





## Structure and Contents for M. Tech. Computer Science and Engineering Program (2018-19) R0


School of Technology Department of Computer Science and Engineering						Sanjay Ghodawat University Kolhapur				
Structure for M. Tech First Year (2018-19) R0 Credit Structure Semester I										
Course Code	Course Title	L	T	Pr	C		Evaluation Scheme			
						Component	Exam	WT%	Min. Pass %	
CCC501 (UC   ST) Version: 1.0	Research Methodology	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC503 (PC   ST) Version: 1.0	Internet of Things	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC505 (PC   ST) Version: 1.0	Design and Development of Cloud Application	4	-	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC507 (PC   ST) Version: 1.0	Cloud Architectures	4	-	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC 509._ (PE   ST) Version: 1.0	Program Elective I	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC511 (PC   ST) Version: 1.0	Open source technology Laboratory I	-	-	2	1	Practical	FET	50	40%	40
							ESE	50	40%	
CCC513 (PC   ST) Version: 1.0	Open source technology Laboratory II	-	-	2	1	Practical	FET	50	40%	40
							ESE	50	40%	
CCC515 (PC   ST) Version: 1.0	Seminar I	-	-	2	1	Practical	FET	100	40%	40
Total		17	03	06	23		Total Hrs: 26, Total Credits: 23			




School of Technology Department of Computer Science and Engineering					Sanjay Ghodawat University Kolhapur					
Structure for M. Tech First Year (2018-19) R0 Credit Structure Semester II										
Course Code	Course Title	L	T	Pr	C		Evaluation Scheme			
						Component	Exam	WT%	Min. Pass %	
CCC502 (PC   ST) Version: 1.0	Service Oriented Architecture	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC504 (PC   ST) Version: 1.0	Cloud Storage Infrastructure	4	-	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC506 (PC   ST) Version: 1.0	Cloud Security	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC508 (PC   ST) Version: 1.0	Cloud Strategy Planning and Management	4	-	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC510._ (PE   ST) Version: 1.0	Program Elective II	3	1	-	4	Theory	FET	20	40%	40
							CAT I	15		
							CAT II	15		
							ESE	50	40%	40
CCC512 (PC   ST) Version: 1.0	Open source technology Laboratory III	-	-	2	1	Practical	FET	50	40%	40
							ESE	50	40%	
CCC514 (PC   ST) Version: 1.0	Open source technology Laboratory IV	-	-	2	1	Practical	FET	50	40%	40
							ESE	50	40%	
CCC516 (PC   ST) Version: 1.0	Seminar II	-	-	2	1	Practical	FET	100	40%	40
Total		17	03	06	23		Total Hrs: 26, Total Credits: 23			



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School of Technology Department of Computer Science and Engineering						Sanjay Ghodawat University Kolhapur			
Structure for M. Tech Second Year (2018-19) R0 Credit Structure Semester III									
Course Code	Course Description	L	T	P	C	Evaluation Scheme			
						Component	Exam	WT	Min Pass %
CCC601	Industry Internship	-	-	-	4	Report and Presentation	ISE	50	50
							ESE	50	
CCC603	Dissertation Phase I	-	-	-	4	Presentation	ISE	100	50
CCC605	Dissertation Phase II	-	-	-	8	Presentation, Report and Demo	ISE	50	50
							ESE	50	
Credits		16							

School of Technology Department of Computer Science and Engineering						Sanjay Ghodawat University Kolhapur			
Structure for M. Tech Second Year (2018-19) R0 Credit Structure Semester IV									
Course Code	Course Description	L	T	P	C	Evaluation Scheme			
						Component	Exam	WT %	Min Pass %
CCC602	Dissertation Phase III	-	-	-	8	Presentation & Demonstration	ISE	100	50
CCC604	Dissertation Phase IV	-	-	-	8	Viva Voce Exam	ESE	50	50
CCC606	Dissertation outcome Dissemination	-	-	-	2	Publications and Patents	ESE	100	50
		Credits				18			



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**Program Elective-I**

<b>Course Code</b>	<b>Course Title</b>
<b>CCC509.1</b> (PE   ST) Version: 1.0	Application Development Frameworks
<b>CCC509.2</b> (PE   ST) Version: 1.0	Data Center Virtualization
<b>CCC509.3</b> (PE   ST) Version: 1.0	Risk Assessments and Security Audit

**Program Elective-II**

<b>Course Code</b>	<b>Course Title</b>
<b>CCC510.1</b> (PE   ST) Version: 1.0	Managing Virtual Environments
<b>CCC510.2</b> (PE   ST) Version: 1.0	Forensics and Incident Response
<b>CCC 510.3</b> (PE   ST) Version: 1.0	Data Science and Big Data Analytics



### CCC501: Research Methodology (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>Research:</b> Definition of research, Applications of research and types, Research process and steps in it, Deductive and inductive reasoning; Validity-conclusion, internal, construct and external; Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	06
<b>II</b>	<b>Single Factor Experiment:</b> Analysis of Variance (ANOVA) for fixed effect model; Total treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors. <b>Two factor Factorial Design:</b> Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two factor factorial design; Models- Effects, means and regression.	06
<b>III</b>	<b>Taguchi Techniques for Experimental Design:</b> Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting- methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects, Parameter Design- Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design.	06
<b>IV</b>	<b>Design of Experiments (DOE):</b> Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE, Simple Comparative Experiments- Basic statistical concepts, random variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample t test-value, Confidence intervals, Paired comparison.	06
<b>V</b>	<b>Literature review:</b> Need, Procedure- Search for existing literature, Review the literature selected, Develop a theoretical and conceptual framework, Writing up the review, Formulating a research problem: Sources, Considerations, Steps in formulation of a problem, formulation of objectives, Definition of variables – Concepts, indicators and variables, Types of variables, Types of measurement scales, Constructing the Hypothesis- Null(Research) and alternative, one-tailed	06



and two-tailed hypotheses, Hypothesis testing, errors in testing.

- VI Research Modeling:** Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling, Data collection methods, Surveys-types and method selection. 06

**Research Proposal:** Contents-Preamble, the problem, objectives, hypothesis to be tested, study design, setup, measurement procedures, analysis of data, organization of report; Displaying data- tables, graphs and charts, Writing a research report-Developing an outline, Key elements- Introduction, Methods, Measurement section, Design& procedure section, Results, conclusion section, Referencing of books and research papers, Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.

### *References*

1. Krishnaswamy, K. N., Sivakumar, AppaIyer and Mathirajan, M. (2006), Management Research Methodology: Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
2. Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1
3. Montgomery, Douglas C. & Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e, . (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN: 978-81-265-1424-3
4. Ranjit Kumar, (2006), Research Methodology- A Step-By-Step Guide for Beginners, (Pearson Education, Delhi) ISBN: 81-317-0496-3
5. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN: 81-7722-372-0
6. Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (New Age International, New Delhi)
7. Ross, Philip J. (1996), 2/e, Taguchi Techniques for Quality Engineering, (McGraw Hill, New York)
8. Dean, Angela & Voss, Daniel, - Design & Analysis of Experiments, (1999), (Springer Verlag), ISBN: 0-387-98561-1
9. Panneerselvam – Research Methodology, (PHI), ISBN: 81-203-2452-8.
10. Ramana, B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, (2008).



### CCC503: Internet of Things (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Understand the basics of Internet of Things.
- CO2** Design and implements project using different sensors.
- CO3** Analyze various protocols for IoT.
- CO4** Design a middleware for IoT.
- CO5** Understand the concepts of Cloud of Things with emphasis on Mobile cloud computing.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>INTRODUCTION:</b> Defining Internet of Things...IoT: A Web 3.0 View. Four Pillars of IoT...The Horizontal, Verticals, and Four Pillars... M2M: The Internet of Devices...Contents....RFID: The Internet of Objects....WSN: The Internet of Transducers...SCADA: The Internet of Controllers.	06
<b>II</b>	<b>Arduino Programming:</b> Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino	06
<b>III</b>	<b>Communication and Connectivity Technologies:</b> The DNA of IoT...DCM: Device, Connect, and Manage...Device: Things That Talk... Connect: Via Pervasive Networks...Wired Networks... Wireless Networks... Satellite IoT... Manage: To Create New Business Value...More Ingredients: LBS, GNSS, RTLS.  Middleware and IoT...An Overview of Middleware... Communication Middleware for IoT... MTC/M2M Middleware...SCADA Middleware... RFID Middleware...WSN Middleware...LBS and Surveillance Middleware.	08
<b>IV</b>	<b>Protocol Standardization for IoT...</b> Web of Things versus Internet of Things... Two Pillars of the Web... IoT Protocol Standardization Efforts...M2M and WSN Protocols...SCADA and RFID Protocols...Issues with IoT Standardization... Unified Data Standards: A Challenging Task...Unified Identification of Objects.  <b>Architecture Standardization for WoT...</b> Platform Middleware for WoT...Standards for M2M... Frameworks for WSN...Standards for SCADA... Extensions on RFID Standards...Unified Multitier WoT Architecture...SOA/EAI versus SODA/MAI...OSGi: The Universal Middleware... WoT Framework Based on Data Standards...WoT Portals and Business Intelligence...Challenges of IoT Information Security.	08



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- V Cloud Computing:** What Is Cloud Computing?.. Grid/SOA and Cloud Computing... Cloud Middleware...NIST's SPI Architecture and Cloud Standards... Cloud Providers and Systems...Summary. 08
- The Cloud of Things... The Internet of Things and Cloud Computing... Mobile Cloud Computing... MAI versus XaaS: The Long Tail and the Big Switch...The Cloud of Things Architecture...Four Deployment Models... Vertical Applications... Fifteen Essential Features...Four Technological Pillars...Three Layers of IoT Systems... Foundational Technological Enablers. Case studies

**Term Work**

No	Description	Nature of Description	Marks out of 20
1	<p>Definitions and Functional,– Four Pillars of IoT – DNA of IoT , Middleware for IoT</p> <p>Protocol , M2M and WSN Protocols – SCADA and RFID Protocols ,– Modbus – KNX – Zigbee Architecture</p> <p><b>Protocol Standardization for IoT..</b> Web of Things versus Internet of Things... Two Pillars of the Web... IoT Protocol Standardization Efforts...M2M and WSN Protocols...SCADA and RFID Protocols</p> <p><b>Architecture Standardization for WoT...</b> Platform Middleware for WoT...Standards for M2M... Frameworks for WSN...Standards for SCADA... Extensions on RFID Standards...Unified Multitier WoT</p> <p><b>Cloud Computing :</b> <b>Cloud Computing:</b> Grid/SOA and Cloud Computing... Cloud Middleware...NIST's SPI Architecture and Cloud Standards... <b>The Cloud of Things...</b> The Internet of Things and Cloud Computing... Mobile Cloud Computing... MAI versus XaaS: The Long Tail and the Big Switch...The Cloud of Things Architecture...Four Deployment Models</p>	<p>Oral will be conducted after every unit at the time of practical session of Open source technologies</p>	10
2	Open Book Test	Open Book Test will be conducted	05
3	Presentations	Students will give presentation on an assigned topic from the syllabus	05





***References***

1. The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou – CRC Press – 2012
2. Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles-(Eds.) – Springer – 2011
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press - 2010
4. The Internet of Things: Applications to the Smart Grid and Building Automation by - Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley -2012
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012
6. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
7. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)



### CCC505: Design and Development of Cloud Application

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
4	-	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Understand different virtualization technique through theoretical concepts and practical training.
- CO2** Understand the practical implementation of map reduce application developments on cloud based hadoop framework.
- CO3** Apply knowledge and expertise in cloud application development process.
- CO4** Create applications on private cloud environment like Eucalyptus and Openneubla.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>INTRODUCTION TO CLOUD COMPUTING AND RESOURCE VIRTUALIZATION:</b> Cloud Computing delivery models and services, Introduction to Virtualization, Layering and virtualization, Virtual machine monitors, Virtual machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case study: Xen, a VMM based on paravirtualization.	08
<b>II</b>	<b>APPLICATIONS CLOUD COMPUTING AND PARADIGMS:</b> Challenges for cloud computing, Existing cloud applications and new application opportunities, Architectural styles for cloud applications, Workflows: Coordination of multiple activities, Coordination based on a state machine model, ZooKeeper, MapReduce programming model, Install Hadoop on Windows system.	09
<b>III</b>	<b>CLOUD BASED APPLICATION DEVELOPMENT:</b> Amazon Web Services: EC2 instances, Connecting clients to cloud instances through firewalls, Application and transport layer protocols in EC2, Launch and connect EC2 Linux instance, Use S3 in Java, Install Simple Notification Service on Ubuntu, Create EC2 Placement Group and use MPI.	09
<b>IV</b>	<b>OPENNEBULA-A CLOUD ON VMWARE VCENTER:</b> Overview of Components and Accounts, Simple Cloud Deployment, Download and Deploy OneCloud, Import Existing vCenter, Create a Virtual Data Center, Interfaces, Security and Resource Consumption Control, Guest Configuration, Infrastructure Configuration, Appliance Configuration.	09
<b>V</b>	<b>EUCALYPTUS OPEN-SOURCE PRIVATE CLOUD</b> Introduction to Eucalyptus, Eucalyptus Overview, Eucalyptus Components, System	09



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Requirements, Eucalyptus Installation, Eucalyptus Network Migration and Upgrade, Eucalyptus Upgrade, Euca2ools Standalone Installation.

**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Introduction to cloud computing and recourse virtualization. Applications cloud computing and paradigms. Cloud based application development. Opennebula-A cloud on VM ware V center Eucalyptus Open-source private cloud	Students will understand and should present the theory associated with.	10
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**References**

1. Dan C. Marinescu, "Cloud Computing - Theory and Practice", 1st Edition, Morgan Kaufmann is an imprint of Elsevier, 2013, ISBN :9780124046276.
2. Biris Lublinsky, Kevin T. Smith and Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN 13:9788126551071, 2015.
3. The Open Replacement for vCloud - Bring your VMware environment to the Cloud in 5 minutes. <http://vonecloud.today/> , <http://docs.vonecloud.com/1.8>
4. Eucalyptus 3.4.2 Fast Start Guide. [http://docs.hpcloud.com/pdf/static/Eucalyptus\\_3.4/faststart-guide-3.4.2.pdf](http://docs.hpcloud.com/pdf/static/Eucalyptus_3.4/faststart-guide-3.4.2.pdf)
5. Cloud services for your virtual infrastructure, Part 1: Infrastructure-as-a-Service (IaaS) and Eucalyptus. <http://www.ibm.com/developerworks/library/os-cloud-virtual1/>
6. Yohan Wadia, "The Eucalyptus Open-Source Private Cloud". Last Accessed on: <http://www.cloudbook.net/resources/stories/the-eucalyptus-open-source-private-cloud>
7. Arshdeep Bahga, Vijay Madiseti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN-13: 978-0996025508.
8. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012



CCC507: Cloud Architectures  
(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
4	-	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Analyze the components of cloud computing showing how business agility in an organization can be created.
- CO2** Evaluate the deployment of web services from cloud architecture.
- CO3** Critique the consistency of services deployed from a cloud architecture.
- CO4** Compare the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.
- CO5** Analyze case studies to derive the best practice model to apply when developing and deploying cloud based applications.

**Syllabus (Theory)**

Units	Description	Hrs
<b>I</b>	<b>Cloud Computing Fundamental:</b> 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.	08
<b>II</b>	<b>Cloud Applications:</b> Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.	09
<b>III</b>	<b>Cloud Services Management:</b> 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).	10
<b>IV</b>	<b>Application Development:</b> Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.	08
<b>V</b>	<b>Best Practice Cloud IT Model:</b> 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	09



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deployment so as to improve the total cost of ownership (TCO).

**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Introduction cloud and cloud computing	Students will understand and should present the theory associated with.	10
	Cloud Applications		
	Cloud Services Management		
	Cloud application Development		
	Best Practice Cloud IT Model		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

***References***

1. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]
2. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach [ISBN: 0071626948]
3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]



### CCC509.1: Application Development Frameworks

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Identify<sup>2</sup> the key aspects of developing applications using a framework.
- CO2** Write<sup>5</sup> code to integrate frameworks to access relational databases.
- CO3** Evaluate<sup>6</sup> framework technologies for remote communication..
- CO4** Design<sup>6</sup> concurrent applications and schedule tasks using an application framework. Assess them integration of serialization and remoting to call remote applications.
- CO5** Integrate<sup>6</sup> an application framework to implement stateful interactions. Compare rapid productivity tools such as Grails and Roo, etc.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>SPRING FRAMEWORK:</b> 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.	07
<b>II</b>	<b>EFFECTIVE MIDDLE-TIER ARCHITECTURE:</b> Adding behavior to an application using aspects, data access with Spring, simplifying JDBC-based data access, driving database transactions in a Spring environment.	08
<b>III</b>	<b>IMPLEMENTING ENTERPRISE INFORMATION CONNECTIVITY:</b> Object-to-relational mapping (ORM), Hibernate in a Spring environment, effective web application architecture, Spring MVC, RESTful web services with Spring MVC.	07
<b>IV</b>	<b>INTEGRATION WITH ENTERPRISE SERVICES:</b> Securing web applications, emoting framework, simplifying message applications with Spring JMS, adding manageability to an application with Spring JMX.	07
<b>V</b>	<b>ENTERPRISE INTEGRATION:</b> Integration Foundations Essential concurrency, tasks and scheduling, serialization 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) <b>Rich Web Applications:</b> Spring Web MVC Spring MVC annotation-based programming model, Page composition with layout technologies such as Tiles,	07



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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 behavior. 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.

**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Spring Framework	Students will understand and should present the theory associated with.	10
	Effective middle-tier architecture		
	Implementing enterprise information connectivity		
	Integration with enterprise services		
	Enterprise integration, Rich Web Applications		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**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 Sources" <http://www.springssource.com>
6. Website "Sun Oracle" <http://www.oracle.com/us/technologies/java/index.html>.
7. Website "IBM" <http://www.ibm.com/developerworks/java>





### CCC509.2: Data Center Virtualization

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Identify<sup>4</sup> various constraints and challenges in setting up a data center.
- CO2** Demonstrate<sup>3</sup> Enterprise level virtualization and access control in virtual machines.
- CO3** Perform<sup>3</sup> Resource monitoring and execute backup and recovery of virtual machines.
- CO4** Design<sup>6</sup> application using virtualization software & implement the resource management.
- CO5** Create<sup>6</sup> application for Data protected environment with virtualization management scheme.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>DATA CENTER CHALLENGES:</b> How server, desktop, network Virtualization and cloud computing reduce data center footprint, environmental impact and power requirements by driving server consolidation.	07
<b>II</b>	<b>EVOLUTION OF DATA CENTERS:</b> The evolution of computing infrastructures and architectures from standalone servers to rack optimized blade servers and unified computing systems (UCS).	08
<b>III</b>	<b>ENTERPRISE-LEVEL VIRTUALIZATION:</b> Provision, monitoring and management of a virtual datacenter and multiple enterprise, Networking and Storage in Enterprise Virtualized Environments -Connectivity to storage area and IP networks from within virtualized environments using industry standard protocols.	07
<b>IV</b>	<b>VIRTUAL MACHINES &amp; ACCESS CONTROL:</b> Virtual machine deployment, modification, management; monitoring and migration methodologies. Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor.	07
<b>V</b>	<b>VIRTUAL MACHINE DATA PROTECTION:</b> Backup and recovery of virtual machines using data recovery techniques; Scalability -Scalability features within Enterprise virtualized environments using advanced management applications that enable clustering, High Availability : Virtualization high availability and redundancy techniques.	07





**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Data center challenges	Students will understand and should present the theory associated with.	10
	Evolution of data centers		
	Enterprise level virtualization		
	Virtual Machines and access control		
	Virtual Machines data protection		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**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.



### CCC509.3: Risk Assessments and Security Audit (Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Gain the knowledge about Information Risk.
- CO2** Discovery knowledge in collecting data about organization.
- CO3** Analyses on Assessment Risk Information
- CO4** Understanding IT audit and its activities.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>INTRODUCTION:</b> What is Risk? –Information Security Risk Assessment Overview- Drivers, Laws and Regulations- Risk Assessment Frame work – Practical Approach.	07
<b>II</b>	<b>DATA COLLECTION:</b> The Sponsors- The Project Team- Data Collection Mechanisms- Executive Interviews- Document Requests- IT Assets Inventories- Profile & Control Survey- Consolidation.	08
<b>III</b>	<b>DATA ANALYSIS:</b> Compiling Observations- Preparation of catalogs- System Risk Computation- Impact Analysis Scheme- Final Risk Score.	07
<b>IV</b>	<b>ASSESSMENT:</b> System Risk Analysis- Risk Prioritization- System Specific Risk <b>RISK</b> Treatment- Issue Registers- Methodology- Result- Risk Registers- Post Mortem.	07
<b>V</b>	<b>SECURITY AUDIT PROCESS:</b> Pre-planning audit- Audit Risk Assessment- Performing Audit- Internal Controls- Audit Evidence- Audit Testing- Audit Finding- Follow-up activities.	07

### Term Work

No	Description	Nature of Description	Marks out of 20
1	Introduction to Risk Assessments and Security Audit	Students will understand and should present the theory associated with.	10
	Data collection		
	Data analysis		
	Assessment		



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	Security audit process		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

***References***

1. Mark Talabis, "Information Security Risk Assessment Toolkit: Practical Assessments through Data Collection and Data Analysis", Syngress; 1 edition, ISBN: 978-1-59749-735-0, 2012.
2. David L. Cannon, "CISA Certified Information Systems Auditor Study Guide", John Wiley & Sons, ISBN: 978-0-470-23152-4, 2009



### CCC511: Open Source Technology Lab-I (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT%	Min. Pass %
-	-	2	1	Practical	FET	50	40%
					ESE	50	40%

**Course Outcomes:** After the end of this course students will able to

- CO1** Learn Iot and its components.
- CO2** Implement programs on Arduino Uno board.
- CO3** Develop Serial Communication between Arduino board and PC.
- CO4** Design Iot application.

### Experiment List

Experiment	Description
<b>I</b>	Study of IoT and its components.
<b>II</b>	Experiments on digital input and digital output on Arduino Uno board and using LED and Buzzer.
<b>III</b>	Implement Electric bulb and Fan automation using Bluetooth communication.
<b>IV</b>	Serial Communication between Arduino board and PC:-characters send and received Read and display on PC and LCD display.
<b>V</b>	Experiment on Ethernet with web page static IP.
<b>VI</b>	Implement program to maintain water level of plant using sensors.
<b>VII</b>	Implement program to design smart home using sensors.
<b>VIII</b>	Send Data to the Azure IoT hub using a Simulated Device.

### Term Work

No	Description	Nature of Description	Marks out of 50
1	Study of IoT and its components	Students will perform Experiments with understanding of the theory associated with.	30
	Experiments on digital input and digital output on Arduino Uno board and using LED and Buzzer.		
	Implement Electric bulb and Fan automation using Bluetooth communication		
	Serial Communication between Arduino board and PC:-character send and received, Read and display on PC and LCD display		
	Experiment on Ethernet with web page static IP		
	Implement program to maintain water level of plant using sensors.		



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	Implement program to design smart home using sensors		
	Send Data to the Azure IoT hub using a Simulated Device		
2	Assignments/Experiment Theory per Unit	Students will submit 4 assignments/ Experiment Theory based on every unit.	10
3	Quiz	Quizzes will be conducted during practical hours	10

**Practical Oral Examination (POE): Will be based on above term work (TW)**



### CCC513: Open Source Technology Lab-II (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT%	Min. Pass %
-	-	2	1	Practical	FET	50	40%
					ESE	50	40%

**Course Outcomes:** After the end of this course students will able to

- CO1 Deploy static web pages hosting using S3 (Simple Storage Service)
- CO2 Configuring an EC2 Web Hosting Instance.
- CO3 Analyse streaming Video to your website or app with Elastic Transcoder, S3, and CloudFront.
- CO3 Analyzing Log Files with EMR

### Experiment List

- | Experiment | Description   |
|------------|---|
| <b>I</b>   | <b>Using S3 for Static Web Hosting:</b> In this lab, we'll use an S3 (Simple Storage Service) bucket to host static web page content. With only a few steps, you can now configure an S3 bucket to host static web pages in practically no time at all. This is useful for prototyping, place holding, or even hosting a full static site.  |
| <b>II</b>  | <b>Introduction to Cloud Formation:</b> Cloud Formation allows AWS users to create templates for generating "stacks" using AWS resources. This allows developers, engineers, and admins to generate identical environments from which to work and otherwise. Cloud Formation, like Puppet and Chef, allows users to create "infrastructure as code."  |
| <b>III</b> | <b>Configuring an EC2 Web Hosting Instance:</b> In this lab, we will be applying basic concepts covered in the EC2 portion of the AWS Certified Solutions Architect. This lab will also include a brief introduction to Amazon Route 53.<br><br>By the end of the lab, you will have: <ul style="list-style-type: none"><li>• Created a t1.micro EC2 image with Ubuntu 14.04 L TS as the distribution</li><li>• Connected to the instance using your .pem key (created during lab)</li><li>• Downloaded Apache2</li><li>• Allocated and assigned a new Elastic IP address to your EC2 instance</li><li>• Used Route 53 to direct linuxacademylab#.com to your Elastic IP</li><li>• Tested your instance by visiting the website</li></ul> |
| <b>IV</b>  | <b>Streaming Video with Elastic Transcoder, S3 and CloudFront:</b> With AWS, streaming video to your website or app can be done through the use of the Elastic Transcoder, S3, and CloudFront. In this lab, we are  |



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combining our knowledge of these services to upload a video, create a pipeline to transcode the video, and output it to S3. We are also configuring a CloudFront distribution to stream the video to a website. We should be able to upload a video to an initial S3 bucket, which then, using an Elastic Transcoder job, transcodes the video. The transcoder then dumps the output into a separate bucket, from which we can stream.

- V Analyzing Log Files with EMR:** Amazon Elastic MapReduce (EMR) provides users a cost-effective way to process large amounts of data. In this lab, we use EMR to review NASA web server log files and group the data by 404 entries.

**Term Work**

No	Description	Nature of Description	Marks out of 50
1	Using S3 for Static Web Hosting	Students will perform Experiments with understanding of the theory associated with.	30
	Introduction to CloudFormation		
	Configuring an EC2 Web Hosting Instance		
	Streaming Video with Elastic Transcoder, S3, and CloudFront		
	Analyzing Log Files with EMR		
2	Assignments/Experiment Theory per Unit	Students will submit 4 assignments/ Experiment Theory based on every unit.	10
3	Quiz	Quizzes will be conducted during practical hours	10

**Practical Oral Examination (POE): Will be based on above term work (TW)**



**CCC 515: Seminar I**

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
-	-	2	1	Practical	FET	100	40%	40

**Course Outcomes:** After the end of this course students will able to

**CO1** Identifying topics of interest related to the program of study and prepare and make presentation before an enlightened audience.

**Syllabus**

**Units**

**Description**

- I** The students are expected to give at least one presentation 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.

**Term Work**

No	Description	Nature of Description	Marks out of 50
1	Presentation	Students will understand the topic and should give presentation on it.	40
2	Paper Work	Student should publish at least one paper on it	10





### CCC502: Service Oriented Architecture (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Explain2 service oriented analysis techniques
- CO2** Analyze advanced concepts such as service composition, orchestration & choreography.
- CO3** Describe technology underlying the service design.
- CO4** Explain about various Web Service specification standards.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>INTRODUCTION:</b> Roots of SOA – Characteristics of SOA - Comparing SOA to client-server and distributed internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of service orientation.	07
<b>II</b>	<b>SERVICE ORIENTED ARCHITECTURE IN WEB SERVICES:</b> Web services – Service descriptions – Messaging with SOAP –Message exchange Patterns – Coordination – Atomic Transactions – Business activities – Orchestration – Choreography - Service layer abstraction – Application Service Layer – Business Service Layer – Orchestration Service Layer.	08
<b>III</b>	<b>BUILDING SOA:</b> Service oriented analysis – Business-centric SOA – Deriving business services -service modeling - Service Oriented Design – WSDL basics – SOAP basics – SOA composition guidelines – Entity-centric business service design – Application service design – Task centric business service design.	07
<b>IV</b>	<b>SOA PLATFORMS:</b> SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAX-WS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC)- Web Services Interoperability Technologies (WSIT) - SOA support in .NET – Common Language Runtime - ASP.NET web forms – ASP.NET web services – Web Services Enhancements (WSE).	07
<b>V</b>	<b>SOA DESIGN:</b> Web Service-BPEL- process, elements, functions -Web Service-Coordination overview –elements, web service business activity & atomic transaction coordination type, -Business process design Web Service-Choreography, Web Service-Policy-elements -Web Service Security-XML–Signature element.	07



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Case study for SOA in given web services	Students will understand and should present the theory associated with.	10
	Creating messaging framework with SOAP description		
	Demonstrating services layers in different web applications		
	Building service oriented architecture for the given applications		
	Creating SOA based cloud systems & relationship between them		
	SOA based design patterns		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

***References***

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2009.
2. Thomas Erl, "SOA Principles of Service Design" (The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005.
3. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
4. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education, 2005.



### CCC504: Cloud Storage Infrastructures (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
4	-	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Critically appraise the opportunities and challenges of information management in complex business environments.
- CO2** Evaluate information storage management design in a cloud environment and how it relates to the business objectives of an organization.
- CO3** Analyze the role technology plays in the design of a storage solution in cloud architecture.
- CO4** Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud.
- CO5** Analyze how best to provide reliable access to information both locally and remotely using storage technologies.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>VIRTUALIZED DATA CENTER ARCHITECTURE:</b> 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.	08
<b>II</b>	<b>INFORMATION STORAGE SECURITY &amp; DESIGN:</b> 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.	09
<b>III</b>	<b>STORAGE NETWORK DESIGN:</b> 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.	09
<b>IV</b>	<b>OPTIMIZATION OF CLOUD STORAGE:</b> 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.	09
<b>V</b>	<b>INFORMATION AVAILABILITY DESIGN:</b> 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.	09



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Discuss public, private and hybrid cloud infrastructure.	Students will understand and should present the theory associated with.	10
	Discuss Storage strategy and governance, security and regulations of cloud.		
	Discuss backup/recovery solutions to guarantee data availability in a virtualized environment.		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**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.



### CCC506: Cloud Security (Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Compare modern security concepts as they are applied to cloud computing.
- CO2** Assess the security of virtual systems.
- CO3** Evaluate the security issues related to multi-tenancy.
- CO4** Appraise compliance issues that arise from cloud computing.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>SECURITY CONCEPTS:</b> 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.	07
<b>II</b>	<b>MULTI-TENANCY ISSUES:</b> 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).	08
<b>III</b>	<b>VIRTUALIZATION SYSTEM-SPECIFIC ATTACKS:</b> 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.	07
<b>IV</b>	<b>TECHNOLOGIES FOR VIRTUALIZATION-BASED SECURITY ENHANCEMENT:</b> IBM security virtual server protection, virtualization-based sandboxing; Storage Security- HIDPS, log management, Data Loss Prevention. Location of the Perimeter.	07
<b>V</b>	<b>LEGAL AND COMPLIANCE ISSUES:</b> 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.	07



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Importance in PaaS, IaaS and SaaS.	Students will understand and should present the theory associated with.	10
	Creating messaging framework with SOAP description		
	Virtualization System Security Issues		
	VM attacks		
	Storage Security		
	Examination of modern Security Standards		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

***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.



### CCC508: Cloud Strategy Planning & Management

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
4	-	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Explain how cloud computing enables IT Transformation and business value in an organization.
- CO2** Analyze the role that cloud computing can play in the business process.
- CO3** Justify how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.
- CO4** Show how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.
- CO5** Prepare IT governance to manage business realization from cloud IT services.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>ACHIEVING BUSINESS VALUE FROM IT TRANSFORMATION</b> 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; <b>Developing Business Strategy:</b> 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.	09
<b>II</b>	<b>STRATEGIC IT LEADERSHIP IN THE ORGANIZATION</b> 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.	08
<b>III</b>	<b>PLANNING A CLOUD COMPUTING BASED IT STRATEGY</b> 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.	09
<b>IV</b>	<b>SOA AND BUSINESS AGILITY</b> 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).	09
<b>V</b>	<b>BENEFIT REALIZATION AND IT GOVERNANCE</b> Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT	09





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services (IaaS, PaaS, PaaS, 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 Sarbanes Oxley (CobiT) and other commonly-used approaches.

**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Case study Investigate business strategy models to gain competitive advantage for organizations	Students will understand and should present the theory associated with.	10
	Role of the strategic IS/IT leaders in planning and managing IT Strategic development in the organization		
	Develop an IT strategy to deliver on strategic business objectives in the business strategy		
	Compare Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud		
	Describe Gartner's 5 pillars of benefit realization		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**References**

1. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise", Addison Wesley [ISBN: 0136009220], 2009.
2. Barry Briggs and Eduardo Kassner "Enterprise Cloud Strategy", (ISBN 9781509301966)
3. Charles Babcock, "Management Strategies for the Cloud Revolution", 1st Ed., Tata McGraw/Hill [ISBN: 0071740759], 2010.
4. Mark I. Williams, "A Quick Start Guide to Cloud Computing: Moving Your Business into the Cloud" Kogan Page [ISBN: 0749461306], 2010.





### CCC510.1: Managing Virtual Environment (Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Assess key performance factors of virtualized systems, principal issues in troubleshooting virtual environments.
- CO2** Evaluate small scale virtual environment developed in the lab.
- CO3** Develop in-depth knowledge and techniques used to efficiently optimize and effectively trouble-shoot virtual infrastructures.

### Syllabus (Theory)

Units	Description	Hrs
<b>I</b>	<b>PERFORMANCE MANAGEMENT IN A VIRTUAL ENVIRONMENT:</b> Management techniques, methodology and key performance metrics used to identifying CPU, memory, network, virtual machine and application performance bottlenecks in a virtualized environment.	07
<b>II</b>	<b>CONFIGURATION AND CHANGE MANAGEMENT:</b> Configuration and change management goals and guidelines, tools and technologies in virtualized environments.	08
<b>III</b>	<b>SECURE VIRTUAL NETWORKING:</b> 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.	07
<b>IV</b>	<b>PROTECTING THE MANAGEMENT ENVIRONMENT:</b> 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.	07
<b>V</b>	<b>TROUBLESHOOTING VIRTUAL ENVIRONMENTS:</b> 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.	07



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Discuss and evaluate the management of complex virtual environments	Students will understand and should present the theory associated with.	10
	Critically analyze key performance factors in virtualized systems		
	Identify and formulate judgments for management requirements relating to the configuration and performance of virtual environments.		
	Identify and analyze the principal issues in troubleshooting virtual environments.		
	Performance evaluations and critical evaluations of a small scale virtual environment developed in the lab.		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**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.
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**Structure and Contents for M. Tech. Computer Science and Engineering Program (2018-19) R0**

**CCC510.2: Forensics and Incident Response**  
(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Plan and prepare for all stages of an investigation - detection, initial response and management interaction.
- CO2** Analyze & Investigate web server attacks, DNS attacks and router attacks and also can learn the importance of evidence handling and storage.
- CO3** Monitor network traffic and identify illicit servers and covert channels.

**Syllabus (Theory)**

Units	Description	Hrs
<b>I</b>	<b>INCIDENT AND INCIDENT RESPONSE:</b> Introduction to Incident - Incident Response Methodology – Steps - Activities in Initial Response Phase after detection of an incident.	07
<b>II</b>	<b>INITIAL RESPONSE AND FORENSIC DUPLICATION:</b> Initial Response & Volatile Data Collection from Windows system - Initial Response & Volatile Data Collection from Unix system - Forensic Duplication: Forensic duplication: Forensic Duplicates as Admissible Evidence, Forensic Duplication Tool Requirements, Creating a Forensic Duplicate/Qualified Forensic Duplicate of a Hard Drive.	08
<b>III</b>	<b>STORAGE AND EVIDENCE HANDLING:</b> File Systems-FAT, NTFS - Forensic Analysis of File Systems - Storage Fundamentals-Storage Layer, Hard Drives Evidence Handling-Types of Evidence, Challenges in evidence handling, Overview of evidence handling procedure.	07
<b>IV</b>	<b>NETWORK FORENSICS:</b> Collecting Network Based Evidence - Investigating Routers - Network Protocols - Email Tracing - Internet Fraud.	07
<b>V</b>	<b>SYSTEMS INVESTIGATION AND ETHICAL ISSUES:</b> Data Analysis Techniques - Investigating Live Systems (Windows & Unix) - Investigating Hacker Tools - Ethical Issues – Cybercrime.	07



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Incident Response Methodology	Students will understand and should present the theory associated with.	10
	Forensic Duplication Tool		
	File Systems-FAT, NTFS		
	Network Protocols - Email Tracing - Internet Fraud		
	Investigating Hacker Tools		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

**References**

1. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.
2. Peter Stephenson, "Investigating Computer Crime: A Handbook for Corporate Investigations", Sept 1999.
3. Eoghan Casey, "Handbook Computer Crime Investigation's Forensic Tools and Technology", Academic Press, 1st Edition, 2001.
4. Skoudis.E, Perlman. R. Counter Hack: "A Step-by-Step Guide to Computer Attacks and Effective Defenses", .Prentice Hall Professional Technical Reference. 2001.
5. Norbert Zaenglein, "Disk Detective: Secret You Must Know to Recover Information From a Computer", Paladin Press, 2000.
6. Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to computer forensics and investigations", course technology, Cengage Learning; 4thedition, ISBN: 1-435-49883-6, 2009.



**CCC510.3: Data Science and Big Data Analytics**

(Ver 1.0, Program Elective, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
3	1	-	4	Theory	FET	20	40%	40
					CAT I	15		
					CAT II	15		
					ESE	50	40%	40

**Course Outcomes:** After the end of this course students will able to

- CO1** Deploy the Data Analytics Lifecycle to address big data analytics projects.
- CO2** Apply appropriate analytic techniques and tools to analyze big data, create statistical models, and identify insights that can lead to actionable results.
- CO3** Select appropriate data visualizations to clearly communicate analytic insights to business sponsors and analytic audiences.
- CO4** Use tools such as: R and RStudio, MapReduce/Hadoop, in-database analytics, Window and MADlib functions.
- CO5** 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.

**Syllabus (Theory)**

Units	Description	Hrs
<b>I</b>	<b>INTRODUCTION TO BIG DATA ANALYTICS:</b> Big Data overview, State of the practice in analytics role of data scientists, Big Data Analytics in industry verticals.	07
<b>II</b>	<b>END-TO-END DATA ANALYTICS LIFE CYCLE:</b> Key roles for successful analytic project, main phases of life cycle, Developing core deliverables for stakeholders.	08
<b>III</b>	<b>BASIC ANALYTIC METHODS:</b> Introduction to “R”, analyzing and exploring data with “R”, statistics for model building and evaluation.	07
<b>IV</b>	<b>ADVANCED ANALYTICS AND STATISTICAL MODELING FOR BIG DATA:</b> Naïve Bayseian Classifier, K-means Clustering, Association Rules, Decision Trees, Linear and Logistic Regression, Time Series Analysis, Text Analytics.	07
<b>V</b>	<b>MAPREDUCE/HADOOP:</b> Technology and Tools – MapReduce / Hadoop, In-database Analytics, MADlib and advanced SQL Tools.	07



**Term Work**

No	Description	Nature of Description	Marks out of 20
1	Study of Hadoop Hive DML commands like Insert, delete, update, data retrieval queries and Join-inner and outer.	Students will understand and should present the theory associated with.	10
	Working with operators in Pig-FOR EACH, ASSERT, FILTER, GROUP, ORDER BY, DISTINCT, JOIN, LIMIT, SAMPE, SPLIT, FLATIEN.		
	Study of R-declaring variables, expressions, functions and executing R script.		
	Working with R with data sets-create, read, write and R Tables-create, read, write.		
	Manipulating and processing data in R- merging datasets, sorting data, putting data into shape, managing data using matrices managing data using data frames.		
	Write a program to count the words with Hadoop.		
2	Assignments per Unit	Students will submit 5 assignments based on every unit.	06
3	Quiz	Quizzes will be conducted based on every unit.	04

***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.



**CCC512: Open Source Technology Lab-III**  
(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT%	Min. Pass %
-	-	2	1	Practical	FET	50	40%
					ESE	50	40%

**Course Outcomes:** After the end of this course students will able to

- CO1** Build a Serverless Application End-to-End.
- CO2** Develop microservice using C# on AWS Lambda -Serving Hello World in .NET Core.
- CO3** Deploying a Simple Web Application with Elastic BeanStalk.
- CO4** Analyzing Log Files with EMR.

**Experiment List**

Experiment	Description
<b>I</b>	<b>Building a Serverless Application End-to-End:</b> Using AWS's new server application model, we are going to build out a simple application to serve a webpage or JSON body. This application will also connect to DynamoDB. Afterwards, we create a CloudFormation template to deploy any needed components, and then deploy the application to AWS.
<b>II</b>	<b>C# on AWS Lambda -Serving Hello World in .NET Core:</b> In this lab, we will be building a microservice using C# and the .NET Core programming language using the AWS CLI, CloudFormation and Lambda.
<b>III</b>	<b>Deploying a Simple Web Application with Elastic BeanStalk:</b> In this lab, we'll learn how to deploy a simple PHP web application. Our sample app will print a "Hello World" message from an `index.php` file, but Elastic BeanStalk can be used to host many other types of web applications as well. We'll deploy our app to an EC2 instance with an Elastic LoadBalancer with an autoscaling group. All of this will be done automatically using Elastic BeanStalk. To start, log into the AWS console with the credentials. Once we're logged in, we'll navigate to Elastic BeanStalk under the Compute section of the service listings.
<b>IV</b>	<b>Analyzing Log Files with EMR:</b> Amazon Elastic MapReduce (EMR) provides users a cost-effective way to process large amounts of data. In this lab, we use EMR to review NASA web server log files and group the data by 404 entries.



**Term Work**

No	Description	Nature of Description	Marks out of 50
1	Building a Serverless Application End-to-End	Students will perform Experiments with understanding of the theory associated with.	30
	C# on AWS Lambda -Serving Hello World in .NET Core		
	Deploying a Simple Web Application with Elastic BeanStalk		
	Analyzing Log Files with EMR		
2	Assignments/Experiment Theory per Unit	Students will submit 4 assignments/ Experiment Theory based on every unit.	10
3	Quiz	Quizzes will be conducted during practical hours	10

**Practical Oral Examination (POE): Will be based on above term work (TW)**





**CCC514: Open Source Technology Lab-IV**  
(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT%	Min. Pass %
-	-	2	1	Practical	FET	50	40%
					ESE	50	40%

**Course Outcomes:** After the end of this course students will able to

- CO1** Creating a Virtual Private Cloud with CloudFormation and Launching an EC2 Instance.
- CO2** Configure Access and Security for Instances.
- CO3** Apply Kinesis Streams and Firehose to real world data.
- CO4** Develop Auto-Scaling Based Off SQS Message Queue Size.

**Experiment List**

Experiment	Description
<b>I</b>	<b>Creating a Virtual Private Cloud with CloudFormation and Launching an EC2 Instance:</b> In this lab, we are going to walk through a CloudFormation template looking at each component required to build a VPC and launch an EC2 instance in the VPC using CloudFormation. We are going to use CloudFormation to build the VPC, subnets, Internet gateway, route tables, attach the Internet gateway and launch the EC2 instance.
<b>II</b>	<b>Configure Access and Security for Instances:</b> In this lab we are going to work securing access to our instance virtual machines. First we will create a key pair that can be used to access our virtual machine. Then we will create a new security group and add rules to that group. Then finally we will launch new virtual machine instances to confirm our rules.
<b>III</b>	<b>Kinesis Streams and Firehose:</b> In this lab, we'll learn about Kinesis Streams and Firehose to capture and process streams for big data. In this lab, we learn how to use Kinesis Firehose to deliver data streams to an S3 bucket, as well as how we can apply this operation to real world data like Apache log files. We also used Kinesis Streams to read a stream of data with a custom KCL application.
<b>IV</b>	<b>Auto-Scaling Based Off SQS Message Queue Size:</b> In this lab, we learn how to auto-scale your infrastructure through a combination of <i>CloudWatch</i> , <i>SQS</i> messages, and AWS's <i>Auto Scaling</i> feature. First, we create an SQS queue, and then, through CloudWatch, set up an alarm to trigger every time we hit 40 messages in our queue. When this alarm triggers, another instance is added. Log in to your AWS Console with the credential. Within your EC2 Dashboard, you can see an instance called <i>Ops</i> — this is the instance we are using to send messages to our SQS queue. However, we first need to create the queue.



**Term Work**

No	Description	Nature of Description	Marks out of 50
1	Creating a Virtual Private Cloud with CloudFormation and Launching an EC2 Instance	Students will perform Experiments with understanding of the theory associated with.	30
	Configure Access and Security for Instances		
	Kinesis Streams and Firehose		
	Auto-Scaling Based Off SQS Message Queue Size		
2	Assignments/Experiment Theory per Unit	Students will submit 4 assignments/ Experiment Theory based on every unit.	10
3	Quiz	Quizzes will be conducted during practical hours	10

**Practical Oral Examination (POE): Will be based on above term work (TW)**



**CCC 516: Seminar II**

(Ver 1.0, Program Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme				
				Component	Exam	WT%	Min. Pass %	
-	-	2	1	Practical	FET	100	40%	40

**Course Outcomes:** After the end of this course students will able to

**CO1** Identifying topics of interest related to the program of study and prepare and make presentation before an enlightened audience.

**Syllabus**

**Units**

**Description**

- I** The students are expected to give at least one presentation 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.

**Term Work**

No	Description	Nature of Description	Marks out of 50
1	Presentation	Students will understand the topic and should give presentation on it.	40
2	Paper Work	Student should publish at least one paper on it.	10



### **CCC601: INDUSTRY INTERSHIP**

All the students enrolled for M.Tech program irrespective of their program of study are required to undergo 4 weeks industry internship in industries pertaining to the respective domain of their program. This internship is aimed at giving sufficient exposure to the students regarding the working of business, various functional areas, norms of work, organization structure, products and services along with the work procedure and systems. This help the students to visualize the inter connectivity between what they learn in classes (theory) to the real world of work. It also helps to understand the expectation of industries regarding Code of Conduct, time management, commitment, planning and scheduling the work activities and meeting and analytical and critical thinking skills required the schedule. Industry internship is to be done by the students at the end of semester II (during the vacation) or students have option to carryout internship in the company where they will take up dissertation work.

#### **Industry Internship Program with Dissertation**

It is full one year two semester program in the second year of the program semester III and IV This course aims at giving students hands on experience to imbibe in them the skills and competencies required to make them competent post graduates for employment as per the expectation of the industry where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the supervisor assigned.

#### **OUTCOME EXPECTED AT THE END OF INTERNSHIP**

After the successful completion of the internship the student should be able to

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts- studied.
6. Analyze the company with respect to its competitors.
7. Carry out SWOT analysis of the company
8. Improve the leadership abilities, interpersonal communication.
9. Demonstrate project management and finance sense



### **WORK DIARY**

Each student should maintain a work which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

### **CODE OF CONDUCT:**

The students should strictly abide by the rules and regulations of the company with respective to safety, timing, discipline. Any violation of the norms will view seriously and the institute may take strict action in such situation and student may face a severe setback in both his academics and career.

### **EXPENSES OF THE INTERSHIP TRAINING and DISSERTATION IN COMPANY:**

All the expenses of the training like travelling, boarding and lodging should be borne by the students. However, if the company offers, they are eligible to get subsidized canteen facility, transport facility.

### **EVALUATION OF INTERNSHIP: (4 CREDITS)**

The assessment of the internship will be done jointly by the industry and the faculty assigned to the students. The tentative scheme of assessment will be

- |    |   |     |
|----|---|-----|
| 1. | Punctuality, behavior and following code of conduct (to be assessed by the company personal)                        | 20% |
| 2. | Initiative, observation and interest in learning new things (faculty in charge)                                     | 20% |
| 3. | Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal) | 20% |
| 4. | Final evaluation based on presentation of work, internship report (By DPGC committee and Supervisors )              | 40% |

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.



**CCC603: DISSERTATION PHASE I (SYNOPSIS SUBMISSION SEMINAR)**

Dissertation is a program requirement for M. Tech wherein under the guidance of a supervisor/ co-supervisor from the industry in case of industry sponsored projects, a second year student is required to some innovative/ contributory/ developmental work with the application of knowledge earned while undergoing various theory and laboratory courses. A student has to exhibit both analytical and practical skills through dissertation work.

A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest specific to the domain in consultation with the dissertation supervisor and industry co- supervisor. The objectives and scope of the dissertation will be expected at a higher level and the use of the new analytical and computer based tools for solving the identified problem is recommended.

A student is required to submit the dissertation synopsis duly signed by supervisor and co-supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPGC (Departmental Program Committee).

The dissertation synopsis seminar presentation comprises of the following details:

- A Dissertation title
- General introduction to the area of the :topic
- Relevance of the dissertation work
- Literature review/ prior work done in the area
- Dissertation objectives and scope
- Expected outcomes
- Methodology
- Phases of work and representation on a Gantt chart with deadlines
- Resources required to complete the work
- Commitment from the student (Ethical conduct)
- References

Based on the report and the presentation, the DPGC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope,etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

**The Evaluation Guidelines**

1. Based on the initiative, the novelty and the skill in identifying the problem and collecting and analyzing the information and co-Supervisor : 50 %
2. Presentation, scope, outcomes, research compilation, relevance DPGC: 50%



### **CCC605: DISSERTATION PHASE II**

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis.

Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPGC (ISE) and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

The Evaluation Scheme	Weightage%
Supervisor and co- supervisor	25
DPGC of the program department	25
Panel of Examiners [Chairman, internal supervisor, external expert]	50

In the DPGC Evaluation, if the progress is not found satisfactory, the student will be given the grace period of 4 weeks to work on the dissertation and present it to the committee again and on approval the ESE will be conducted. In this case, the student has to suffer one grade penalty and the next semester Phase III starts only on satisfactory completion of Phase II

### **CCC607: ONLINE CERTIFICATION/ SELF-STUDY COURSE**

A student may be requiring learn the new software, Mathematical/ analytical tools or entirely a new course which he/ she has not studied prior to this which is required for the dissertation work. A student has to learn this new software through a certification program through various web based sources (online courses) i.e. NPTEL or MIT Open Source material and produce course completion certification/grade card In case, the courses are not available online, supervisor can recommend a self-study course with curriculum jointly drawn by student and guide and approved by DPGC.

Either category of courses are to be approved by DPGC during the synopsis presentation. The grades for the courses are to be decided based on the rubrics designed for this purpose. A student has to earn credits for this course before registering for Semester IV- Phase III.



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**CCC602: DISSERTATION PHASE III**

This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co-supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co-supervisor submit the same to the PG program coordinator of department.

The Program coordinator will schedule the presentation of student (Pre submission) before the DPGC members once the student has completed all the academic requirements for the prescribed program.

1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III
5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal )

Based on the recommendation of DPGC, the dissertation is processed further. Viva-Voce examination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

**Evaluation Scheme for Phase III**

S No		Weightage %	Min. Passing %
1	Supervisor and Co supervisor	50	50
2	DPGC Committee	50	

**Evaluation Scheme for Phase IV**

	Weightage %	Min. for Passing%
External Viva-voce examination by a panel (ESE)	100	50%

If the DPGC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the





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dissertation and a presentation is to be given to DPGC. The DPGC will take a final decision on whether to schedule the final exam or give additional extension of the work.

**CCC606: Dissemination of Outcomes' of Dissertation**

It is mandatory on the part of the student to

1. Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier Springer, Materials Today or any other reputed conferences.
2. A paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor
3. If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.
4. In case of NDA with company when student is pursuing his dissertation, publication may not be possible in public domain. These cases are to be treated as special cases. A rubrics is developed for evaluation.

The evaluation of the dissertation work of a student shall be carried out in four phases: First and third phase being evaluated for ISE by Department Post Graduate Committee (DPGC) while second and fourth phase by DPGC for ISE and by a panel of examiners for ESE. Except for phase I evaluation i.e. evaluation based on synopsis submission seminar, a student shall be evaluated for all other phases for his/her understanding, the work done and his/her presentation followed by demonstration.

DPGC shall consist of three faculty members from the department, Guide assigned to a student being one of the members. A panel of examiners for ESE shall consist of Chairman (who shall be one of the DPGC members and shall monitor the process as per norms), an Internal Examiner (who shall be the Guide) and an External Examiner (who shall be a subject expert from outside the institute).