

**B.Tech(Hons) in Computer Science & Engineering
with specialization in Cloud Computing
Semester wise Breakup of Courses**

SEMESTER V														
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ES	Total		Credit
				L	T	P	C	A	Total	P	S	TE	P	
1	BCME-501	Introduction to Cloud Computing	PECM-1	3	0	0	20	10	30	-	70	-	100	3
2	BCME-551	Introduction to PHP using IDE	PECM-2	0	0	4	-	-	-	15	-	35	50	2
TOTAL												150	5	

Introduction to Cloud Computing

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-501	Introduction to Cloud Computing	3	0	0	3

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 - MANAGEMENT OF CLOUD SERVICES 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.

UNIT III - APPLICATION DEVELOPMENT (10 hours) Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Unit-IV

INTRODUCTION TO VIRTUAL REALITY: Introduction to Virtual Reality – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Components of Virtual Reality System - Benefits of Virtual Reality - Disadvantages of Virtual Reality. VR Hardware : Input Devices – 3D Position Trackers - Performance Parameters – Types of Trackers - Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices. Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Haptic Feedback. Human Factors : Vision and Display -Hearing, Tactile and Equilibrium - Health and Safety Issues.

Unit-V

VR ARCHITECTURE: Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering –PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – Distributed VR Architectures – Multi pipeline Synchronization – Distributed Virtual Environments. VR MODELING: Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behaviour Modeling. VR PROGRAMMING: VR Programming – Toolkits and Scene Graphs – World Toolkit – Java 3D – Comparison of World Toolkit and Java 3D - General Haptics Open Software Toolkit (GHOST). VR APPLICATIONS: Medical Applications of VR – Education, Training and Entertainment – Applications of VR in Gaming and Robotics.

COURSE OUTCOMES:

CO1: Understand the basics of cloud computing and its benefits and challenges.

CO2: How security of services deployed from the cloud is explained.

CO3: Practical development of cloud.

CO4: Virtual reality and its in-out is delivered in this unit.

CO5: Hand on experience for VR APPLICATIONS

Introduction to PHP using IDE

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-551	Introduction to PHP using IDE	0	0	4	2

1. Introduction to basic HTML tags.
2. Write a Program to check and print whether a given number is even or odd.
3. Write a program to compute net amount from the given quantity purchased and rate per quantity. Discount @10% is allowed if the quantity purchased exceeds 100.
4. Write a program to find largest among three numbers using ternary operators.
5. Write a program to print sum of digits of a given number. (using while loop)
6. Write a program to print Fibonacci series upto a given number.
7. Write a program to enter numbers till the user wants. At the end it should display the count of positive, negative and zeros entered. (Using do-while loop)
8. Write a function count Words (\$str) that takes any string of characters and finds the Number of time search word occurs. You should ignore the distinction between capital and lowercase letters.
9. Create a form with one text field and submit buttons for string length, string reverse and uppercase, lowercase, string replace. Display the result accordingly.
10. Write a Menu-Driven program to implement a calculator which performs only addition, subtraction, multiplication and division. The operation should happen based on the user choice. (use switch case)
11. Write a function to swap two string values using call by value and call by references.
12. Write a program that will accept an array of integers as input, and output an array where for each item in the source array, the new array will perform the following operations:
For even numbers divide by 2, For odd numbers multiply by 3
13. Create an associative array using the countries as keys, the cities as values and transform it into 2-dimensional array and display the data as a table.
14. Given two strings A and B, how would you find out if the characters in B were a subset of the characters in A?
15. Write a program that create a file and write contents to it and display it. Then append some data to it

SEMESTER VI														
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ES	Total		Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	BCME-601	Cloud Computing Infrastructure	PECM-3	3	0	0	20	10	30	-	70	-	100	3
2	BCME-651	Cloud Application Development	PECM-4	0	0	4	-	-	-	15	-	35	50	2
TOTAL												150	5	

Cloud Computing Infrastructure

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-601	Cloud Computing Infrastructure	3	0	0	3

UNIT I - VIRTUALIZED DATA CENTER ARCHITECTURE

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

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

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

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

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.

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.

COURSE OUTCOME:

CO1: To understand Basics of Data centre infrastructure.

CO2: To understand how monitoring and management of infrastructure.

CO3: To understand analysis and planning of Storage network design

CO4: Focus on optimization of cloud storage.

CO5: Design a replication solution and local remote is delivered

Cloud Application Development

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-651	Cloud Application Development	0	0	4	2

1. Working of Goggle Drive to make spreadsheet and notes.
2. Installation and Configuration of Justcloud.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Installation and Configuration of Hadoop/Eucalyptus
6. Working and installation of Google App Engine
7. Working and installation of Microsoft Azure
8. Working with Mangra soft Aneka Software

SEMESTER VII														
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ES	Total		Credit
				L	T	P	CT	AT	Total	PS	TE	PE		
1	BCME-701	Data Center Networking	PECM-5	3	0	0	20	10	30	-	70	-	100	3
TOTAL												100	3	

DATA CENTER NETWORKING

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-701	Data Center Networking	3	0	0	3

UNIT I - EVOLUTION OF DATA CENTRE DESIGN

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

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

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

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

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 Multicastings. Data centre application services. Data centre networking use case studies and the enabling technologies and protocols in the modern data centre.

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.

COURSE OUTCOMES:

CO1: To understand the Modern data centre use case studies

CO2: To understand the Network connectivity optimization evolution.

CO3: To deeply analysis the SERVER ARCHITECTURES.

CO4: CASE STUDY for LAYER 2 NETWORKS is focused.

CO5: CASE STUDY for LAYER 3 NETWORKS is focused

SEMESTER VIII														
S. No.	Course Code	Course Name	Course Type	Periods			CCA				ES	Total		Credit
				L	T	P	C T	A T	Total	P S	TE	P E		
1	BCME-801	Cloud Security	PECM-6	3	0	0	20	10	30	-	70	-	100	3
2	BCME-802	Virtual Environment	PECM-7	3	0	0	20	10	30	-	70	-	100	3
3	BCME-851	App. Development & Development on Cloud	PECM-8	0	0	4	-	-	-	15	-	35	50	2
TOTAL												250	8	

Cloud security

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-801	Cloud Security	3	0	0	3

Unit-I

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

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.

UNIT III - VIRTUALIZATION SYSTEM-SPECIFIC ATTACKS

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 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

Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCI DSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

REFERENCES

1. Tim Mather, SubraKumaraswamy, 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.

COURSE OUTCOMES:

- CO1: To understand why and how cloud security is important
- CO2: To understand the MULTI-TENANCY ISSUES
- CO3: To deeply analysis the Guest hopping and attacks on the VM.
- CO4: To understand data lost Data Loss Prevention.
- CO5: Examination of modern Security Standards (eg PCIDSS),.

App. Development & Development on Cloud

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-851	App. Development & Development on Cloud	0	0	4	2

Project work will be carried out for application development on cloud

VIRTUAL ENVIRONMENTS

SL. NO	Engineering Minor Elective		L	T	P	C
1	BCME-802	Virtual Environment	3	0	0	3

UNIT I - PERFORMANCE MANAGEMENT IN A VIRTUAL ENVIRONMENT 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

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

UNIT III - SECURE VIRTUAL NETWORKING

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

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

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.

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.

COURSE OUTCOMES:

CO1: To understand application performance bottlenecks in a virtualized environment.

CO2: To understand the goals and guidelines of change management in virtual environment.

CO3: To understand the traffic isolation to secure a virtual network configuration

CO4: To understand Protecting the host and virtual machine systems.

CO5: Hand on experience on troubleshooting virtual environments