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Internal Assessment Test 1 – October 2024


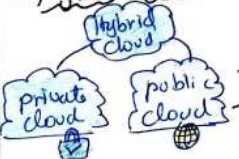
Sub:	Cloud Computing	Sub Code:	21CS72	Branch:	CSE
Date:	15.10.2024	Duration:	90 mins	Max Marks:	50
Sem / Sec:	7 B,C				OBE

Answer any FIVE FULL Questions

MARKS

CO RBT

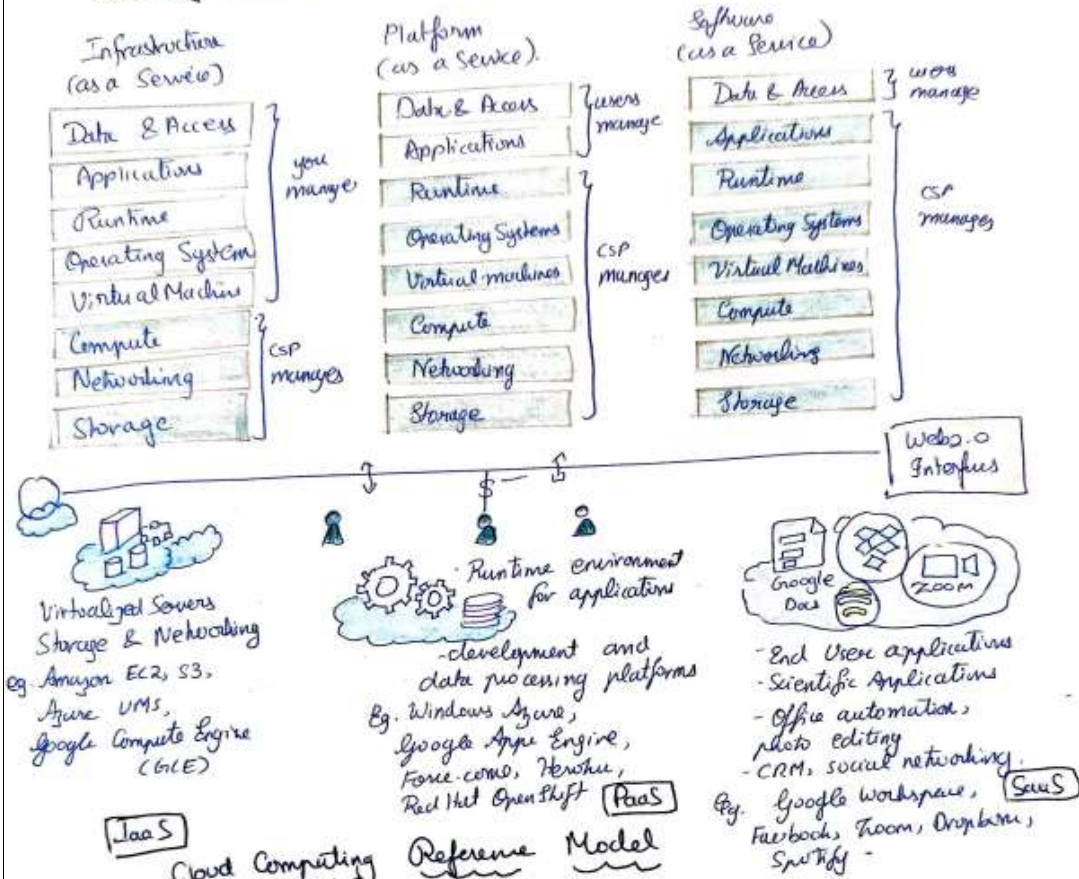
1 (a)	<p>With a neat diagram explain the major cloud delivery models (private, public, hybrid, community)</p> <p><u>Deployment Models.</u></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Public Cloud</p> <p>“Third party multitenant cloud infrastructure and services Available to all on subscription basis</p> </div> <div style="text-align: center;"> <p>Private/Enterprise Cloud</p> <p>public cloud model within company's own datacenter/infrastructure for internal/partners use</p> </div> <div style="text-align: center;"> <p>Hybrid/Inter. cloud</p> <p>Mixed use of private and public clouds - leasing public cloud resources when private cloud capacity is not sufficient</p> </div> </div> <p>• <u>Public cloud</u>: most common deployment model is established by a third-party service providers.</p> <ul style="list-style-type: none"> - IT infrastructure (eg. virtualized datacenters) - users can quickly leverage compute, storage and application services. - user's data and applications are deployed on the vendor's premises. <p><i>Logos: Google, Amazon, AWS, Azure</i></p> <p>• <u>Private cloud</u> - when large organizations have massive computing infrastructure, &</p> <ul style="list-style-type: none"> - they can benefit from cloud IT service delivery model in-house. - confidential information can be kept within an organization's premises. - banks & governments - need high privacy, security & regulatory concerns. 	8M	CO1	L2
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	<ul style="list-style-type: none"> • <u>Community Cloud</u> - when infrastructure is shared by several organizations with shared considerations. <ul style="list-style-type: none"> - it may be managed by the organization or 3rd party - may exist on-premise or off-premises.  • <u>Hybrid cloud</u> - when private clouds are unable to meet quality-of-service requirements. <ul style="list-style-type: none"> - Hybrid computing systems are created - composed of public cloud resources & privately owned resources - serves the organizations needs.  			
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(b)	<p>Company Y experience major database corruption and could not ship DVDs to members. The databases in the datacenter could only scale vertically and result in single points of failure. The company has a worldwide customer base who stream the media content. How would migrating their services to the cloud solve their problems of horizontal scalability and high availability of their services with fast response times?</p> <p>Cloud is inherently distributed in nature. This allows for horizontal scalability and avoids single point of failure.</p> <p>In cloud, data may be replicated within a datacenter or within a zone or in a geo-redundant manner that ensures high availability. Edge locations across the world allow for data caching which allow for fast response times.</p>	2M	CO1	L3
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2 (a)	<p>Give the NIST definition of cloud computing. Explain the cloud reference model with a neat diagram</p> <p>According to U.S. National Institute of Standards and Technology</p> <p>“Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (eg. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.</p> <p>↳ this is the ‘pay-per-use’ strategy</p> <p>↳ this is a cloud computing service</p>	8M	CO1	L2
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Cloud Computing Reference Model (Delivery Models)



IaaS

Cloud Computing Reference Model

IaaS - delivers infrastructure on demand

- Hardware, storage, networking
 - ↳ virtual machines - provided with tools and interface to configure software stack.
 - pricing - dollars per hour.
- ↳ Storage - raw disk space on object store.
 - ↑ resistant storage ↑ High level abstraction for storing entities
- ↳ networking - collection of services that manages networking among virtual instances and connects to Internet or private network.

	<ul style="list-style-type: none"> • <u>PaaS</u> - deliver scalable and elastic runtime environments on demand. and host the execution of applications - have a core middleware platform for creating an abstract environment. - provider gives scalability & fault tolerance. - users focus on logic of applications by leveraging API's & libraries <ul style="list-style-type: none"> • SaaS - provides applications and services on demand. - desktop automation - document management, photo editing, CRM, - software is in providers infrastructure and is made more scalable and accessible through browser on demand. - shared across multiple users where access is isolated. - social networking websites use SaaS to sustain load generated by popularity. 			
(b)	Classify as IaaS, PaaS, SaaS, i) Amazon EC2 - IaaS ii) Google Docs - SaaS iii) Google App Engine - PaaS iv) Amazon S3 - IaaS	2M	CO1	L1
3 (a)	<p>Explain any 2 of the following cloud services in details</p> <p>i) Amazon Web services ii) Microsoft Azure iii) Google App Engine iv) Hadoop</p> <p>Amazon Web Services</p> <p><u>Amazon Web Services (AWS)</u></p> <ul style="list-style-type: none"> - IaaS services - compute, storage, networking. • <u>EC2</u> (Elastic Compute Cloud) • <u>S3</u> (Simple Storage Service) - <u>EC2</u> - choose from large variety of virtual hardware configurations, including GPU and cluster instances AWS console - web portal for accessing AWS services - A running instance can be stored as an image - Allows users to create own instances for deployments. <u>S3</u> - delivers persistent storage on demand - organized into buckets. - these are containers of objects stored in binary form - can store objects of any size - offers other networking support, caching systems, DNS, database - support. 	8M	CO1	L2

Networking

- Virtual Private Cloud (VPS)
- CloudFront : A content delivery network (CDN) that delivers data and applications globally.

Databases

- RDS (Relational Database Service) - MySQL, PostgreSQL, Oracle.
- DynamoDB - NoSQL

Machine Learning

- SageMaker

Security

- IAM (Identity and Access Management)
- AWS (Shield) protects DDoS Attacks.

Customer Lost

Carve Facebook

Adobe Airbnb

Formula1 Zomato

Sony Netflix McAfee

Goldman Sachs Reddit

34 regions

North America

South America

Europe

Middle East

108 Availability

Zones

Africa

Asia Pacific

Australia & NZ

245 countries
& territories

India

2022

Hyderabad - 3 Availability Zones

2016

Mumbai - 3 Av. Zones

2 Local Zones

Microsoft Azure

- Cloud computing platform and service provided by Microsoft.

- Earlier there were 3 roles

- ① Web Role - preconfigured VM's with IIS for hosting ASP.NET application
- ② Worker Role - used for background processing that do not require UI
- ③ VM Role - like Azure VMs, allowing for more control

Currently Azure has VMs, App Services and Kubernetes.

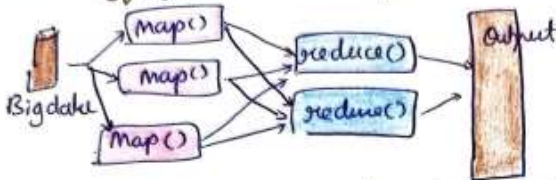
- it also provides
 - storage (blobs files) disk,
 - networking (Azure VNet, Load Balancer, VPN gateway)
 - databases (SQL Db, Cosmos Db, MySQL, PostgreSQL)
 - AI & ML (Azure ML, Cognitive Services, Bot Service)
 - Analytics & Big Data (Azure Synapse Analytics, HDInsight, Data Lake)
 - Security & Identity (AD, Key Vault, security center)
 - DevOps (CI/CD pipelines)
 - Azure Functions - serverless compute

Google App Engine

- scalable runtime environment devoted to executing web applications.
- provides a secure environment and a collection of services that simplify development of scalable & high-performance web applications.
- Services: in-memory caching, scalable data store, job queues, messaging, cron tasks.
- developers can build their own machines using AppEngine SDK.
- Languages Supported: Python, Java, Go, Node.js, PHP, Ruby.
- developers can also use custom runtimes using Docker.
- Useful for
 - ↳ web applications
 - ↳ mobile backends
 - ↳ APIs and microservices
 - ↳ Applications for fast scaling
 - ↳ Multitenant SaaS applications

Hadoop

- open-source framework designed for processing large datasets on commodity hardware.
- an implementation of MapReduce (an API developed by Google)
- it provides two fundamental operations - map and reduce
- map: synthesizes data from user
- reduce: aggregates output by map operations



- Hadoop provides the run time environment.
- developers need to provide input data and specify map-reduce functions
- Yahoo played a significant role in development of Hadoop.
- It is based off of Google File System (GFS)
- has a large ecosystem of related tools and technologies
 - Apache Hive - data warehouse.
 - Apache Pig - high level scripting language for analyzing large data sets
 - Apache Spark - in-memory data processing engine that can run on top of Hadoop.

(b) Briefly explain i) Web 2.0 ii) Utility Computing

2M

CO1

L3

- ③ Web 2.0 - brings interactivity and flexibility into web pages.
- by integrating several technologies: XML, Asynchronous JavaScript and XML (AJAX), Web Services
 - extremely dynamic - new updates and features are integrated based on usage trend of the community.
 - no need to deploy new software releases
 - Lightweight deployment and programming models are used.
 - Loose coupling - using existing services & integrating them providing value.
 - eg. Google Docs, Google Maps, Twitter, YouTube, ...
 - Web 2.0 delivers rich Internet Applications (RIAs)
 - fundamental in people accustomed to use of Internet in everyday lives.

④ Utility-Oriented Computing

- where the service-provisioning model for compute services and infrastructure are offered on a pay-per-use basis.
- computing grids provided distributed computing infrastructures.
- e-commerce technologies supported market orientation
- after dot.com bubble burst - online payment became accessible and well-proven.

4 (a) Explain virtualization, list the pros and cons of virtualization.

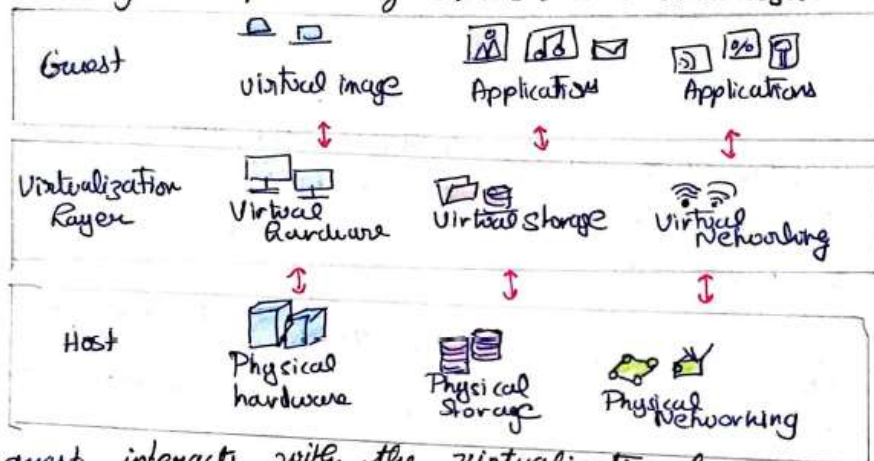
6M

CO1

L2

Virtualization - any technology that provides an abstract environment (virtual hardware/os) to run applications.

3 major components: guest, host, and virtualization layer.



- guest: interacts with the virtualization layer
- host: the original environment.
- virtualization layer: recreates same or different environment where guest will operate.

In Hardware virtualization - guest is represented by VM's with an OS and applications

- the virtual hardware is managed by a virtual machine manager (VMM).

In virtual storage - the virtual storage manager is deployed onto real storage system.

Virtual Private Network - software (VPN client) is used to manage physical virtual networks.

Software program - allows for a wide variety of interactions with the physical hardware and enables virtualization.

■ Pros & Cons of Virtualization

■ Advantages

① Managed Execution & Isolation

- allows for building secure and controllable environments.
- a sandbox environment prevents any harmful operation to cross borders of the virtual host.
- allocation of resources and partitioning becomes simpler.
- possible to fine-tune the resources.

② Portability and self-containment

- portable - "compiled once, run everywhere"
- self-contained - no other dependencies other than the VM
- VM migration is possible in a hardware virtualization

③ Reduced cost of Maintenance

- fewer VMM's than VM's.
- reduced hosts to manage due to server consolidation

④ Efficient resource usage

- multiple systems can coexist and share resources

⑤ Reduced downtime and better disaster recovery

- when - easier to provision when a server is down

⑥ Green computing

- when you cut down on servers, reduces the carbon foot-print of a data center

■ Disadvantages of Virtualization

① Performance Degradation

In bare-metal virtualization latency is caused by

- maintaining status of virtual processors
- support of privileged instructions (trap)
- support of paging within VM
- console functions

- in VM running on top of OS - severe performance degradation
- ② Inefficiency & degraded user experience.
 - hardware virtualization: some features like device drivers become inaccessible
 - if a VM maps onto a graphics card - it only maps on to certain features -
 - programming-level VMs - initially Java had little support for UI later Swing and support for OpenGL was added.
- ③ Security risks and new threats-
 - malicious programs can preload themselves and act as thin VMs. OS is controlled to extract information.
 - g. BluePill, Sobriol
 - modified versions of runtime environment can also access sensitive information or monitor memory locations used by guest applications
- ④ Complexity - Managing virtualized environments can be tough, if number of VMs are more
- ⑤ High initial costs - though virtualization reduces costs in the long run, the initial setup for storage and servers can be higher than a traditional setup.

(b) Explain the following terms briefly: i) Supervisor Mode ii) User Mode iii) Hypercalls iv) trap v) Binary Translation vi) Privileged Instructions

4M

CO2

L3

Supervisor mode (master mode / kernel mode) - both privileged and non-privileged instructions can be executed without any restrictions.

User mode - restrictions to control machine-level resources.
- if code running in user mode crashes privileged instructions, hardware interrupts occur, trap the harmful execution.

Hypercall - system calls reimplemented as hypercalls in modified OS. This allows the hypervisor to catch the execution of sensitive instructions, manage them and return control to the guest OS.

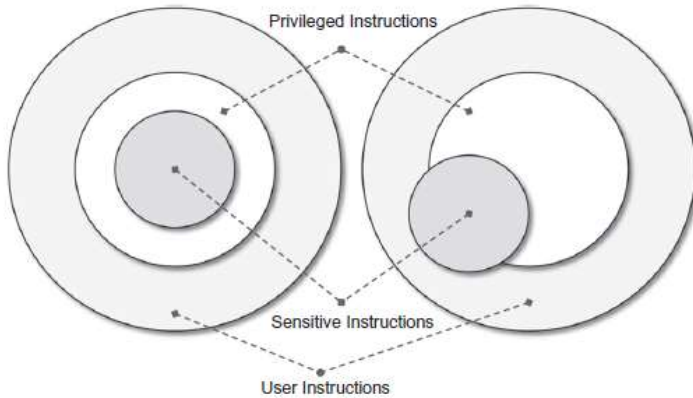
- In dynamic binary translation - trap suggests the translation of the offending instructions into an equivalent set of instructions that achieve same goal without raising exceptions.
- to improve performance, the equivalent set of instructions are cached and reused.
- advantage: - guest OS runs unmodified.
 - binary translation is more portable for full virtualization.
 - " " is only applied to a subset of instructions, others are managed through direct execution.

Traps - silent faults that prevent normal operations in guest OS that is the result of user mode instructions that are allowed to be executed in Ring 0.

Privileged Instructions - executed under specific restrictions

- ↪ behaviour sensitive - operate on I/O
- ↪ control sensitive - alter state of CPU registers

5 (a)



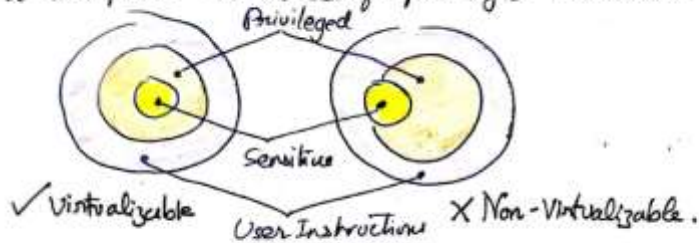
[07]

CO 2

L2

The computer on the left is virtualizable whereas the one on the right is not. Why?

① A VMM can be constructed if the set of sensitive instructions for a computer is a set of privileged instructions.



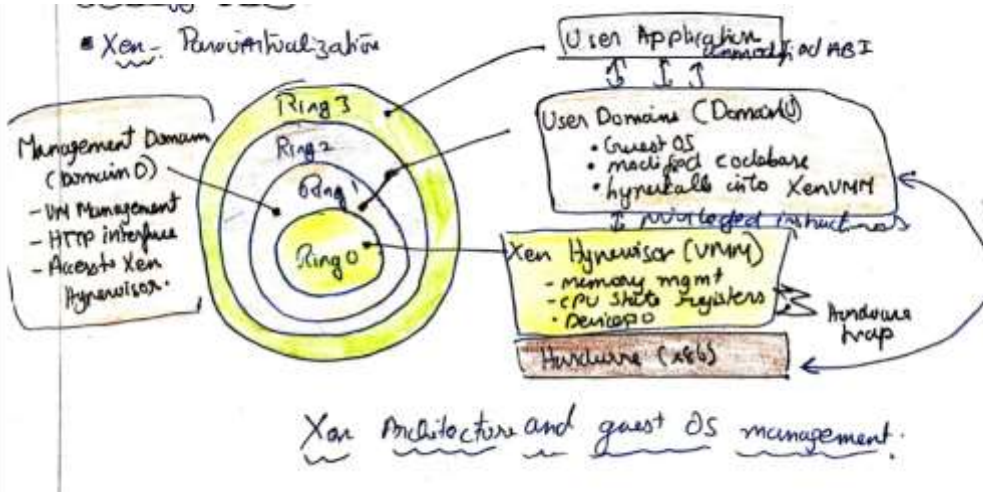
- ✓ Virtualizable
- ✗ Non-Virtualizable.
- all instructions that ~~can~~ change configuration of a system should generate a trap in user mode and executed under control of VMM.

(b) Explain para virtualization supported in Xen with its architecture.

[03]

CO2

L3



- Xen - is an open source initiative based on paravirtualization
- may be used for desktop/server virtualization
 - initially developed by researchers in Univ. of Cambridge
 - commercial solution by Citrix - XenSource
 - also a cloud service - Xen Cloud Platform
 - Xen has also been advanced to support full virtualization
 - was developed for x86 architecture - used in commodity machines
 - guest OS has to be modified
 - Xen is managed by Xen Hypervisor (XMM)
 - ↳ runs on highest privileged mode
 - guest OS executes within Domains (V)
 - Domain 0: specific control software that has privileged access to the host and controls all other guest OS.
 - ↳ hosts an HTTP server and serves request for VM creation, configuration & termination.
 - x86 implementations run on 4 rings.
 - Applications can run on Ring 3 with ABI unchanged. So there is an easy switch to Xen virtualization from the application point of view
 - x86 allows code in Ring 3 to jump to Ring 0 (kernel mode)
 - this results in a trap/silent fault, prevents normal operations in guest OS.
 - to avoid this, OS is modified and system calls are reimplemented as Hypercalls
 - Hypercalls - specific calls exposed by VM to Xen.
 - this allows Xen to catch execution of sensitive instructions, manage them, and return control to the guest OS.

Limitations

- Paravirtualization - requires OS codebase to be modified.
- legacy hardware, legacy OS - cannot be modified to run on Ring 1.
 - code base is not accessible
 - underlying hardware does not support MMIO to run on Ring 0.
- Linux - can be modified whereas components of the Windows family are not supported.

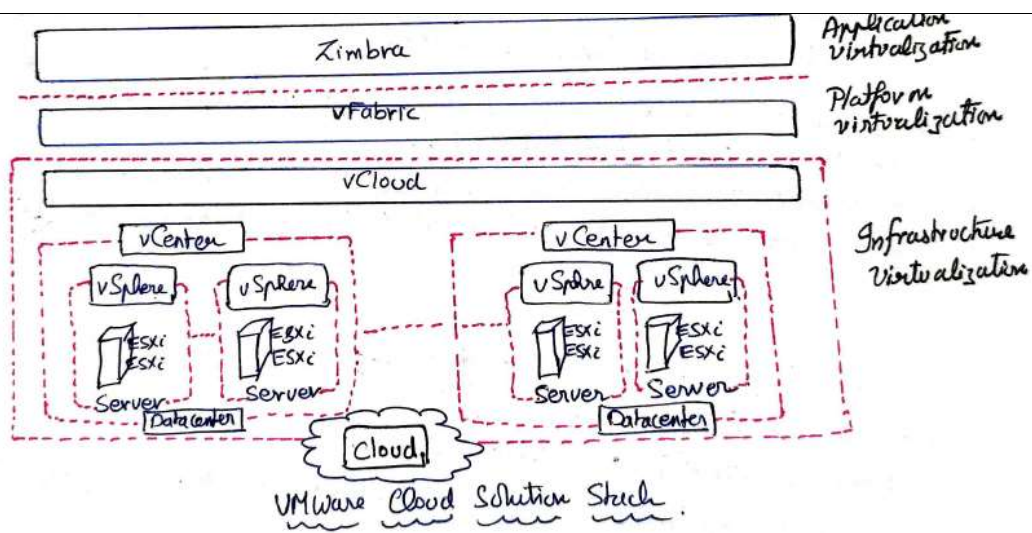
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a) With a neat diagram, explain the VM ware cloud solution stack

[8M]

CO2

L2



- VMware provides a set of products covering entire stack of cloud computing solutions.
- ESX and ESXi - building blocks for virtual infrastructure management
- A pool of virtualized servers is tied together and remotely managed as a whole by vSphere.

- virtual compute services, virtual file system, virtual storage, virtual network - make up the core infrastructure.
- vSphere - offers application services:
 - VM migration
 - storage migration
 - data recovery
 - security zones
- vCenter - provides centralized administration and mgmt of vSphere installations in a data center environment.
- vCloud - IaaS of a collection of virtualized data centers
 - pay-per-use
 - has a web portal for choosing templates and setting up virtual networks.
- vFabric - PaaS for application development
 - collection of components for application monitoring, scalable data management, scalable execution and provisioning of Java web applications.
- Zimbra - SaaS for office automation, messaging, collaboration that is completely hosted in the cloud.

b) Identify the type of virtualization

- VM Ware Workstation – Desktop Virtualization
- JVM – Programming Level virtualization
- Xen hypervisor-Para virtualization
- VMWare ESXi – Hardware assisted Full Virtualization
- virtual LAN – Network Virtualization
- Storage Area Network (SAN) – Storage Virtualization

[2M]

CO2

L1

CO-PO and CO-PSO Mapping																			
Course Outcomes		Blooms Level	Modules covered	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	Explain cloud computing, virtualization and classification of services of cloud computing	L2	1,2	3	2	2	2	0	3	3	0	0	0	0	0	3	0	2	2
CO2	Illustrate architecture and programming examples in cloud	L3	2,3,4	3	2	0	2	2	3	3	0	0	0	0	0	3	2	0	2
CO3	Describe the platforms for development of cloud applications with examples	L2	4,5	3	3	3	3	2	3	3	0	0	0	0	0	3	2	0	2

CO PO Mapping

COGNITIVE LEVEL	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)				CORRELATION LEVELS	
PO1	Engineering knowledge	PO7	Environment and sustainability	0	No Correlation
PO2	Problem analysis	PO8	Ethics	1	Slight/Low
PO3	Design/development of solutions	PO9	Individual and team work	2	Moderate/Medium
PO4	Conduct investigations of complex problems	PO10	Communication	3	Substantial/High
PO5	Modern tool usage	PO11	Project management and finance		
PO6	The Engineer and society	PO12	Life-long learning		
PSO1	Develop applications using different stacks of web and programming technologies				
PSO2	Design and develop secure, parallel, distributed, networked, and digital systems				
PSO3	Apply software engineering methods to design, develop, test and manage software systems.				
PSO4	Develop intelligent applications for business and industry				

