Date: 28/05/2025 FN **ENTERPRISE CLOUD CONCEPTS (** DATA SCIENCES **) Descriptive Exam** **Max Marks: 20**

Q.No.		Question and Answers	Marks
		Unit - I	
1.	a)	List the five essential characteristics of cloud computing and Explain the three basic cloud delivery models with examples. *0.5 mark each for the five essential characteristics, 0.5 mark each for the three cloud delivery models, and 1 mark for the examples.*	**5**
		Cloud computing has five essential characteristics, The word essential, which means that if any of these characteristics is missing, then it is not cloud computing. <write one line each> 1. On-demand self-service 2. Broad network access 3. Elastic resource pooling 4. Rapid elasticity 5. Measured service The three kinds of services (cloud service delivery model) with which the cloud-based computing resources are available to end customers are: <write one more line each> 1. Software as a Service (SaaS) - End user application is delivered as a service. Eg: Saleforce.com, Google Apps like Google Drive, and Microsoft office 365. 2. Platform as a Service (PaaS) - Application platform onto which custom applications and services can be deployed. Eg: Google App Engine and Microsoft Azure Services. 3. Infrastructure as a Service (IaaS) - Physical infrastructure is abstracted to provide computing, storage, and networking as a service. Eg: Amazon Web Services (AWS) and Google Compute Engine.	
		Unit - I	
2.	a)	What is one major security challenge faced by cloud consumers when using public cloud services? *1 mark for the correct identification of any one of the security challenges.*	**1**
		Security is an important aspect to be considered in the cloud computing environment. Increased security vulnerabilities arise as following: ● Shared responsibility and trust boundary expansion - Moving data to the cloud creates overlapping trust boundaries between cloud consumers and providers, making it difficult to establish compatible security architectures and potentially introducing vulnerabilities. ● Multi-tenant security risks - Shared cloud resources among different consumers create opportunities for malicious users to attack IT resources and access other organizations' data due to overlapping trust boundaries.	
	b)	Explain the four common cloud deployment models with suitable diagrams. *0.5 mark each for a clear and concise explanation of deployment model and 0.5 mark each for the diagrams.*	**4**

Deployment models describe the ways with which the cloud services can be deployed or made available to its customers, depending on the organizational structure and the provisioning location.
Four deployment models are:

1. Public cloud - The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

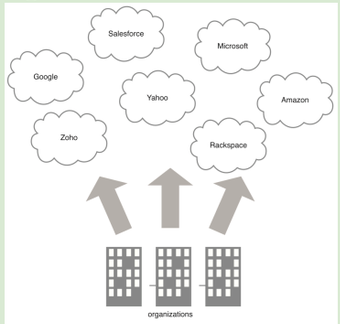

Figure 4.17
Organizations act as cloud consumers when accessing cloud services and IT resources made available by different cloud providers.

2. Private cloud - The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

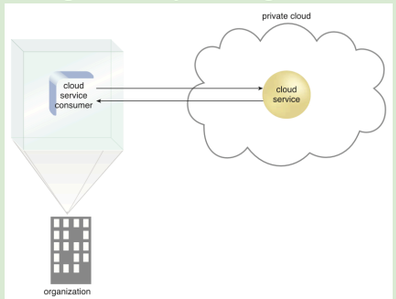

Figure 4.19
A cloud service consumer in the organization's on-premise environment accesses a cloud service hosted on the same organization's private cloud via a virtual private network.

3. Community cloud - The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

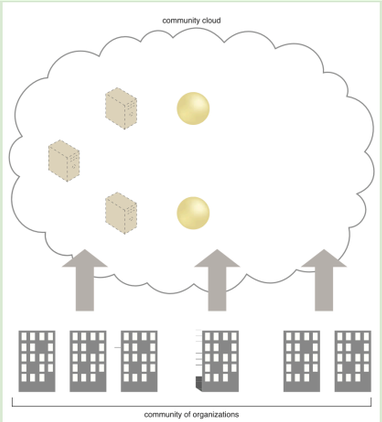

Figure 4.18
An example of a "community" of organizations accessing IT resources from a community cloud.

4. Hybrid cloud - The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

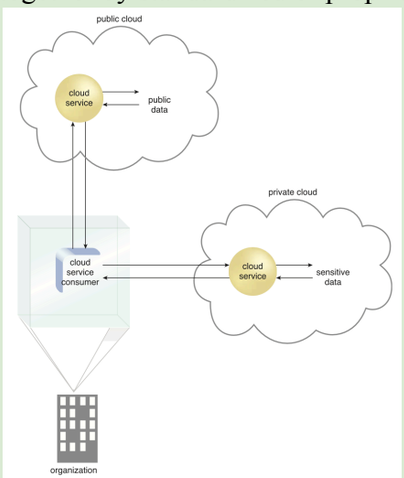

Figure 4.20
An organization using a hybrid cloud architecture that utilizes both a private and public cloud.

		Unit - I and II	
3.	a)	State the NIST definition of Cloud Computing. *2 mark for exact or near-exact statement of official NIST definition.*	**2**
		The formal definition of cloud computing comes from the National Institute of Standards and Technology (NIST): — Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models —	
	b)	What is a data center in cloud computing? Briefly explain the core components of a data center. *1 mark for a clear definition of a data center. 2 marks for explanation of the core components.*	**3**
		A data center is a specialized IT infrastructure that houses centralized IT resources, such as servers, databases, networking and telecommunication devices, and software systems. Core Components of a Data Center: 1. Computing Hardware: a. Data center IT hardware is typically composed of standardized commodity servers of increased computing power and storage capacity. b. Computing hardware technologies include rackmounted server arrays and multi-core CPU architectures 2. Storage Hardware: a. Storage system technologies include hard disk arrays and storage virtualization b. Technologies used to increase storage capacity include DAS (Direct-Attached Storage), SAN (Storage Area Network), and NAS (Network-Attached Storage) 3. Network Hardware: a. Specialized high-capacity network hardware and technology, such as content-aware routing, LAN and SAN fabrics, and NAS gateways, are used to improve network connectivity. b. Ultra high-speed network optical links can be used to aggregate individual gigabit-per- second channels into single optical fibers using multiplexing technologies like dense wavelength-division multiplexing (DWDM) 4. Supporting Infrastructure: a. Virtualization layer for resource abstraction and control b. Facilities with specialized power supplies, environmental control systems, and security measures	

		Unit - II	
4.	a)	Draw the Internet Reference Model and protocol stack. *1.5 mark for all 5 layers correctly labeled and arranged (Application, Transport, Network, Data Link, Physical). 0.5 marks for correctly mentioning the protocols in each layer.*	**2**

Figure 5.4 presents the Internet Reference Model and the protocol stack.

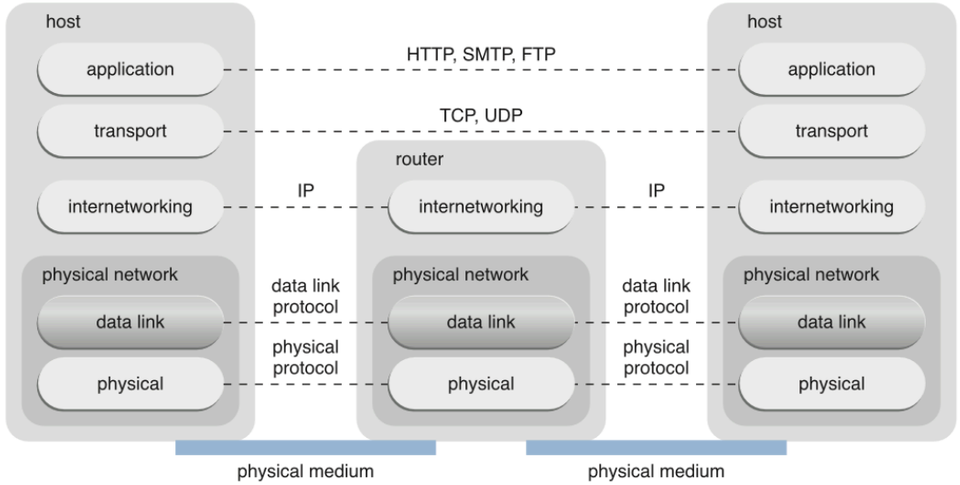

Figure 5.4
A generic view of the Internet reference model and protocol stack.

	b)	What is a cloud storage device? Briefly explain the three primary levels of cloud storage with one AWS service as an example for each type. *1 mark each for defining the cloud storage levels (Block, File, Object) with an example from AWS.*	**3**

The cloud storage device mechanism represents storage devices that are designed specifically for cloud-based provisioning. Instances of these devices can be virtualized, similar to how physical servers can spawn virtual server images. Cloud storage devices are commonly able to provide fixed-increment capacity allocation in support of the pay- per-use mechanism. Cloud storage devices can be exposed for remote access via cloud storage services.

Cloud Storage Levels - Cloud storage device mechanisms provide common logical units of data storage, such as:

1. Files – Collections of data are grouped into files that are located in folders.
   File Storage for shared access via file systems.
   Eg: Amazon EFS, Filestore, Azure Files

2. Blocks – The lowest level of storage and the closest to the hardware, a block is the smallest unit of data that is still individually accessible.
   Block Storage for high-performance apps and databases
   Eg: Amazon EBS, Persistent Disks (PD), Azure Disk Storage

3. Objects – Data and its associated metadata are organized as Web-based resources.
   Object Storage for unstructured data: media, backups, logs.
   Eg: Amazon S3, Google Cloud Storage, Azure Blob Storage

4. Datasets – Sets of data are organized into a table-based, delimited,or record format.

		Unit – II	
5.	a)	What is virtualization? Explain any five types of virtualization used in cloud computing. *1 mark each for a clear and concise explanation of five types of virtualization (Server virtualization, Storage virtualization, Network virtualization, Desktop virtualization, Application virtualization) .*	**5**

Virtualization is the process of converting a physical IT resource into a virtual IT resource. Most types of IT resources can be virtualized, including:

- Servers: A physical server can be abstracted into a virtual server.
- Storage: A physical storage device can be abstracted into a virtual storage device or a virtual disk.
- Network: Physical routers and switches can be abstracted into logical network fabrics, such as VLANs.
- Power: A physical UPS and power distribution units can be abstracted into what are commonly referred to as virtual UPSs.

1. Server virtualization is a process that partitions a physical server into multiple virtual servers. It is an efficient and cost-effective way to use server resources and deploy IT services in an organization.

2. Storage virtualization combines the functions of physical storage devices such as network attached storage (NAS) and storage area network (SAN). It uses all your physical data storage and creates a large unit of virtual storage that you can assign and control by using management software.

3. Any computer network has hardware elements such as switches, routers, and firewalls. Network virtualization is a process that combines all of these network resources to centralize administrative tasks.

4. Most organizations have nontechnical staff that use desktop operating systems to run common business applications. You can use desktop virtualization to run these different desktop operating systems on virtual machines, which your teams can access remotely.

5. Application virtualization pulls out the functions of applications to run on operating systems other than the operating systems for which they were designed. For example, users can run a Microsoft Windows application on a Linux machine without changing the machine configuration.

		Unit – III	
6.	a)	Briefly explain the four cloud management mechanisms with relevant case study examples. *1 mark each for a clear and concise explanation of four cloud management mechanisms (Remote Administration, Resource Management, SLA Management, Billing and Usage Monitoring) and 1 mark for the case study example.*	**5**

Cloud-based IT resources need to be set up, configured, maintained, and monitored. Following are the cloud management-related mechanisms:

1. Remote Administration System - The remote administration system mechanism provides tools and user-interfaces for external cloud resource administrators to configure and administer cloud-based IT resources.
   Eg: DTGOV has been offering its cloud consumers a user-friendly remote administration system for some time, and recently determined that upgrades are required in order to accommodate the growing number of cloud consumers and increasing diversity of requests.

2. Resource Management System - The resource management system mechanism helps coordinate IT resources in response to management actions performed by both cloud consumers and cloud providers. Core to this system is the virtual infrastructure manager (VIM) that coordinates the server hardware so that virtual server instances can be created from the most expedient underlying physical server.
   Eg: The DTGOV resource management system is an extension of a new VIM product it purchased and provides management of virtual IT resources with a flexible allocation of pooled IT resources across different data centers.

3. SLA Management System - The SLA management system mechanism represents a range of commercially available cloud management products that provide features pertaining to the administration, collection, storage, reporting, and runtime notification of SLA data.
   Eg: DTGOV implements an SLA management system that interoperates with its existing VIM. This integration allows DTGOV cloud resource administrators to monitor the availability of a range of hosted IT resources via SLA monitors.

4. Billing Management System - The billing management system mechanism is dedicated to the collection and processing of usage data as it pertains to cloud provider accounting and cloud consumer billing. Specifically, the billing management system relies on pay-per-use monitors to gather runtime usage data that is stored in a repository that the system components then draw from for billing, reporting, and invoicing purposes.
   Eg: DTGOV decides to establish a billing management system that enables them to create invoices for custom-defined billable events, such as subscriptions and IT resource volume usage. The billing management system is customized with the necessary events and pricing scheme metadata.

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