302-2605-5], 2010.
4. Noah Gift and Jeremy Jones, "*Python for Unix and Linux system administration*", O'Reilly Farnham [ISBN: 978-0596515829], 2008.
5. Marty Alchin, "*Pro Python*" A press [ISBN: 978-1-4302-2757-1],2010.
6. Mark Lutz, "*Learning Python*" O'Reilly Media; 5 edition [ISBN: 978-0596158064], 2013.
7. Mark Summerfield, "*Programming in Python 3: A Complete Introduction to the Python Language*" Addison-Wesley Professional; 2 edition, [ISBN: 978-0-321-68056-3], 2009.
8. David N. Blank-Edelman, "*Automating system administration with Perl*", O'Reilly Media Sebastopol, CA [ISBN: # 978-0596006396], 2009.
9. Website: "*Command Line Kung Fu*" http://blog.commandlinekungfu.com/.

			L	T	P	C
CC2104	**DATA WAREHOUSING AND MINING**		**L**	**T**	**P**	**C**
	Total Contact Hours - 45		**3**	**0**	**0**	**3**
	Pre-requisites					
	Nil					

PURPOSE
This course focuses on the fundamentals of data warehousing and their associated problem areas. Data pre-processing and preparation, outlier detection, data warehouse design, On-line analytical processing are the major areas of coverage of this course. This course also deals with the fundamentals of data mining and algorithms associated with the same.

INSTRUCTIONAL OBJECTIVES	
1.	Describe the fundamental concepts, benefits and problem areas associated with data warehousing
2.	Describe the various architectures and main components of a data warehouse.
3.	Design a data warehouse, and be able to address issues that arise when implementing a data warehouse.
4.	Compare and contrast OLAP and data mining as techniques for extracting knowledge from a data warehouse.

UNIT I - DATA WAREHOUSING   **(6 Hours)**

OLTP systems versus data warehousing. Data warehousing concepts; benefits and problem areas; Architecture and main components of a data warehouse; Managing metadata.

UNIT II - DATA PREPARATION AND PRE-PROCESSING   (11 Hours)
Need to pre-process data; Data Cleaning; Handling Missing Data; Identifying Misclassifications; Graphical methods for identifying Outliers; Data Transformation; Numerical Methods for Identifying Outliers.

UNIT III - DATA WAREHOUSE DESIGN   (8 Hours)
Corporate Information Factory (CIF) versus Business Dimensional Lifecycle Methodologies. Dimensionality modeling: Star, Snowflake and Starflake schemas.

UNIT IV - ON-LINE ANALYTICAL PROCESSING (OLAP)   (8 Hours)
OLAP applications. OLAP operations: roll-up, drill-down, slice and dice, and pivot. OLAP Tools: Multidimensional OLAP (MOLAP), Relational OLAP (ROLAP), Hybrid OLAP (HOLAP) and Desktop OLAP (DOLAP).

UNIT V - Data Mining   (12 Hours)
Algorithms: Predictive modeling, database segmentation, link analysis and deviation detection. Cross Industry Standard Process for Data Mining (CRISP-DM) specification.

REFERENCES
1. Thomas M. Connolly, Carolyn E. Begg, "*Database Systems: A Practical Approach to Design, Implementation and Management*", 5th Ed., Addison Wesley [ISBN: 0321523067], 2010.
2. Jiawei Han and Micheline Kamber, Jian Pei, "*Data Mining Concepts and Techniques*", Third Edition, Elsevier, 2012.
3. Anthony David Giordano, "*Data Integration Blueprint and Modeling*", IBM Press; 1 edition [ISBN: 0137084935], 2011.
4. Ralph Kimball, Margy Ross, Warren Thornthwaite (Contributor), Joy Mundy (Contributor), Bob Becker (Contributor) "*The Kimball Group Reader*", Wiley [ISBN: 9780470563106], 2010.
5. Daniel T. Larose "*Discovering knowledge in data*", Wiley-Interscience Hoboken, N.J. [ISBN: 978-0-471-66657-8], 2005.
6. Richard Roiger, Michael Geatz, "*Data mining*", Addison Wesley Boston [ISBN: 0201741288], 2002.

CC2105	CONVERGED NETWORKS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

	Prerequisites			
	Knowledge of basic networking concepts, routing protocols and IP addressing mechanisms.			

PURPOSE

This course focuses on the design, development, selection, deployment and support of advanced IP based audio, video and data transmission in a converged network. The course aims at providing an in depth knowledge to the learners in the field of Multi protocol label switching and IP Multicasting. QoS details of converged network shall be dealt in a detailed manner in this course.

INSTRUCTIONAL OBJECTIVES

1.	Implement applications enabled by a multi-service convergent network
2.	Explain how real-time traffic is prioritized and carried within a data network.
3.	Design Multicast Networks
4.	Engineer networks suitable for voice, multicast traffic and high-speed switched Internet based networks

UNIT I - TELEWORKER SOLUTIONS   (8 Hours)

Cable and DSL Technology, cable system components and benefits, DOCSIS ,HFC Cable Network Architecture; DSL Variants, DSL performance and distance limitations

UNIT II - REAL-TIME APPLICATIONS IN A CONVERGED NETWORK   (10 Hours)

Review of Traditional Voice Networks; Codec / Vocoder Technologies; VoIP Transport; Real-Time Concerns; RTP/RTCP; H.323 and SIP as signaling protocols; Cloud-based VoIP & Video services

UNIT III - QOS FOR A CONVERGED NETWORK   (10 Hours)

IP QOS review of QoS; 802.1p/q; Queuing mechanisms – WFQ,CBWFQ,Low-Latency, Random Early Detection; Integrated Services; Reservation Protocol (RSVP); Differentiated Services (Diffserv); QoS issues in WANs; implementation of Diffserv QoS model

UNIT IV - MULTIPROTOCOL LABEL SWITCHING   (10 Hours)

MPLS Header; MPLS forwarding basics; Quality of service with MPLS TE; MPLS VPN applications; implementation of MPLS and MPLS VPN

UNIT V - IP MULTICAST (7 Hours)

Multicast addressing; IGMP, IGMP snooping; Multicast routing protocols (PIM-DM, - SM, SDM); Configuration

REFERENCES

1. Scott Firestone, ThiyaRamalingam, Steve Fry, "*Voice and Video Conferencing Fundamentals*", 1st Ed. Ed., Cisco Press [ISBN: 978-1-58705-268-7], 2007
2. Luc De Ghein, "*MPLS Fundamentals*", 1st Ed. Ed., Cisco Press [ISBN: 978-1-58705-197-5] 2006.
3. Christina Hattingh, Darryl Sladden, ATM ZakariaSwapan, "*SIP Trunking*", Cisco Press [ISBN: 978-1-58705-944-4] 2010.
4. Eric Osborne, Ajay Simha, "*Traffic engineering with MPLS*", Cisco Press [ISBN: 978-1587050312], 2003.
5. Amir Ranjbar, "*CCNP ONT Official Exam Certification Guide*", Cisco Press [ISBN: 978-1-58720-176-3], 2007.
6. Website: Cisco Systems Inc., "*Voice/Data Integration Technologies*". 2006.
7. http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/voicedata.htm.

	NETWORK SECURITY	L	T	P	C
CC2106	Total Contact Hours - 45	3	0	0	3
	Prerequisites				
	Networking Fundamentals				

PURPOSE
This course will explore the aspects of IPSec, Virtual Private Networks and SSH tunneling in addition to the cloud security issues. The course covers the details of wireless security including WEP and WPA. Different types of firewalls including packet filters, application level gateway and NAT are also the topics of discussion in this course. This course provides the learners with the details on IDS/IPS, sniffers and, packet capturing tools and mechanisms.

INSTRUCTIONAL OBJECTIVES	
1.	Identify and evaluate threats to network security and data loss.
2.	Install, configure, and evaluate firewalls.
3.	Configure and appraise Intrusion Detection and Response Systems.
4.	Install, configure, and evaluate VPN (Virtual Private Network) Technology.
5.	Evaluate the security of a wireless network system.
6.	Create and evaluate packet captures.

UNIT I - INTERNET SECURITY & ENCRYPTION　　　　　(10 Hours)

Encryption of static data, IPSec, AH, ESP, IKE, ISAKMP/Oakley, Tunnel mode, Transport mode, Virtual Private Networks (VPNs), SSH Tunneling, IP6 issues, Cloud Security Issues.

UNIT II - FIREWALLS　　　　　(10 Hours)

Packet Filters, Stateful, Stateless, Bastion Host, Circuit Level, Application Gateway, SOCKS, DMZ, Host-Based Firewall, Egress Filtering, Network Address Translation (NAT), Multi-homing, IPTables/NetFilter, implementing NAT.

UNIT III - SNIFFERS AND PACKET CRAFTING　　　　　(10 Hours)

Libpcap, dSniff, Wireshark, tcpdump, Mitigation of Sniffer Attacks, ARP Cache Poisoning, Port Stealing, Switch flooding, DNS and IP Spoofing, Session Hijacking, Sequence Numbers, Ettercap, idle host scanning, Default TTLs, Countermeasures, Packet Crafting using eghping, scapy.

UNIT IV - WIRELESS SECURITY　　　　　(6 Hours)

802.11, wardriving, netstumbler, kismet, wellenreiter, WEP, WPA, cowpatty.

UNIT V - INTRUSION DETECTION & PREVENTION　　　　　(9 Hours)

Focus on NIDS, snort, Types of IDSs, Network IDSs, Anomaly based Detection, Signature based Detection, Evasion Techniques, False Positives, NIDS implementation using eg snort, Data Loss Prevention.

REFERENCES

1. Eric Cole, Ronald L. Krutz, James Conley, "*Network Security Bible*", Wiley [ISBN: 0764573977], 2005.
2. John R. Vacca, "*Guide to Wireless Network Security*", Springer [ISBN: 0387954252], 2006.
3. Johnny Long, Chris Hurley, SensePost, Mark Wolfgang, Mike Petruzzi, "*Penetration Tester's Open Source Toolkit*", Syngress [ISBN: 1597490210] 2005.
4. Barrie Dempster, James Eaton-Lee, "*Configuring IPCop Firewalls: Closing Borders with Open Source*", Packet Publishing [ISBN: 1-904811-36-1], 2006.
5. Lucian Gheorghe, "*Designing and Implementing Linux Firewalls and QoS using netfilter, iproute2, NAT, and L7-filter*", Packt Publishing [ISBN: 1-904811-65-5] 2006.
6. Mark Rhodes-Ousley, Roberta Bragg, Keith Strassberg "*Network Security: The Complete Reference*", McGraw-Hill [ISBN: 0072226978], 2003,.
7. Chuck Easttom , "*Network Defense and Countermeasures: Principles and Practices*" [ISBN: 978-0131711266], 2005.
8. Juniper Networks, "*VPN Decision Guide: IPSec vs. SSL VPN Decision Criteria*" 2007*.*

9. http://www.juniper.net/solutions/literature/white_papers/200232.pdf.
10.

CC2107	**ENTERPRISE STORAGE SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Pre-requisites				
	Nil				

PURPOSE

This course provides a comprehensive introduction to storage technology in an increasingly complex IT environment. It builds a strong understanding of underlying storage technologies and prepares you to learn advanced concepts and technologies. The course also deals with architectures, features and benefits of Intelligent Storage Systems; networked storage technologies such as FC-SAN, NAS and IP-SAN; long-term archiving solutions, the increasingly critical area of information security and the emerging field of storage virtualization technologies.

INSTRUCTIONAL OBJECTIVES

1.	Evaluate various storage classifications and technologies.
2.	Analyze storage architectures, processes, components and how they relate to virtualization.
3.	Justify the implementation of aa range of storage solutions to enable business continuity.
4.	Analyze storage security design, implementation, monitoring and management.

UNIT I - STORAGE SYSTEMS   **(10 Hours)**

Data Classification, Storage Evolution and Data Center infrastructure. Host components, Connectivity, Storage, and Protocols. Components of a disk drive, physical disk and factors affecting disk drive performance. RAID level performance and availability considerations. Components and benefits of an intelligent storage system.

UNIT II - STORAGE NETWORKING TECHNOLOGIES   **(12 Hours)**

Direct-Attached Storage (DAS)architecture, Storage Area Network (SAN) attributes, components, topologies, connectivity options and zoning. FC protocol stack, addressing, flow control, and classes of service. Networked Attached Storage (NAS)components, protocols, IP Storage Area Network (IP SAN) iSCSI, FCIP and FCoE architecture. Content Addressed Storage (CAS) elements, storage, and retrieval processes.

UNIT III - VIRTUALIZATION   **(6 Hours)**

Block-level and file-level storage virtualization technology, virtual provisioning and cloud computing.

UNIT IV - BUSINESS CONTINUITY   **(10 Hours)**

Business Continuity measurement, terminologies, and planning. Backup designs, architecture, topologies, and technologies in SAN and NAS environments. Local and Remote replication using host and array-based replication technologies such as Synchronous and Asynchronous methods.

UNIT V - STORAGE SECURITY AND MANAGEMENT   (7 Hours)
Storage security framework and various security domains. Security implementation in SAN,NAS and IP-SAN networking. Monitoring and Storage management activities and challenges

REFERENCES
1. EMC, "*Information Storage and Management*" Wiley; 2 edition   [ISBN: 978-0470294215], 2012.
2. Richard Barker, Paul Massiglia, "*Storage area network essentials*", Wiley New York [ISBN: 978-0471034452] 2002.
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, "*Storage Networks Explained*" Wiley; 2 edition, [ISBN: 978-0470741436], 2009.
4. W. Curtis Preston, "*Using SANs and NAS*", O'Reilly & Associates Sebastopol, Calif. [ISBN: 978-0596001537], 2002.
5. Himanshu Dwivedi, "*Securing storage*", Addison-Wesley Upper Saddle River, NJ [ISBN: 978-0321349958], 2006.

CC2108	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
	Total Contact Hours - 60	2	0	2	3
	Pre-requisites				
	Nil				
PURPOSE					
To learn the advanced software engineering principles and methodologies for effective software development					
INSTRUCTIONAL OBJECTIVES					
1.	To learn about software prototyping, analysis and design				
2.	To learn UML and its usage				
3.	Case studies to apply the principles				

UNIT I - INTRODUCTION   (5 Hours)

Software Engineering Paradigms - Software Development process models - Project & Process -Project management – Process & Project metrics - Object Oriented concepts & Principles.

UNIT II - PLANNING & SCHEDULING   (6 Hours)

Software prototyping - Software project planning – Scope – Resources - Software Estimation -Empirical Estimation Models-Planning-Risk Management - Software Project Scheduling – Object oriented Estimation & Scheduling.

UNIT III - ANALYSIS & DESIGN   (10 Hours)

Analysis Modeling - Data Modeling - Functional Modeling & Information Flow-Behavioral Modeling-Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behavior Model; Design Concepts & Principles - Design Process - Design Concepts - Modular Design –Design Effective Modularity - Introduction to Software Architecture - Data Design – Transform Mapping – Transaction Mapping – OOD - Design System design process- Object design process -Design Patterns.

UNIT IV - IMPLEMENTATION & TESTING   (5 Hours)

Top-Down, Bottom-Up, object oriented product Implementation & Integration. Software Testing methods-White Box, Basis Path-Control Structure –Black Box-Unit Testing- Integration testing-Validation & System testing. Testing OOA & OOD models-Object oriented testing strategies.

UNIT V - MAINTENANCE   (4 Hours)

Maintenance process-System documentation-program evolution dynamics-Maintenance costs-Maintainability measurement – Case Studies

PRACTICAL - (30 Hours)

REFERENCES

1. Roger S. Pressman, "*Software Engineering A Practitioner's Approach*", Fifth Edition, Tata McGraw Hill,2010.
2. Grady Booch, James Rumbaugh, Ivar Jacobson –"*the Unified Modeling Language User Guide*" – (Unit III) Addison Wesley, 1999.
3. Ian Sommerville, *Software Engineering*", 9th Edition, Pearson Education, 2011.
4. Carlo Ghezzi Mehdi Jazayer, Dino Mandrioli, *"Fundamentals of Software Engineering"*, Prentice Hall of India 2002.
5. Fairley*, "Software Engineering Concepts",* Tata McGraw Hill, 2001.

CC2109	DATA CENTER VIRTUALIZATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

	Pre-requisites				
	Managing Virtual Environments				

PURPOSE

This course focuses on the challenges in setting up a data center. Resource monitoring using hypervisors and access control to virtual machines will be covered in depth in this course. Setting up of a virtual data center and how to manage them with software interfaces will be discussed in detail.

INSTRUCTIONAL OBJECTIVES

1.	Identify various constraints and challenges in setting up a data center
2.	Demonstrate Enterprise level virtualization and access control in virtual machines
3.	Perform Resource monitoring and execute backup and recovery of virtual machines.

UNIT I - DATA CENTER CHALLENGES   (9 Hours)

How server, desktop, network Virtualization and cloud computing reduce data center footprint, environmental impact and power requirements by driving server consolidation; **Evolution of Data Centers:** The evolution of computing infrastructures and architectures from standalone servers to rack optimized blade servers and unified computing systems (UCS).

UNIT II - ENTERPRISE-LEVEL VIRTUALIZATION   (12 Hours)

Provision, monitoring and management of a virtual datacenter and multiple enterprise-level virtual servers and virtual machines through software management interfaces; **Networkin**g and Storage in Enterprise Virtualized Environments - Connectivity to storage area and IP networks from within virtualized environments using industry standard protocols.

UNIT III - VIRTUAL MACHINES & ACCESS CONTROL   (6 Hours)

Virtual machine deployment, modification, management; monitoring and migration methodologies.

UNIT IV - RESOURCE MONITORING   (6 Hours)

Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor.

UNIT V - VIRTUAL MACHINE DATA PROTECTION   (12 Hours)

Backup and recovery of virtual machines using data recovery techniques; Scalability - Scalability features within Enterprise virtualized environments using advanced management applications that enable clustering, distributed network switches for

clustering, network and storage expansion; High Availability **:** Virtualization high availability and redundancy techniques.

REFERENCES

1. Mickey Iqbal, *"IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach"*, MC Press [ISBN: 978-1583473542] 2010.
2. Mike Laverick, *"VMware vSphere 4 Implementation"* Tata McGraw-Hill Osborne Media; 1 edition [ISBN: 978-0071664523], 2010.
3. Jason W. McCarty, Scott Lowe, Matthew K. Johnson, *"VMware vSphere 4 Administration Instant Reference"* Sybex; 1 edition [ISBN: 978-0470520727],2009.
4. Brian Perry, Chris Huss, Jeantet Fields, *"VCP VMware Certified Professional on vSphere 4 Study Guide"* Sybex; 1 edition [ISBN: 978-0470569610], 2009.
5. Jason Kappel, Anthony Velte, Toby Velte, *"Microsoft Virtualization with Hyper-V: Manage Your Datacenter with Hyper-V, Virtual PC, Virtual Server, and Application Virtualization"* McGraw-Hill Osborne [ISBN: 978-0071614030],2009.

	CLOUD APPLICATION DEVELOPMENT	**L**	**T**	**P**	**C**
CC2110	Total Contact Hours - 60	**2**	**0**	**2**	**3**
	Pre-requisites				
	Nil				

PURPOSE

This module introduces students to developing web and cloud applications. By the end of the module the student will be able to build and deploy web and cloud-based application.

INSTRUCTIONAL OBJECTIVES

1.	Use best practices in the design and development of elegant and flexible cloud software solutions.
2.	Create, implement and deploy a cloud/LAMP based application.
3.	Analyze a real world problem and develop a cloud/LAMP based software solution.
4.	Contrast software development in the web, cloud and others

UNIT I - CLOUD BASED APPLICATIONS   **(4 Hours)**

Introduction, Contrast traditional software development and development for the cloud. Public v private cloud apps. Understanding Cloud ecosystems – what is SaaS/PaaS, popular APIs, mobile;

UNIT II - DESIGNING CODE FOR THE CLOUD   **(8 Hours)**

Class and Method design to make best use of the Cloud infrastructure; **Web** Browsers and the Presentation Layer- Understanding Web browsers attributes and differences. Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash.

UNIT III - WEB DEVELOPMENT TECHNIQUES AND FRAMEWORKS   (8 Hours)

Building Ajax controls, introduction to Javascript using JQuery, working with JSON, XML, REST. Application development Frameworks e.g. Ruby on Rails , .Net, Java API's or JSF; Deployment Environments – Platform As A Service (PAAS) ,Amazon, vmForce, Google App Engine, Azure, Heroku, AppForce

UNIT IV - USE CASE 1: BUILDING AN APPLICATION USING THE LAMP STACK
(4 Hours)

Setting up a LAMP development environment. Building a simple Web app demonstrating an understanding of the presentation layer and connectivity with persistence.

UNIT V - USE CASE 2: DEVELOPING AND DEPLOYING AN APPLICATION IN THE CLOUD   (6 Hours)

Building on the experience of the first project students will study the design, development, testing and deployment of an application in the cloud using a development framework and deployment platform.

PRACTICAL - (30 Hours)

REFERENCES

1. Chris Hay, Brian Prince, "*Azure in Action*" Manning Publications [ISBN: 978-1935182481],2010.
2. Henry Li, "*Introducing Windows Azure*" Apress; 1 edition [ISBN: 978-1-4302-2469-3],2009.
3. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, MatiasWoloski, "*Developing Applications for the Cloud on the Microsoft Windows Azure Platform*" Microsoft Press; 1 edition [ISBN: 9780735656062],2010.
4. Eugene Ciurana, "*Developing with Google App Engine*" Apress; 1 edition [ISBN: 978-1430218319],2009.
5. Charles Severance, "*Using Google App Engine*" O'Reilly Media; 1 edition, [ISBN: 978-0596800697], 2009.
6. George Reese, "*Cloud application architectures*", O'Reilly Sebastopol, CA [ISBN: 978-0596156367] 2009.
7. Dan Sanderson, "*Programming Google App Engine*" O'Reilly Media; 1 edition [ISBN: 978-0596522728],2009.
8. Paul J. Deitel, Harvey M. Deitel, "*Ajax, rich Internet applications, and web development for programmers*", Prentice Hall Upper Saddle River, NJ [ISBN: 978-0-13-158738-0], 2008.

		L	T	P	C
CC2111	**CLOUD STRATEGY PLANNING & MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Pre-requisites				

	Nil				

PURPOSE

This course deals with the concepts and technological advances fueling the rapid adoption of cloud computing today. This course provides the students with the skills and knowledge required to plan and manage a Cloud Computing strategy within an organization. This course will enable students to evaluate the strategic value of Cloud Computing using IT Governance and Compliance.

INSTRUCTIONAL OBJECTIVES

1.	Strategically assess how cloud computing enables IT Transformation and business value in an organization.
2.	Analyze the role that cloud computing can play in the business process.
3.	Critically appraise how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.
4.	Evaluate how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.
5.	Implement IT governance to manage business realization from cloud IT services.

UNIT I - ACHIEVING BUSINESS VALUE FROM IT TRANSFORMATION   (9 Hours)

Moving to a cloud architecture and strategy to achieve business value. BPM, IS, Porter's Value chain model and BPR as a means of delivering business value; **Developing Business Strategy:** Investigate business strategy models to gain competitive advantage for organizations, SWOT/PEST, Economies of scale, Porter's 3 Strategies and 5 Competitive Forces, D'Aveni's hyper competition models.

UNIT II - STRATEGIC IT LEADERSHIP IN THE ORGANIZATION   (9 Hours)
Emphasize the roles of the strategic IS/IT leaders such as Chief Information Officer (CIO) and the Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.

UNIT III - PLANNING A CLOUD COMPUTING BASED IT STRATEGY   (9 Hours)
Develop an IT strategy to deliver on strategic business objectives in the business strategy. IT Project planning in the areas of ITaaS, SaaS, PaaS and IaaS are essential in delivering a successful strategic IT Plan.

UNIT IV - SOA AND BUSINESS AGILITY   (9 Hours)
Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud. Services, Databases and Applications on demand. The effect on Enterprise Architecture and its traditional frameworks such as Zachman and The Open Group Architecture Framework (TOGAF).

UNIT V - BENEFIT REALIZATION AND IT GOVERNANCE   (9 Hours)
Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services (IaaS, PaaS, PraaS, SaaS), Gartner's 5 pillars of benefit realization. IT governance as a service in measuring the delivery of IT Strategy from Cloud IT Services using Sarbannes Oxley (CobiT) and other commonly-used approaches.

REFERENCES
1. Arnold J Cummins, "*Easiest Ever Guide to Strategic IT Planning*" http://strategicitplanningguide.com/.
2. Andy Mulholland, Jon Pyke, Peter Finger, "*Enterprise Cloud Computing - A Strategy Guide for Business and Technology Leaders*", Meghan Kiffer [ISBN: 0929652290],2010.
3. David S. Linthicum, "*Cloud Computing and SOA Convergence in Your Enterprise*", Addison Wesley [ISBN: 0136009220], 2009.
4. Charles Babcock, "*Management Strategies for the Cloud Revolution*", 1st Ed., Tata McGraw/Hill [ISBN: 0071740759],2010.
5. Mark I. Williams, "*A Quick Start Guide to Cloud Computing: Moving Your Business into the Cloud*" Kogan Page [ISBN: 0749461306],2010.
6. Website: "*Whitepapers and news for the CIO*" www.cio.com.
7. Website: "*Gartner Research Website*" www.gartner.com.

CC2112	DATA SCIENCE AND BIG DATA ANALYTICS	L	T	P	C
	Total Contact Hours - 60	2	0	2	3

	Pre-requisites				
	Knowledge of statistical techniques				

PURPOSE

This course provides practical foundation level training that enables immediate and effective participation in big data and other analytics projects. It includes an introduction to big data and the Data Analytics Lifecycle to address business challenges that leverage big data. The course provides grounding in basic and advanced analytic methods and an introduction to big data analytics technology and tools, including MapReduce and Hadoop.

INSTRUCTIONAL OBJECTIVES

1.	Deploy the Data Analytics Lifecycle to address big data analytics projects
2.	Apply appropriate analytic techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results
3.	Select appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences
4.	Use tools such as: R and RStudio, MapReduce/Hadoop, in-database analytics, Window and MADlib functions
5.	Explain how advanced analytics can be leveraged to create competitive advantage and how the data scientist role and skills differ from those of a traditional business intelligence analyst

UNIT I - INTRODUCTION TO BIG DATA ANALYTICS: (5 Hours)

Big Data overview, State of the practice in analytics role of data scientists, Big Data Analytics in industry verticals

UNIT II - END-TO-END DATA ANALYTICS LIFE CYCLE (4 Hours)

Key roles for successful analytic project, main phases of life cycle, Developing core deliverables for stakeholders

UNIT III - BASIC ANALYTIC METHODS: (8 Hours)

Introduction to "R", analyzing and exploring data with "R", statistics for model building and evaluation

UNIT IV - ADVANCED ANALYTICS AND STATISTICAL MODELING FOR BIG DATA (7 Hours)

Naïve Bayseian Classifier, K-means Clustering, Association Rules, Decision Trees, Linear and Logistic Regression, Time Series Analysis, Text Analytics;

UNIT V - MAPREDUCE/HADOOP (6 Hours)

Technology and Tools – MapReduce/Hadoop , In- database Analytics, MADlib and advanced SQL Tools

PRACTICAL - (30 Hours)

REFERENCES

1. Noreen Burlingame , "*The little book on Big Data",* New Street publishers, 2012.
2. Norman Matloff, "*The Art of R Programming: A Tour of Statistical Software Design",* No Starch Press; 1 edition , 2011.
3. http://www.johndcook.com/R_language_for_programmers.html.
4. http://bigdatauniversity.com/.
5. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction.

CAC2001	Career Advancement Course For Engineers - I	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills					

INSTRUCTIONAL OBJECTIVES
1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal and written communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Practice verbal communication by making a technical presentation to the class
6. Develop time management Skills

UNIT I–BASIC NUMERACY
Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNIT II-ARITHMETIC – I
Percentages, Profit & Loss, Equations

UNIT III-REASONING - I
Logical Reasoning

UNIT IV-SOFT SKILLS - I
Presentation skills, E-mail Etiquette

UNIT V-SOFT SKILLS - II
Goal Setting and Prioritizing

ASSESSMENT
Soft Skills (Internal)
Assessment of presentation and writing skills.

Quantitative Aptitude (External)
Objective Questions- 60 marks
Descriptive case lets- 40 marks*
Duration: 3 hours
Engineering problems will be given as descriptive case lets.

REFERENCES
1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. Soft Skills for Everyone by Jeff Butterfield – Cengage Learning India Private Limited
5. Six Thinking Hats is a book by Edward de Bono - Little Brown and Company
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd – Meerut

CAC2002	Career Advancement Course For Engineers - II	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				
PURPOSE					
To enhance holistic development of students and improve their employability skills					

INSTRUCTIONAL OBJECTIVES
1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Understand the fundamentals of listening and how one can present in a group discussion
6. Prepare or update resume according to the tips presented in class.

UNIT I- ARITHMETIC – II
Ratios & Proportions, Mixtures & Solutions

UNIT II - MODERN MATHEMATICS
Sets & Functions, Data Interpretation, Data Sufficiency

UNIT III- REASONING - II
Analytical Reasoning

UNIT IV - COMMUNICATION - I
Group discussion, Personal interview

UNIT V - COMMUNICATION - II
Verbal Reasoning test papers

ASSESSMENT
Communication (Internal)
- Individuals are put through formal GD and personal interviews.
- Comprehensive assessment of individuals' performance in GD & PI will be carried out.

QUANTITATIVE APTITUDE (EXTERNAL)
Objective Questions- 60 marks (30 Verbal +30 Quants)
Descriptive case lets- 40 marks*

Duration: 3 hours
*Engineering problems will be given as descriptive case lets.

REFERENCES

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. General English for Competitive Examination by A.P. Bharadwaj – Pearson Educaiton
5. English for Competitive Examination by Showick Thorpe - Pearson Educaiton
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd - Meerut
7. Verbal Ability for CAT by Sujith Kumar - Pearson India
8. Verbal Ability & Reading Comprehension by Arun Sharma - Tata McGraw - Hill Education

CAC2003	Career Advancement Course For Engineers - III	L	T	P	C
	Total Contact Hours - 30	1	0	1	1
	Prerequisite				
	Nil				

PURPOSE

To develop professional skills abreast with contemporary teaching learning methodologies

INSTRUCTIONAL OBJECTIVES
At the end of the course the student will be able to

1	acquire knowledge on planning, preparing and designing a learning program
2	prepare effective learning resources for active practice sessions
3	facilitate active learning with new methodologies and approaches
4	create balanced assessment tools
5	hone teaching skills for further enrichment

UNIT I- DESIGN **(2 Hours)**
Planning &Preparing a learning program.
Planning & Preparing a learning session

UNIT II – PRACTICE **(2 Hours)**
Facilitating active learning
Engaging learners

UNIT III – ASSESSMENT **(2 Hours)**
Assessing learner's progress
Assessing learner's achievement

UNIT IV – HANDS ON TRAINING **(10 Hours)**
Group activities – designing learning session
Designing teaching learning resources
Designing assessment tools
Mock teaching session

UNIT V – TEACHING IN ACTION **(14 Hours)**
Live teaching sessions
Assessments

ASSESSMENT (Internal)

Weightage:
Design - 40%
Practice – 40%
Quiz – 10%
Assessment – 10%

REFERENCES
1. Cambridge International Diploma for Teachers and Trainers Text book by Ian Barker - Foundation books
2. Whitehead, Creating a Living Educational Theory from Questions of the kind: How do I improve my Practice? Cambridge J. of Education