

CS8791 CLOUD COMPUTING

OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing. • To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm •

UNIT I INTRODUCTION

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT II CLOUD ENABLING TECHNOLOGIES

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computingll , Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approachll , Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)ll , O'Reilly, 2009.

UNIT – I
INTRODUCTION TO CLOUD COMPUTING
PART - A

1. What are the computing Paradigm Distinctions? [R]

- Centralized computing
- Parallel Computing
- Distributed Computing
- Cloud Computing

2. What are the differences between Grid computing and cloud computing? (Nov/Dev 2017) [AZ]

	Grid computing	Cloud computing
What?	Grids enable access to shared computing power and storage capacity from your desktop	Clouds enable access to leased computing power and storage capacity from your desktop
Who provides the service?	Research institutes and universities federate their services around the world.	Large individual companies e.g. Amazon and Microsoft.
Who uses the service?	Research collaborations, called "Virtual Organizations", which bring together researchers around the world working in the same field.	Small to medium commercial businesses or researchers with generic IT needs
Who pays for the service?	Governments - providers and users are usually publicly funded research organizations.	The cloud provider pays for the computing resources; the user pays to use them

3. What is meant by Centralized Computing? [U]

- This is a computing paradigm by which all computer resources are centralized in one physical system.
- All resources (processors, memory, and storage) are fully shared and tightly coupled within one integrated OS.

4. What is meant by Parallel Computing? [U]

- In parallel computing, all processors are either tightly coupled with centralized shared memory or loosely coupled with distributed memory.
- Interprocessor communication is accomplished through shared memory or via message passing.
- A computer system capable of parallel computing is commonly known as a parallel computer.
- Programs running in a parallel computer are called parallel programs. The process of writing parallel programs is often referred to as parallel programming.

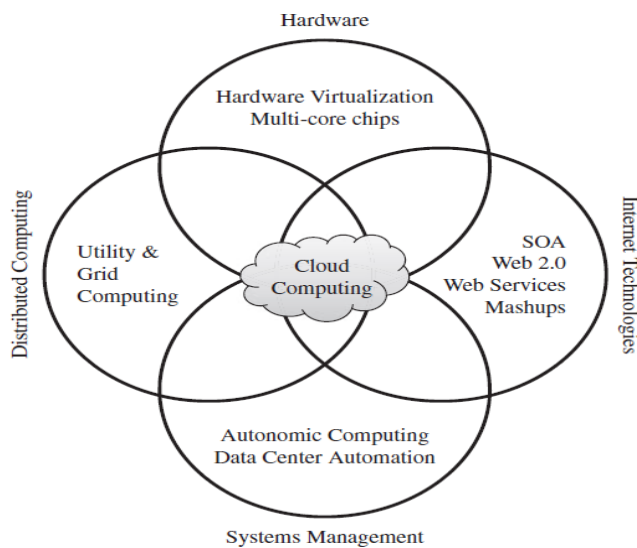
5. What is meant by Distributed computing? [R]

- A distributed system is a network of autonomous computers that communicate with each other in order to achieve a goal.
- The computers in a distributed system are independent and do not physically share memory or processors. They communicate with each other using *messages*, pieces of information transferred from one computer to another over a network.

6. What is Cloud Computing[U]

“Cloud is a parallel and distributed computing system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers.”

7. What are the Convergence of various advances leading to the advent of cloud computing. [U]



8. What is Service Oriented Architecture (SOA)? (Nov/Dec 2018) [R]

A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity.

9. Highlight the importance of the term “cloud computing” (Nov/Dec 2016) [U]

- Elasticity Demand
- Cost Savings
- Speed
- Flexibility
- Integration
- Data Security & Recovery
- Workforce Efficiency

10. What is a Virtual Machine (VM) ? [R]

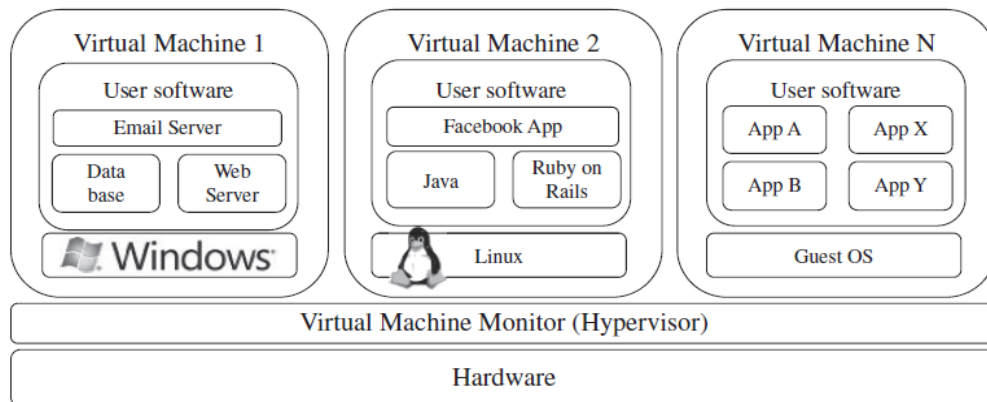
A virtual machine (VM) is a software program or operating system that not only exhibits the behavior of a separate computer, but is also capable of performing tasks such as running applications and programs like a separate computer. A virtual machine, usually known as a guest is created within another computing environment referred as a "host." Multiple virtual machines can exist within a single host at one time. A virtual machine is also known as a guest.

11. What is a grid system? [U]

Interconnected computer systems where the machines utilize the same resources collectively. Grid computing usually consists of one main computer that distributes information and tasks to a group of networked computers to accomplish a common goal. Grid computing is often used to complete complicated or tedious mathematical or scientific calculations.

12. What is a hypervisor? [R]

A hypervisor, also called a virtual machine manager, is a program that allows multiple operating systems to share a single hardware host. Each operating system appears to have the host's processor, memory, and other resources all to itself.



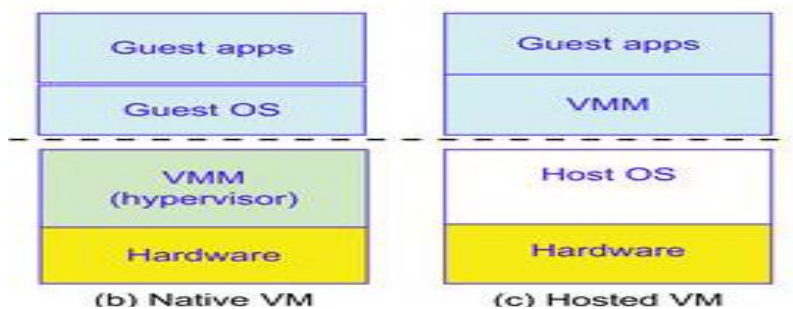
13. List down the different types of VMM. [R]

- VMWare ESXi
- Xen.
- KVM

14. What are the types of hypervisor? [R]

Type 1 hypervisors run directly on the system hardware. They are often referred to as a "native" or "bare metal" or "embedded" hypervisors in vendor literature.

Type 2 hypervisors run on a host operating system.



15. What are the desirable features of Cloud[U]

- self-service
- per-usage metering and billing
- elasticity
- customizable

16. List down the types of clouds based on deployment models. [R]

- Public/Internet Clouds
- Private / Enterprise Cloud
- Hybrid /Mixed Cloud
- Community

17. Bring out the difference between private and public cloud (Nov/Dec 2016) [AZ]

• **Public Cloud**

These are based on shared physical hardware which is owned and operated by a third-party provider. Public clouds are ideal for small and medium sized businesses or businesses that have fluctuating demands.

• **Private Cloud**

A private cloud is infrastructure dedicated entirely to our business that's hosted either on-site or in a service provider's data center

18. What is a community cloud [U]

A community cloud is "shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations)".

19. What is a hybrid [U]

A hybrid cloud takes shape when a private cloud is supplemented with computing capacity from public clouds.

20. What is cloud-bursting. [U]

The approach of temporarily renting capacity to handle spikes in load is known as "cloud-bursting".

21. What is cloud orchestration? [U]

Cloud computing handles a prodigious amount of data and processes across multiple systems. This heterogeneity makes manageability and coherence a major challenge in cloud computing. The solution to this challenge lies in implementing a tool or a product that can manage these interconnections and interactions among cloud connected units. This solution is called as cloud orchestration. The software toolkit responsible for this orchestration is called a virtual infrastructure manager

22. What is Virtualized Infrastructure Manager (VIM). [U]

The virtualized infrastructure manager (VIM) in a Network Functions Virtualization (NFV) implementation manages the hardware and software resources that the service provider uses to create service chains and deliver network services to customers.

23. List down the characteristics of cloud [R]

- Virtualization Support.
- Self-Service, On-Demand Resource Provisioning
- Multiple Backend Hypervisors.
- Storage Virtualization.
- Interface to Public Clouds.
- Virtual Networking.
- Dynamic Resource Allocation.
- Reservation and Negotiation Mechanism.
- High Availability and Data Recovery.

24. What is OGSA in grid computing? /Define OGSA [R]

- Open Grid Services Architecture (OGSA) is a set of standards that extends Web services and service-oriented architecture to the grid computing environment.
- OGSA definitions and criteria describe how information is shared and distributed among the components of large, heterogeneous grid systems; they apply to hardware, platforms and software.
- It was developed within the Open Grid Forum, which was called the Global Grid Forum (GGF)

25. What is virtualization in cloud computing? [R]

Virtualization is a software that creates virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resource . It is the fundamental technology that powers cloud computing.

PART –B

1. Discuss in detail about Roots of Cloud computing technology
2. Explain about various features of Cloud computing with an example
3. Discuss about advantage and disadvantages of Cloud computing
4. Explain about Layers and Types of Cloud [R]
5. Elaborate on Cloud Infrastructure Management [U]

PART –C

1. Explain about Challenges and Risks faced by Cloud[AZ]
2. Explain in detail about Roots of Cloud Computing[AZ]

ASSIGNMENT QUESTIONS

1. Explain in detail, pros and cons of cloud. (8) [U]
2. Write short notes on OS level virtualization. List the pros and cons of OS level virtualization.[R]

UNIT-II
CLOUD ENABLING TECHNOLOGIES
PART-A

1. What is Service Oriented Architecture (SOA)? [R]

A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity.

2. What is a Web Service? Give any four examples. [R]

A web service is a kind of software that is accessible on the Internet. It makes use of the XML messaging system and offers an easy to understand, interface for the end users.

3. Give me an example of real web service? [R]

One example of web services is IBM Web Services browser. You can get it from IBM Alphaworks site. This browser shows various demos related to web services. Basically web services can be used with the help of SOAP, WSDL, and UDDI . All these, provide a plug-and-play interface for using web services such as stock-quote service, a traffic-report service, weather service etc.

4. Differentiate between a SOA and a Web service? [AZ]

SOA is a design and architecture to implement other services. SOA can be easily implemented using various protocols such as HTTP, HTTPS, JMS, SMTP, RMI, IIOP, RPC etc. While Web service, itself is an implemented technology. In fact one can implement SOA using the web service.

5. What is REST? (Remembering)

REST stands for Representational State Transfer. REST itself is not a standard, while it uses various standards such as HTTP, URL, XML/HTML/GIF/JPEG (Resource Representations) and text/xml, text/html, image/gif, image/jpeg, etc (MIME Types).

6. What is virtualization in cloud computing? [R]

Virtualization is a software that creates virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resource . It is the fundamental technology that powers cloud computing.

7. Difference between virtualization and cloud computing [AZ]

Virtualization differs from cloud computing because virtualization is software that manipulates hardware, while cloud computing refers to a service that results from that manipulation.

8. Define virtual machine manager [R]

Virtual machine monitors (VMM) or virtual manager, which separates compute environments from the actual physical infrastructure.

9. What is virtual machine template? [R]

A Virtual Machine Manager template provides a standardized group of hardware and software settings that can be used repeatedly to create new virtual machines configured with those settings

10. List the implementation levels of virtualization [R]

- Instruction set architecture (ISA) level
- Hardware abstraction layer (HAL) level
- Operating System Level
- Library (user-level API) level
- Application level

11. Merits of virtualization at various levels. [AZ]

“X”’s Means Higher Merit, with a Maximum of 5 X’s)

Level of Implementation	Higher Performance	Application Flexibility	Implementation Complexity	Application Isolation
ISA	X	XXXXX	XXX	XXX
Hardware-level virtualization	XXXXX	XXX	XXXXX	XXXX
OS-level virtualization	XXXXX	XX	XXX	XX
Runtime library support	XXX	XX	XX	XX
User application level	XX	XX	XXXXX	XXXXX

12. Illustrate the three structures of virtualization [U]

- Hypervisor architecture/ VMM (Virtual Machine Monitor).
- Para-virtualization
- Host-based virtualization

13. Explain hypervisor architecture [U]

A hypervisor or virtual machine monitor (VMM) is a piece of computer software, firmware or hardware that creates and runs virtual machines.

14. Define para-virtualization [R]

Para-virtualization is a virtualization technique that presents a software interface to virtual machines that is similar, but not identical to that of the underlying hardware.

15. What are the two types of hypervisor [R]

- micro-kernel architecture
- monolithic hypervisor architecture

16. What is Hardware Support for virtualization [R]

Hardware virtualization refers to the creation of virtual (as opposed to concrete) versions of computers and operating systems. This technology was developed by Intel and AMD for their server platforms

17. What is CPU virtualization? [R]

CPU virtualization involves a single CPU acting as if it were two separate CPUs.

18. What are the design issues in virtual cluster [R]

- Live migration of VMs
- Memory and file migrations
- Dynamic deployment

19. Outline the role of a VM [U]

A virtual machine (VM) is an operating system (OS) or application environment that is installed on software, which imitates dedicated hardware. The end user has the same experience on a virtual machine as they would have on dedicated hardware.

20. List the requirements of VMM [R]

- Provides a duplicate or essentially identical to the original machine environment for program**
- programs run in this environment should show minor decreases in speed.
- VMM should be in complete control of the system resources. It includes
 - a. The VMM is responsible for allocating hardware resources for programs
 - b. it is not possible for a program to access any resource not explicitly allocated to it
 - c. it is possible under certain circumstances for a VMM to regain control of resources already allocated.

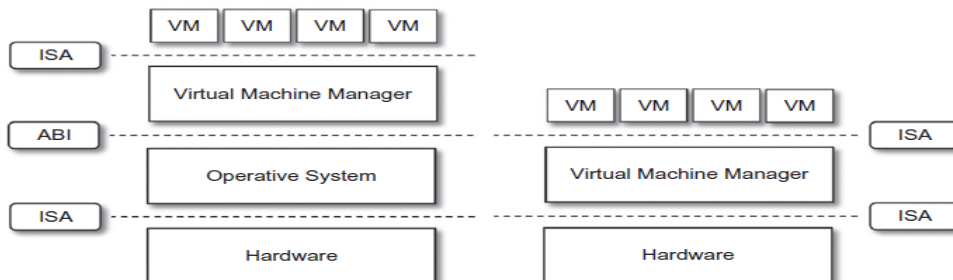
21. What are all the features in virtualization. [R]

Virtualization of the execution environment not only allows increased security, but a wider range of features also can be implemented. In particular, sharing, aggregation, emulation, and isolation are the most relevant features.

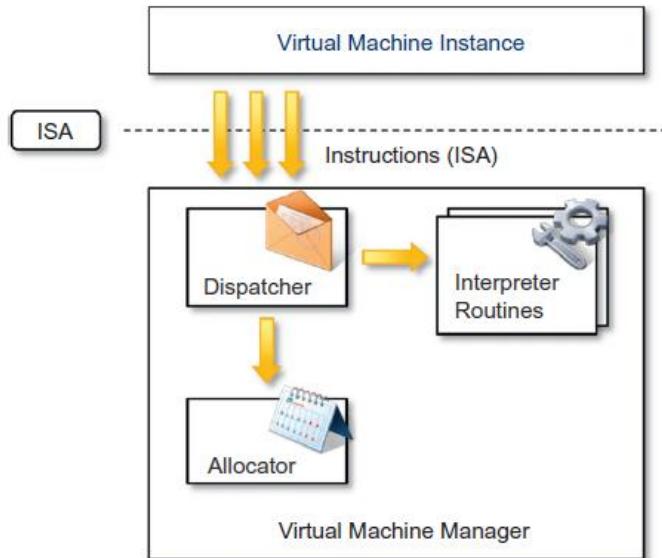
22. Define the Taxonomy of Virtualization Techniques. [R]

Virtualization is mainly used to emulate execution environments, storage, and networks.

23. Outline the graphical representation for two types of hypervisors. [U]



Outline a hypervisor reference architecture. [U]



24. List the disadvantages of virtualization [R]

- Performance degradation
- Inefficiency and degraded user experience
- Security holes and new threats

25. List the advantages of virtualization [R]

Application virtualization is a good solution in the case of missing libraries in the host operating system; in this case a replacement library can be linked with the application, or library calls can be remapped to existing functions available in the host system.

26. List the other types of virtualization[R]

- Storage virtualization
- Desktop virtualization
- Network virtualization
- Application server virtualization

27. Define Application virtualization. [R]

Application-level virtualization is a technique allowing applications to be run in runtime environments that do not natively support all the features required by such applications. These techniques are mostly concerned with partial file systems, libraries, and operating system component emulation.

PART-B

1. Explain implementation levels of virtualization/Discuss how virtualization is implemented in different layers [U]
2. Explain virtualization structure with diagram [U]
3. Explain virtualization of CPU, Memory and I/O devices [U]
4. Explain in detail about Load Balancing Techniques. [U]
5. Discuss in detail about the types of virtualization. [R]

PART-C

1. Explain in detail about Virtualization for data centre automation./What do you mean by centre automation using Virtualization [U]
2. What are the types of cluster and explain about virtual clusters and Resource Management [R]

ASSIGNMENT QUESTIONS

1. Write short notes on virtual clusters. [U]
2. Explain in detail, the virtualization for data center automation.[R]

UNIT III
CLOUD ARCHITECTURE, SERVICES AND STORAGE

PART-A

1. What are deployment models? [R]

- a) Private b) Public c) Hybrid d)Community

2. What is public deployment model? [R]

- Is a huge data centre that offers the same services to all its users.
- The services are accessible for everyone and used for consumer segmentation
- Eg., facebook, google, LinkedIn

3. What is private deployment model? [R]

- A *private cloud* is built within the domain of an intranet owned by a single organization.
- It is a client owned and managed, and its access is limited to the owning clients and their partner

4. What is hybrid deployment model? [R]

- A *hybrid cloud* is built with both public and private clouds.
- The *Research Compute Cloud (RC2)* is a private cloud, built by IBM, that interconnects the computing and IT resources at eight IBM Research Centers scattered throughout the United States, Europe, and Asia.

5. What is community deployment model? [R]

More than one group with common and specific needs shares the cloud infrastructure. This can include environments such as a U.S. federal agency cloud with stringent security requirements, or a health and medical cloud with regulatory and policy requirements for privacy matters.

6. List categories of cloud computing?/three layers of cloud computing? [AZ]

- IaaS - Infrastructure as a Service
- PaaS - Platform as a Service
- SaaS - Software as a Service

7. Define IaaS? [R]

Allows users to rent the infrastructure itself: servers, data center space, and software, network equipment such as routers/switches.

8. Define PaaS?(Apr/May-2017) [R]

Platform as a service (PaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app. The PaaS model provides the user to deploy user-built applications on top of the cloud infrastructure, that are built using the programming languages and software tools supported by the provider (e.g., Java, python, .Net).

9. Define SaaS? (Apr/May-2017) [R]

Software as a Service (SaaS) is a software delivery method that provides access to software and its functions remotely as a Web-based service. SaaS model provides the software applications as a service. As a result, on the customer side, there is no upfront investment in servers or software licensing. On the provider side, costs are rather low, compared with conventional hosting of user applications. The customer data is stored in the cloud that is either vendor proprietary or a publically hosted cloud supporting the PaaS and IaaS.

10. List some of public cloud offerings as IaaS? [AZ]

Amazon EC2, GoGrid, Raackspace Cloud, FlexiScale in the UK, Joyent Cloud

11. List some of public cloud offerings as PaaS? [R]

Google App Engine, Salesforce.com's, force.com, Microsoft Azure, Amazon Elastic MapReduce, Aneka

12. What are the Benefits of deployment model? [R]

Customer Scenario	Service Model	Deployment Model	Benefits
Payroll Processing	IaaS(VMs), Cloud storage	Public Cloud	Processing time reduced Hardware requirements reduced. Elasticity enabled for future expansion
Astronomic Data Processing	IaaS (VMs), Cloud Storage	Public Cloud	Hardware expense greatly reduced Processing power and storage. Energy costs greatly reduced. Administration Simplified
Central Government	IaaS,PaaS	Private Cloud	IT expertise consolidated. Hardware requirements reduced.
Local Government	IaaS,PaaS	Hybrid Cloud	IT expertise consolidated. Hardware requirements reduced.

13. List the design objectives of cloud computing? [AZ]

1. Shifting computing from desktops to data centers
2. Service provisioning and cloud economics
3. Scalability in performance
4. Data privacy protection
5. High quality of cloud services
6. New Standards and interfaces

14. Why do we need hybrid cloud (Nov/Dec 2016) [R]

- Maintain security and high performance
- Run workloads where they perform best
- Reduce IT cost and improve network efficiency

15. Mention the characteristics features of the cloud(Apr/May 2017) [AZ]

- On-Demand Usage
- Ubiquitous Access
- Multi-tenancy (Resourcing Pooling)
- Elasticity (and Scalability)
- Measured Usage
- Resiliency

16. Define Public Cloud. [R]

A public cloud is built over the Internet, which can be accessed by any user who has paid for the service. Public clouds are owned by service providers. They are accessed by subscription. Eg. Google App Engine GAE, Amazon Web Services AWS, Microsoft Azure, IBM Blue Cloud etc.

17. Define Hybrid Cloud. [R]

Hybrid cloud is a cloud computing environment which uses a mix of on-premises, private cloud and third-party, public cloud services with orchestration between the two platforms. For example, an enterprise can deploy an on-premises private cloud to host sensitive or critical workloads, but use a third-party public cloud provider, such as Google Computer Engine, to host less-critical resources, such as test and development workloads.

18. List the design objectives of cloud computing? [R]

- Shifting Computing from Desktops to Datacenters
- Service Provisioning and Cloud Economics
- Scalability in Performance
- Data Privacy Protection
- High Quality of Cloud Services
- New Standards and Interfaces

19. List some of the advantages of cloud computing? [R]

- Unlimited Storage
- Cost Efficient
- Backup and Recovery
- Easy Access to Information
- Quick Deployment
- Lower IT Infrastructure Costs
- Fewer Maintenance Issues
- Lower Software Costs
- Instant Software Updates
- Increased Computing Power
- Easier Group Collaboration
- Universal Access to Documents

20. List some of the disadvantages of cloud computing? [R]

- Technical Issues
- Less Secured
- Prone to Attack
- Limited Control
- Requires Constant Internet Connection
- Can Be Slow
- Stored Data Might Not Be Secure

21. State any two service provider of SaaS. [R]

Some of the service providers are

- Amazon Web services
- Google Apps

- icloud
- Oracle

- Salesforce.com
- Windows Azure

22. Define anything-as-a-service? [R]

Providing services to the client on the basis on meeting their demands at some pay per use cost such as data storage as a service, network as a service, communication as a service etc. It is generally denoted as anything as a service XaaS.

PART-B

1. What are the services provided by cloud with deployment model? Explain in detail (Nov/Dec 2017) [R]
2. List the cloud deployment models and give a detailed about them (Nov/Dec 2016) [AZ]
3. Explain in detail about cloud delivery model. [R]
4. Discuss the operational and economic benefits of SaaS. [AZ]

PART –C

1. Give the importance of cloud computing and elaborate the different types of services offered by it. (Nov/Dec 2016) [E]

Assignment Questions

1. Specify a scenario where PaaS can be applied (U)
2. Identify upfront Investment in New Initiatives and what will be its benefits in cloud(U)

Unit – IV
RESOURCE MANAGEMENT AND SECURITY IN CLOUD

PART A

1. Define Intercloud. [R]

Intercloud is a network of clouds that are linked with each other. This includes private, public, and hybrid clouds that come together to provide a seamless exchange of data.

2. What are the challenges of intercloud.[U]

- **Identification:** A system should be created where each cloud can be identified and accessed by another cloud, similar to how devices connected to the internet are identified by IP addresses.
- **Communication:** A universal language of the cloud should be created so that they are able to verify each other's available resources.
- **Payment:** When one provider uses the assets of another provider, a question arises on how the second provider will be compensated, so a proper payment process should be developed.

3. What is Resource Provisioning in cloud? [U]

Cloud provisioning is the allocation of a **cloud** provider's **resources** and services to a customer. The growing catalogue of **cloud** services that customers can **provision** includes infrastructure as a service, software as a service and platform as a service, in public or private **cloud** environments.

4. What are the types of resource provisioning methods. [U]

- a. Demand-Driven Resource Provisioning
- b. Event-Driven Resource Provisioning
- c. Popularity-Driven Resource Provisioning

5. What is Demand Driven resource provisioning. [U]

This method adds or removes computing instances based on the current utilization level of the allocated resources. The demand-driven method automatically allocates two processors for the user application, when the user was using one processor more than 60 percent of the time for an extended period. When a resource has surpassed a threshold for a certain amount of time, the scheme increases that resource based on demand. When a resource is below a threshold for a certain amount of time, that resource could be decreased accordingly.

6. What is Event-Driven Resource Provisioning. [U]

This scheme adds or removes machine instances based on a specific time event. The scheme works better for seasonal or predicted events. During these events, the number of users grows before the event period and then decreases during the event period. This scheme anticipates peak traffic before it happens. The method results in a minimal loss of QoS, if the event is predicted correctly.

7. What is Popularity-Driven Resource Provisioning. [U]

In this method, the Internet searches for popularity of certain applications and creates the instances by popularity demand. The scheme anticipates increased traffic with popularity. Again, the scheme has a minimal loss of QoS, if the predicted popularity is correct. Resources may be wasted if traffic does not occur as expected.

8. What are the Extended Cloud Computing Services.[U]

1. Hardware as a Service (HaaS).
2. Network as a Service (NaaS).
3. Location as a Service (LaaS),
4. Security as a Service (“SaaS”).
5. Data as a Service (DaaS).
6. Communication as a Service (CaaS)

9. What is Data integrity ? [U]

Data integrity means ensuring that data is identically maintained during any operation (such as transfer, storage, or retrieval).

10. List the security issues in cloud. [R]

1. Privileged user access
2. Regulatory compliance
3. Data location
4. Data segregation
5. Recovery
6. Investigative support
7. Long-term viability

11. What are The baseline security practices for the SaaS environment. [U]

- a) Security Management
- b) Security Governance
- c) Risk Management
- d) Risk Assessment
- e) Security Portfolio Management
- f) Security Awareness
- g) Education and Training
- h) Policies, Standards, and Guidelines

12. Define Secure Software Development Life Cycle (SecSDLC). [R]

The SecSDLC involves identifying specific threats and the risks they represent, followed by design and implementation of specific controls to counter those threats and assist in managing the risks they pose to the organization and/or its customers. The SecSDLC must provide consistency, repeatability, and conformance.

13. List phases of SecSDLC. [R]

- a) Investigation
- b) Analysis
- c) Logical design

- d) Physical design
- e) Implementation
- f) Maintenance

14. What is Third-Party Risk Management. [R]

As SaaS moves into cloud computing for the storage and processing of customer data, there is a higher expectation that the SaaS will effectively manage the security risks with third parties. Lack of a third-party risk management program may result in damage to the provider's reputation, revenue losses, and legal actions should the provider be found not to have performed due diligence on its third-party vendors.

15. List the services across all technology layers. [R]

1. Authentication
2. Authorization
3. Availability
4. Confidentiality
5. Integrity
6. Accountability
7. Privacy

16. What is Vulnerability Assessment. [R]

Vulnerability assessment classifies network assets to more efficiently prioritize vulnerability-mitigation programs, such as patching and system upgrading. It measures the effectiveness of risk mitigation by setting goals of reduced vulnerability exposure and faster mitigation. Vulnerability management should be integrated with discovery, patch management, and upgrade management processes to close vulnerabilities before they can be exploited.

17. List the frame works in Data Governance. [R]

- a) Data inventory
- b) Data classification
- c) Data analysis (business intelligence)
- d) Data protection
- e) Data privacy
- f) Data retention/recovery/discovery
- g) Data destruction

18. What is Identity Access Management. [R]

Identity management is also known as identity and access management (IAM). IAM refers to a framework of policies and technologies for ensuring that the **proper** people in an enterprise have the **appropriate** access to technology resources.

19. Define Data Security. [R]

The ultimate challenge in cloud computing is data-level security, and sensitive data is the domain of the enterprise, not the cloud computing provider. Security will need to move to the data level so that enterprises can be sure their data is protected wherever it goes.

20. Define Application Security. [R]

Application security is one of the critical success factors for a world-class SaaS company. This is where the security features and requirements are defined and application security test results are reviewed. Application security processes, secure coding guidelines, training, and testing scripts and tools are typically a collaborative effort between the security and the development teams.

21. Define Virtual Machine Security. [R]

virtual machine security, which connects the machine back to the mother ship, has some advantages in that the security software can be put into a single software agent that provides for consistent control and management throughout the cloud while integrating seamlessly back into existing security infrastructure investments, providing economies of scale, deployment, and cost savings for both the service provider and the enterprise.

22. What are the types of cloud players? [R]

- 1) Cloud service providers and IT administrators.
- 2) Software developers or vendors.
- 3) End users or business users.

23. Define Runtime Support Services. [R]

As in a cluster environment, there are also some runtime supporting services in the cloud computing environment. Cluster monitoring is used to collect the runtime status of the entire cluster. One of the most important facilities is the cluster job management system.

24. State the Cloud Differences in Perspectives of Providers, Vendors, and Users.[AZ]

Cloud Players	IaaS	PaaS	SaaS
IT administrators/cloud providers	Monitor SLAs	Monitor SLAs and enable service platforms	Monitor SLAs and deploy software
Software developers (vendors)	To deploy and store data	Enabling platforms via configurators and APIs	Develop and deploy Software
End users or business users	To deploy and store data	To develop and test web software	Use business software

25. Give an example for Paas and Iaas. [U]

PaaS is provided by Google, Salesforce.com, and Facebook,
IaaS is provided by Amazon, Windows Azure, and RackRack.

PART B

- 1. Explain in detail about cloud resource provisioning methods.[U]
- 2. Write short note on cloud security challenges. [R]
- 3. Write short notes on data security. [R]
- 4. Write short on Virtual machine security. [R]

PART C

1. Investigate the differences among encryption, watermarking, and colouring for protecting data sets and software in cloud environments. Discuss their relative strengths and limitations.[AZ]
2. Compile a table to compare public clouds and private clouds in each of the following four aspects. Also identify their differences, advantages, and shortcomings in terms of design technologies and application flexibility. Give several example platforms that you know of under each cloud class.[AZ]
 - a. Technology leveraging and IT resource ownership
 - b. Provisioning methods of resources including data and VMs, and their management
 - c. Workload distribution methods and loading policies
 - d. Security precautions and data privacy enforcement

Assignment Questions

1. Discuss different ways for cloud service providers to maximize their revenues.(R)
2. Write down where SaaS is extremely useful and not useful (U)

UNIT-V
UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS

PART-A

1. What is Google App Engine? [R]

Google App Engine (often referred to as GAE or simply App Engine) is a web framework and cloud computing platform for developing and hosting web applications in Google-managed data centers. Applications are sandboxed and run across multiple servers

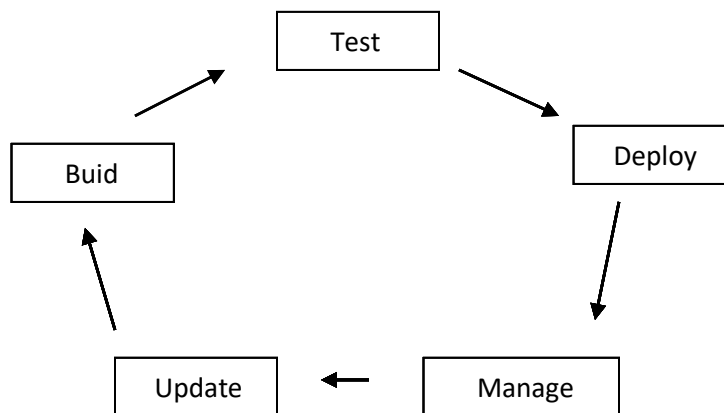
2. What are the key features in Google App Engine application environment? [R]

- dynamic web serving, with full support for common web technologies
- persistent storage with queries, sorting and transactions
- automatic scaling and load balancing
- APIs for authenticating users and sending email using google accounts
- a fully featured local development environment that simulates Google App Engine on users computer
- task queues for performing work outside of the scope of a web request
- scheduled tasks for triggering events at specified times and regular intervals

3. What are the advantages of Google App Engine ? [R]

- Scalability
- Lower total cost of ownership
- Rich set of APIs
- Fully featured SDK for local development
- Ease of deployment
- Web administration console and diagnostic utilities

4. Give the application lifecycle of Google App Engine. [R]



5. What are the services provided by Google App Engine? [R]

Wide range of services available

- User service
- Blobstore
- Task Queues
- Mail Service
- Image
- Memcache, etc

6. Describe the services available in User services? [U]

It provides a simple API for authentication and authorization

It detects if a user is signed in App

It detects if a user is an admin

7. What are the three authentication options in User service? [R]

Google Account

Google Apps domains users

OpenID - experimental

8. Describe the services available in Blobstore services? [U]

- Blobstore service allows our application to serve binary objects, larger than the entities in the Datastore.
- Blobs are created by uploading files through HTTP
- The upload and store logic is handled by the service
- the HTTP request is redirected to a dispatcher, by specified by the developer

9. Describe the services available in Task Queues? [U]

- Task queues allow the application to perform work, initiated by a user request, outside of that request.
- It is suitable for triggering background processes

10. What are the different ways of storing application data in Google App Engine? [R]

- Datastore
- Google Cloud SQL
- Google Cloud Storage

11. What are the two different Datastore types that can be used? [R]

- High Replication Datastore(HRD)
- Master/Slave Datastore

12. List some of the restrictions in Google App Engine. [AZ]

- Read only access to file system
- Pure Python based web servers
- Application cannot create new threads
- 10MB request and response size limit
- 1000 results max per datastore query

- 30 sec deadline for every request/response

13. What are the components of Google App Engine. [R]

- SDK
- Language Runtime
- Web Based Admin Console
- Scalable Infrastructure

14. What is Amazon Web Service(AWS)? [R]

Amazon web services is a collection of remote computing services(web services) that together make up a cloud computing platform offered over the internet by Amazon.com

15. What does Amazon Web Service offering? [R]

- Low ongoing cost
- Instant Elasticity and Flexible capacity (Scaling up and down)
- Speed and Agility
- Apps not Ops
- Global Reach
- Open and flexible
- Secure

16. What is Amazon Elastic Compute Cloud(EC2)? [R]

A Web service that provides resizable compute capacity in the cloud. EC2 allows creating virtual machine on-demand

17. What is Amazon Elastic Block Store(EBS)? [R]

EBS provides block level storage volumes(1 GB to 1 TB) for use with Amazon EC2 instances

- multiple volumes can be mounted to the same instance
- EBS volumes are network-attached and persist independently from the life of an instance
- Storage volumes behave like raw, unformatted block devices, allowing users to create a file system on top of Amazon EBS volumes or use them in any other way you would use a block device

18. What is Amazon Simple Storage Service (S3)? [R]

Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web.

19. What is Amazon Elastic Map Reduce(EMR)? [R]

Amazon EMR is a web service that makes it easy to quickly and cost-effectively process vast amounts of data using Hadoop. Amazon EMR distribute the data and processing across a resizable cluster of Amazon EC2 instances.

20. What is Amazon Relational Database Service(RDS)? [R]

Amazon RDS is a web service that makes it easy to set up, operate, and scale a relational database in the cloud. It gives access to the capabilities of a familiar MySQL, Oracle or Microsoft SQL Server database engine.

21. What is Amazon DynamoDB? [R]

DynamoDB is a fast, fully managed NoSQL database service that makes it simple and cost-effective to store and retrieve any amount of data and serve any level of request traffic.

22. What is Eucalyptus. [R]

Eucalyptus is an open source software platform for implementing Infrastructure as a Service (IaaS) in a private or hybrid cloud computing environment.

The Eucalyptus cloud platform pools together existing virtualized infrastructure to create cloud resources for infrastructure as a service, network as a service and storage as a service.

The name Eucalyptus is an acronym for Elastic Utility Computing Architecture for Linking Your Programs To Useful Systems.

23. List the features of Eucalyptus. [AZ]

- Linux and Windows virtual machines (VMs). Supports both
- program interface- (API) compatible with Amazon EC2 platform. Application
- Amazon Web Services (AWS) and Simple Storage Service (S3). Compatible with
- multiple hypervisors including VMware, Xen and KVM. Works with
- and deployed from source code or DEB and RPM packages. Can be installed
- communications are secured through SOAP and WS-Security. Internal processes
- can be virtualized as a single cloud. Multiple clusters
- features such as user and group management and reports. Administrative

24. What are the components of Eucalyptus? [R]

- Cluster Controller (CC)
- Cloud Controller (CLC)
- Node Controller (NC)
- Walrus Storage Controller (WS3)
- Storage Controller (Sc)

25. What is OpenNebula? [R]

OpenNebula is an open source platform for constructing virtualised private, public and hybrid clouds. It is a simple yet feature-rich, flexible solution to build and manage data centre virtualisation and enterprise clouds.

26. What are the benefits of OpenNebula? [R]

- It is 100 per cent open source and offers all the features in one edition.
- It provides control via the command line or Web interface, which is ideal for a variety of user groups and needs.
- OpenNebula is available for all major Linux distributions, thus simplifying installation.
- The long-term use of OpenNebula in large scale production environments has proven its stability and flexibility.
- OpenNebula is interoperable and supports OCCI (Open Cloud Computing Interface) and AWS (Amazon Web Services).

27. List out the key features of OpenNebula. [AZ]

OpenNebula has features for scalability, integration, security and accounting. The developers also claim that it supports standardisation, interoperability and portability.



28. What is Open Stack? [R]

OpenStack is a free and open-source software platform for cloud computing, mostly deployed as infrastructure-as-a-service (IaaS), whereby virtual servers and other resources are made available to customers.[2] The software platform consists of interrelated components that control diverse, multi-vendor hardware pools of processing, storage, and networking resources throughout a data center.

PART-B

1. Explain in details about various service provided by Google App Engine(GAE)? [U]
2. Explain in detail the architecture of Google App Engine? [U]
3. Discuss about the various applications of GAE? [R]
4. Describe in detail about Amazon Web Service? [U]
5. Write short notes on [R]
 - i. Eucalyptus

- ii. Open Nebula
- iii. Open Stack

PART-C

1. Create a successful Google Application and deploy it in Google App Engine along with Google's Cloud data storage facility for App Engine Developers. [C]
2. How to authenticate a private Go Module using Google App Engine Standard. [AZ]
3. What is the use of eucalyptus in cloud computing environment? [U]

Assignment Questions

1. Determine how to provide elastic capacity(resources) to meet business demand. (U)
2. Assess how to achieve cost-effective business continuity. (R)