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Information Systems and IT Fundamentals

2.1 Introduction

Information Technology is a key enabler in modern enterprises and the relevance of IT on auditing in terms of risks; security, control and changes required in audit process and procedures; cannot be ignored. Any enterprise needs effective and efficient ways to use Business Process Automation (BPA), which is largely aided by Information Technology. Information Systems, which forms the backbone of any enterprise comprises of various layers such as: Application Software; Database Management Systems (DBMS); System Software; Hardware; Network Links and People-Users. Further, whenever an information system has to be deployed for the first time or some major changes are required, we need to implement Information System Life Cycle. This has different phases which encompass System Development, System Investigation, System Analysis, System Design, System Implementation, System Maintenance and Review.

2.2 Need for Information Technology

Understanding 'How IT is deployed in enterprises' is imperative to learning about business. IT in the present context may be referred as a computer-based tool that people use to work with information and support the information-processing needs of an enterprise. IT allows enterprises to work more efficiently and to maximize productivity. Faster communication, electronic storage and the protection of records are advantages that IT can give to any enterprise. IT enables business enterprises to differentiate their products and services from their competitors.

2.2.1 Communication Capabilities

IT provides resources to enterprises to communicate quickly and effectively. With these communication capabilities, enterprises can now integrate their business functions and segments spread across different geographical areas. Any global enterprise having an international presence can integrate its far flung business locations using communication capabilities offered by IT.

Some of the common and efficient communication tools are Emails, Voice over Internet Protocol (VoIP), WhatsApp Messenger etc. Skype is one such popular VoIP service, which allows people across the world to make free, unlimited, superior quality voice calls via its innovative peer-to-peer software.

2.2.2 Data and Information Management
<p>Today, most enterprises store digital versions of documents on servers, storage devices and on cloud. These documents are instantly available to anyone with access rights, regardless of their geographical location. Further, IT also enables Information Security encompassing the protection of information from accidental or intentional misuse by persons inside or outside an enterprise. IT security engineering systems protect enterprise electronic information from being hacked, or wiped out during a technological disaster.</p>
2.2.3 Automated Processes
<p>Business Process Automation (BPA) is a strategy that is used to optimize and streamline the essential business processes, using the latest technology to automate the functions involved in carrying them out. BPA allows the organizations to extract maximum benefit by using the available resources to their best advantage, while keeping the operational cost as low as possible. Doing so helps the enterprise to generate greater profits and achieve a level of stability that would be hard to realize without the use of automation.</p>
2.3 Importance of IT in Auditing
<p>Information Technology encompasses all aspects of functioning of enterprises from strategy to operations, conception to completion and from ideation to value creation. Enterprises, professionals as individuals are becoming increasingly dependent on IT and understand the need to embrace IT. Information Technology is evolving at an accelerating pace and the role of IT is transforming business processes. Auditors provide solutions to complex issues by integrating specialized technology with their extensive experience to create new strategic business processes. They provide assurance on the security; effectiveness and reliability of information; applications; and new and effective business practices and processes.</p>
2.3.1 Auditing in IT Environment
<p>Audit broadly would involve the process of evaluating and reporting the adequacy of system controls, efficiency, economy, effectiveness, and security practices to assure that assets and information resources are safeguarded; that data integrity is protected; and that the system complies with applicable policies, procedures, standards, rules, laws and regulations.</p>
2.3.2 IT Risks and Issues
<p>It becomes critical for enterprises to implement IT not only with right security but also to create business value. Auditors can play a critical role in reviewing security and facilitating enterprises to realize business value. Enterprise risks include several components such as business risks, technology risks, operational risk and other risks.</p> <p>Technology risks are faced by enterprises that are heavily driven by and dependent on technology, especially where the types of technology used are rare and keep changing. When the technology used fails or becomes obsolete, the enterprise may not be able to continue with its business.</p>

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2.3.3 Need for Controls in Information Systems

With the advent of affordable hardware, technology has become a critical component of business. Today's dynamic global enterprises need information integrity, reliability and validity for timely flow of accurate information throughout the organization. A well designed information system should have controls built-in for all its sensitive or critical sections.

Information System Control procedure may include Strategy and Direction; General Organization and Management; Access to IT resources including data and programs; System Development Methodologies and Change Control; Operation Procedures; System Programming and Technical Support Functions; Quality Assurance Procedures; Physical Access Controls; Business Continuity Planning (BCP) and Disaster Recovery Planning (DRP); Network and Communication; Database Administration; and Protective and Detective mechanisms against internal and external attacks.

2.3.4 Special features of auditing in an IT environment

Auditors in an IT environment are to know the methodology of audit to ensure the proper performance of audit being carried out.

2.3.5 Impact of IT on Risks and Controls

Data handling capacity of computer combined with telecommunications technology greatly increases ability of an individual to access and perhaps to manipulate large quantities of data - within a relatively short time period: thus, increasing amount of potential damage or risk of exposure.

2.3.6 Auditors' Concern

The increased risks and changes in traditional control functions lead to a shift in the auditors concern. The key concerns of auditor are to develop and apply new criteria in evaluating control weaknesses in Computerized Information Systems (CIS) and to use computers to perform some portions of audit examination.

2.4 Business Process Automation

Business Process Automation (BPA) is a process of managing information, data and processes to reduce costs, resources and investment. BPA capabilities range from automating a simple data-entry-manipulation task to building complex, automated financial management processes using existing applications. The resulting benefits are cost reduction, elimination of human error, freeing people from routine and volume, and allow management to do what they are best at: make decisions, analyze data implications and trends and focus on providing better customer service.

The steps involved in any BPA are as follows:

Step 1	Define why we plan to implement BPA?
Step 2	Understand the rules/ regulation under which it needs to comply with?
Step 3	Document the process, we wish to automate.
Step 4	Define the objectives/goals to be achieved by implementing BPA.
Step 5	Engage the business process consultant.
Step 6	Calculate the ROI for project.
Step 7	Development of BPA.
Step 8	Testing the BPA.

2.4.1 Business Process Management

Business Process Management (BPM) is the methodology used by enterprises to improve end-to-end business processes in various stages. An Enterprise Resource Planning (ERP) application divides BPM into the phases: **Analysis, Design, Implementation, Run & Monitor** and **Optimize**. BPA makes existing processes more efficient, not only at enterprise level but even for desktop users' through simple workflows, access and authorizations. BPA application ties up these activities – **Integration, Orchestration and Automation**.

2.5 Computing

Computing may be defined as any goal-oriented activity requiring, benefiting from or creating computers. It includes designing and building hardware and software systems for a wide range of purposes; processing, structuring, and managing various kinds of information; doing scientific studies using computers; making computer systems behave intelligently; creating and using communications and entertainment media; finding and gathering information relevant to any particular purpose, and so on.

2.6 Computing Technologies

Brief overview of some of the key computing technologies are given as follows:

2.6.1 Server

From a hardware perspective, a server is a computer (hardware) or device on a network dedicated to run one or more services (as a host), to serve the needs of the users of other computers on a network. In client-server architecture, a server is a computer program running to serve the requests of other programs, the "clients". Thus, the server performs some computational task on behalf of "clients". The clients either run on the same computer or they connect through the network. Servers are often dedicated, meaning that they perform no other tasks besides their server tasks.

2.6.2 Popular Computing Architecture

Computer architecture is the art that specifies the relations and parts of a computer system. In computer engineering, Computer Architecture is the conceptual design and fundamental operational structure of a computer system. The computer is based on a fixed hardware platform capable of executing a fixed repertoire of instructions. CPU, the centre piece of the computer's architecture, is in charge of executing the instructions of the currently loaded program. These instructions tell the CPU to carry out various calculations, to read and write values from and into the memory, and to conditionally jump to execute other instructions in the program. Popular computing architecture used today is called **Instruction Set Architecture (ISA)**. Computer architecture includes at least three main subcategories: **Instruction Set Architecture, Micro-Architecture and System Design**.

2.6.3 Emerging Computing Models

(I) Cloud Computing: Cloud Computing is the use of various services such as software development platforms, servers, storage, and software over the Internet, often referred to as the "cloud."

A. Cloud Computing Environment: The cloud computing environment can consist of multiple types of clouds based on their deployment and usage – **Public, Private, Community and Hybrid**.

B. Cloud Computing Architectural Considerations: A cloud computing architecture consists of two parts - **Front End** and a **Back End** that connect to each other through a network, usually the Internet.

C. Service Models of Cloud Computing: Mainly, there are five Cloud Computing Service based models. These are **Information as a Service (IaaS), Software as a Service (SaaS), Platform as a Service (PaaS), Network as a Service (NaaS)** and **Communication as a Service (CaaS)**.

(II) Mobile Computing: Mobile Computing is the use of portable computing devices (such as laptop and handheld computers) in conjunction with mobile communications technologies to enable users to access the Internet and data on their home or work computers from anywhere in the world. It is a human-computer interaction by which a computer is expected to be transported during normal usage. Mobile computing involves **Mobile Communication, Mobile Hardware and Mobile Software**.

A. Business Applications of Mobile Computing: Mobile devices provide the capability to conduct business anywhere and enable users to seamlessly communicate and access information whether they are in the office or anywhere. The change driven largely by video, web-browsing, gaming and other entertainment related applications is one of the hottest trends in the consumer sector.

B. Mobile Computing Concerns: Major concerns relating to mobile computing are dangers of misrepresentation; Power consumption; and security concerns.

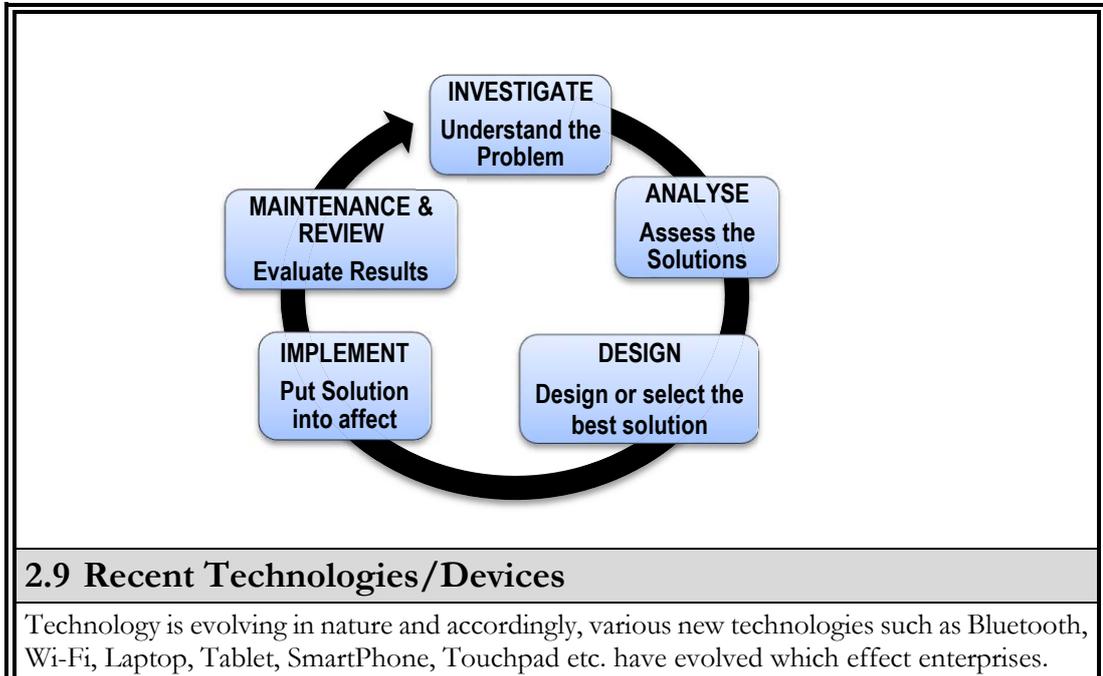
2.7 Information System Layers

The layers are discussed as follows:

	Component	Explanation
2.7.1	Application Software	This includes all those computer software that cause a computer to perform useful tasks beyond the running of the computer itself. Application Suite, Enterprise Software, Enterprise Infrastructure Software, Information Worker Software, Content Access Software, Educational Software and Media Development Software are the application software.
2.7.2	Database Management Systems (DBMS)	DBMS are software that aid in organizing, controlling and using the data needed by the application programme. Commercially available DBMS are Oracle, My SQL, SQL Servers and DB2 etc.
2.7.3	System Software	System software is computer software that is designed to operate the computer hardware and to give and maintain a platform for running application software. Example - Operating System.
2.7.4	Hardware	Hardware basically consists of devices that perform the functions of input, processing, data storage and output activities of the computer.
2.7.5	Network Links	Effective and efficient communication is a valuable resource which helps in good management. To enable this communication, we need communication networks.
2.7.6	People/Users	The people involved include users of the system and information systems personnel, including all the people who manage, run, program, and maintain the system.

2.8 Information System Life Cycle

This is commonly referred as **Software/System Development Life Cycle (SDLC)**, which is a methodology used to describe the process of building information systems. It is the logical starting point in the entire life cycle of a computerized system. SDLC framework provides a sequence of activities for system designers and developers to follow. It consists of a set of steps or phases in which each phase of the SDLC uses the results of the previous one. An SDLC adheres to important phases that are essential for developers, such as **Investigation; Analysis, Design; Implementation and Maintenance and Review.**



Question 1

Define the following:

- (a) Multiprocessing
- (b) Hardware Virtualization
- (c) Cloud Computing
- (d) Groupware
- (e) Computer Bus
- (f) Memory Controller
- (g) Direct Memory Access (DMA)

Answer

- (a) **Multiprocessing:** Multiprocessing is the use of two or more Central Processing Units (CPUs) within a single computer system to allocate tasks between them.
- (b) **Hardware Virtualization:** Hardware Virtualization or Platform Virtualization refers to the creation of a virtual machine that acts like a real computer with an operating system. Software executed on these virtual machines is separated from the underlying hardware resources.
- (c) **Cloud Computing:** Cloud computing is the use of various services, such as software development platforms, servers, storage, and software, over the Internet, often referred to as the "cloud."

- (d) **Groupware:** Groupware also known as Team-ware, Collaboration Software is software that allows collective and collaborative working of teams from different geographical locations on an online and real-time basis.
- (e) **Computer Bus:** Computer Bus is a communication system that transfers data between components inside a computer, or between computers that covers all related hardware components (wire, optical fiber, etc.) and software, including communication protocol.
- (f) **Memory Controller:** Memory Controller is a digital circuit which manages the flow of data going to and from the main memory and can be a separate chip or integrated into another chip.
- (g) **Direct Memory Access (DMA):** Direct Memory Access (DMA) is a feature of modern computers that allows certain hardware subsystems within the computer to access system memory independently of the Central Processing Unit (CPU).

Question 2

Write short notes on the following:

- (a) Bluetooth

Or

What is Bluetooth? Name some devices that utilize Bluetooth technology.

- | | |
|------------------------|--|
| (b) Wi-Fi | (c) Tablet |
| (d) SmartPhone | (e) Touchpad |
| (f) Notebook | (g) Cache Memory |
| (h) Virtual Memory | (i) Instruction Set Architecture (ISA) |
| (j) Micro Architecture | (k) Software as a Service (SaaS) |
| (l) Android | (m) WhatsApp Messenger |

Answer

- (a) **Bluetooth:** Bluetooth is a wireless technology standard for exchanging data over short distances up to 50 meters (164 feet) from fixed and mobile devices, creating personal Area Networks (PANs) with high levels of security. Bluetooth is like a very low-power, short-range radio signal which is secure from the moment they're sent, so unlike any other wireless network we don't have to worry about turning on security. Few devices that utilize Bluetooth technology are Keyboards and mice, Printers, mobile phones and headsets, PDAs (Personal Digital Assistants), Desktop and laptop computers, Digital cameras, and Remotes. Using a mobile phone with Bluetooth enabled; we can send pictures, videos, exchange business cards and transfer files to our PC. Both data and voice transmissions can be sent and received using short range networks.
- (b) **Wi-Fi:** Wi-Fi is a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. Wi-Fi networks have limited range.

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A typical wireless access point might have a range of 32 meters (120 ft.). Wi-Fi can be less secure than wired connections because an intruder does not need a physical connection. Wi-Fi networks use radio technologies called 802.11 to provide secure, reliable, fast wireless connectivity. A Wi-Fi network can be used to connect electronic devices to each other, to the Internet, and to wired networks (which use Ethernet technology). Wi-Fi networks work well for small businesses providing connectivity between mobile salespeople, floor staff and behind-the-scenes finance and accounting departments.

- (c) **Tablet:** A Tablet computer, or simply tablet is a one piece general-purpose computer contained in a single panel. Its distinguishing characteristic is the use of a touch screen as the input device. Tablet PCs have extreme portability, easy to use interfaces and the wide range of ways they can be used. Some features of Tablets are as follows:
- ◆ **Input Method:** Tablets rely solely on a touch interface on the screen for all input.
 - ◆ **Size:** Tablets have the size roughly of a small pad of paper and a weight that is less than one Kg.
 - ◆ **Battery Life:** Tablets are designed for efficiency because of the low power requirements of their hardware components. Tablets can achieve all day usage.
 - ◆ **Storage Capacity:** Most tablets come with configurations that allow between 16 and 64 gigabytes of storage.
 - ◆ **Performance:** Most tablet PCs are based on extremely low powered processors more suited for tasks like email, web browsing, playing video or audio.
 - ◆ **Software:** The two major tablet platforms are Android and iOS amongst plenty of applications that are available.
 - ◆ **Wireless:** Because tablets by design are mobile computers; most of them have Wi-Fi, blue tooth and mobile connectivity.
- (d) **SmartPhone:** A SmartPhone is a mobile phone built on a mobile operating system with more advanced computing capability connectivity than a feature phone. This handheld device integrates mobile phone capabilities with the more common features of a handheld computer or PDA. Smartphone allows users to store information, e-mail and install programs, along with using a mobile phone in one device. Modern Smartphones also include high-resolution touch screens and web browsers that display standard web pages as well as mobile-optimized sites. High-speed data access is provided by Wi-Fi and mobile broadband.
- (e) **Touchpad:** A Touchpad is a pointing device featuring a tactile sensor, a specialized surface that can translate the motion and position of a user's fingers to a relative position on screen. Touchpad is a common feature of laptop computers, can also be found on Personal Digital Assistants (PDAs) and some portable media players.
- (f) **Notebook:** Notebook is an extremely lightweight personal computer that typically weighs less than 3 Kg and is small enough to fit easily in a briefcase. Notebook computers use

flat-panel technologies to produce a lightweight and non-bulky display screen. Modern notebook computers are almost equivalent to personal computers having the same CPUs, memory capacity and disk drives.

- (g) **Cache Memory:** Cache Memory (pronounced as cash) is a smaller, faster memory which stores copies of the data from the most frequently used main memory locations so that Processor/Registers can access it more rapidly than main memory. It is the property of locality of reference, which allows improving substantially the effective memory access time in a computer system.
- (h) **Virtual Memory:** Virtual Memory is an imaginary memory area supported by some operating systems (for example, Windows) in conjunction with the hardware. If a computer lacks the Random Access Memory (RAM) needed to run a program or operation, Windows uses virtual memory to compensate. Virtual memory combines computer's RAM with temporary space on the hard disk. When RAM runs low, virtual memory moves data from RAM to a space called a paging file. Moving data to and from the paging file frees up RAM to complete its work. Thus, Virtual memory is an allocation of hard disk space to help RAM.
- (i) **Instruction Set Architecture (ISA):** It is the abstract model of a computing system that is seen by a machine language programmer, including the instruction set, memory address modes, processor registers, and address and data formats. Instruction Set Architecture (ISA) is related to the programming of a computer – that is, how the computer understands, what each element in its basic language means, what instructions are to be carried out and in what order, etc. The ISA basically deals with what the chip does.
- (j) **Micro architecture:** It, also known as Computer organization, is a lower level detailed description of the system that is sufficient for completely describing the operation of all parts of the computing system, and how they are inter-connected and inter-operate in order to implement the ISA. The Micro architecture can be seen as how the ISA does and what it does. It is the term used to describe the resources and methods used to achieve architecture specification. The term typically includes the way in which these resources are organized as well as the design techniques used in the processor to reach the target cost and performance goals. The micro architecture essentially forms a specification for the logical implementation.
- (k) **Software as a Service (SaaS):** It includes a complete software offering on the cloud. Users can access a software application hosted by the cloud vendor on pay-per-use basis. SaaS is a model of software deployment where an application is hosted as a service provided to customers across the Internet by removing the need to install and run an application on a user's own computer. SaaS can alleviate the burden of software maintenance and support but users relinquish control over software versions and requirements.
- (l) **Android:** Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers. Android is an open source and the permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. Android provides

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access to a wide range of useful libraries and tools that can be used to build rich applications.

- (m) **WhatsApp Messenger:** It is a cross-platform mobile messaging application which allows us to exchange messages without having to pay for SMS. It is available for iPhone, BlackBerry, Android, Windows phone, Nokia and these phones can message each other. Because WhatsApp Messenger uses the same internet data plan that we use for e-mail and web browsing, there is no cost to message and stay in touch with friends.

Question 3

What are the three critical pillars of Business Process Automation (BPA)?

Answer

Business Process Automation rests on the following three critical pillars:

- ◆ **Integration:** BPA allows applications and operating systems not only to read data that the systems produce, but also to pass data between the component applications of the business process and to modify the data as necessary.
- ◆ **Orchestration:** The process of orchestration enables the ability to bring tasks that exist across multiple computers and different business departments or branches under one umbrella that is the business process itself.
- ◆ **Automation:** Orchestration and integration unite with automation to deliver the capability to provide a rule-based process of automatic execution that can span multiple systems and enable a more effective, nimble and efficient business process.

Question 4

Discuss some of the benefits of using Business Process Automation.

Answer

Some benefits of using Business Process Automation include:

- ◆ **Reducing the Impact of Human Error:** BPA removes human participation in the process, which is the source of many errors.
- ◆ **Transforming Data into Information:** BPA can, apart from collecting and storing data also analyze data and make it available in a form that is useful for decision-making.
- ◆ **Improving performance and process effectiveness:** In many cases, tasks that must be done manually are the bottleneck in the process. Automating those manual tasks speeds up the effective throughput of the application.
- ◆ **Making users more efficient and effective:** People can focus their energies on the tasks they do best, allowing the computers to handle those that machines are best suited for.
- ◆ **Making the business more responsive:** Business can easily automate new applications and processes as they are introduced.

- ◆ **Improving Collaboration and Information Sharing:** Business processes designed through a collaborative interface mean Information Technology can integrate its processes with the business-side logic that drives day-to-day operations.

Question 5

Discuss different types of servers based on the services they provide.

Answer

There are different types of servers based on the nature of service they provide. Some of them are given as follows:

- ◆ **File server:** This is a computer and storage device dedicated to storing files. Any user on the network can store files on the server.
- ◆ **Print server:** This is a computer that manages one or more printers.
- ◆ **Network server:** This is a computer that manages network traffic.
- ◆ **Database server:** This is a computer system that processes database queries.
- ◆ **Application Server:** This is a program that handles all application operations between users and an enterprise's backend business applications or databases.
- ◆ **Web Server:** Web server is a computer that delivers (serves up) web pages. Every web server has an IP address and possibly a domain name. For example, if we enter the URL <http://www.icai.org> in our browser, this sends a request to the Web server whose domain name is www.icai.org. The server then fetches the named home page and sends it to our browser. Any computer can be turned into a Web server by installing server software and connecting the machine to the Internet.
- ◆ **Mail Server:** Mail server moves and stores mail over corporate networks.

Question 6

What is Cloud Computing? Describe any three types of clouds in cloud computing environment.

Or

What are the different types of clouds in a Cloud computing environment?

Answer

Cloud Computing: Cloud computing is the use of various services, such as software development platforms, servers, storage, and software, over the Internet, often referred to as the "Cloud."

The Cloud Computing environment can consist of multiple types of clouds based on their deployment and usage. They are **Public Cloud**, **Private/Internal Cloud**, **Community Cloud** and **Hybrid Cloud**.

- ◆ **Public Clouds:** The public cloud is made available to the general public or a large industry group. They are administrated by third parties or vendors over the Internet, and services

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are offered on pay-per-use basis. It is widely used in the development, deployment and management of enterprise applications, at affordable costs; and allows organizations to deliver highly scalable and reliable applications rapidly and at more affordable costs.

- ◆ **Private/Internal Clouds:** This cloud computing environment resides within the boundaries of an organization and is used exclusively for the organization's benefits. They are built primarily by IT departments within enterprises who seek to optimize utilization of infrastructure resources within the enterprise by provisioning the infrastructure with applications using the concepts of grid and virtualization. The Private Cloud enables an enterprise to manage the infrastructure and have more control.
- ◆ **Community Clouds:** This is the sharing of computing infrastructure in between organizations of the same community. For example, all Government organizations within India may share computing infrastructure on the cloud to manage data. The risk is that data may be stored with the data of competitors.
- ◆ **Hybrid Clouds:** It is a composition of two or more clouds (Private, Community or Public) and is maintained by both internal and external providers. Though they maintain their unique identity, they are bound together by standardized data and application portability. With a hybrid cloud, organizations might run non-core applications in a public cloud, while maintaining core applications and sensitive data in-house in a private cloud.

Question 7

Discuss Cloud Computing architecture.

Answer

Cloud Computing architecture refers to the components and subcomponents that typically consist of a front end platform (fat client, thin client, mobile device), back end platform (servers, storage), a cloud based delivery, and a network (Internet, Intranet, Intercloud). Cloud architecture typically involves multiple cloud components communicating with each other over a tight or loose coupling of cloud resources, services, middleware, and software components.

A cloud computing architecture consists of two parts - **Front End** and a **Back End** that connect to each other through a network, usually the Internet. The front end is the side the computer user or client, sees. The back end is the "cloud" section of the system.

- ◆ **Front End:** The front end of the cloud computing system comprises of the client's devices (or it may be a computer network) and some applications are needed for accessing the cloud computing system. All the cloud computing systems do not give the same interface to users. For example - Web services like electronic mail programs use some existing web browsers such as Firefox, Microsoft's Internet Explorer or Apple's Safari. Other types of systems have some unique applications which provide network access to its clients.
- ◆ **Back End:** Back end refers to some physical peripherals. In cloud computing, the back end is cloud itself which may encompass various computer machines, data storage systems and servers. Groups of these clouds make a whole cloud computing system.

Theoretically, a cloud computing system can include practically any type of web application program such as video games to applications for data processing, software development and entertainment residing on its individual dedicated server for services. There are some set of rules, generally called as **Protocols** which are followed by this server and it uses a special type of software termed as **Middleware** that allow computers that are connected on networks to communicate with each other. If any cloud computing service provider has many customers, then there's likely to be very high demand for huge storage space. Many companies that are service providers need hundreds of storage devices.

Question 8

Discuss Service models of Cloud Computing.

Answer

Service Models of Cloud Computing are as follows:

- ◆ **Infrastructure as a Service (IaaS):** It is the foundation of cloud services that provides clients with access to server hardware, storage, bandwidth and other fundamental computing resources. The service is typically paid for on a usage basis and may also include dynamic scaling so that if the customer needs more resources than expected, s/he can get them on the fly (probably to a given limit). It provides access to shared resources on need basis, without revealing details like location and hardware to clients.
- ◆ **Software as a Service (SaaS):** It includes a complete software offering on the cloud. Users can access a software application hosted by the cloud vendor on pay-per-use basis. SaaS is a model of software deployment where an application is hosted as a service provided to customers across the Internet by removing the need to install and run an application on a user's own computer. SaaS can alleviate the burden of software maintenance and support but users relinquish control over software versions and requirements.
- ◆ **Platform as a Service (PaaS):** It provides clients with access to the basic operating software and optional services to develop and use software applications (e.g. database access and payment service) without the need to buy and manage the underlying computing infrastructure. For example, Google App Engine allows clients to run their web applications (i.e. software that can be accessed using a web browser such as Internet Explorer over the internet) on Google's infrastructure.
- ◆ **Network as a Service (NaaS):** It is a category of cloud services where the capability provided to the cloud service user is to use network/transport connecting services. NaaS involves optimization of resource allocation by considering network and computing resources as a whole. Some of the examples are: Virtual Private Network, Mobile Network Virtualization etc.
- ◆ **Communication as a Service (CaaS):** CaaS is an outsourced enterprise communication solution that can be leased from a single vendor. The CaaS vendor is responsible for all hardware and software management and offers guaranteed Quality of Service (QoS). It

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allows businesses to selectively deploy communication devices and modes on a pay-as-you-go, as-needed basis. This approach eliminates the large capital investments. Examples are: Voice over IP (VoIP), Instant Messaging (IM), Collaboration and Videoconferencing application using fixed and mobile devices.

Question 9

What is Mobile Computing? Discuss its components.

Answer

Mobile Computing: Mobile Computing is the use of portable computing devices (such as laptop and handheld computers) in conjunction with mobile communication technologies to enable users to access the Internet and data on their home or work computers from anywhere in the world. Mobile computing is enabled by use of mobile devices (portable and hand held computing devices) such as PDA, laptops, mobile phones, MP3 players, digital cameras, tablet PC and Palmtops on a wireless network.

Mobile computing involves **Mobile Communication, Mobile Hardware and Mobile Software;** which are discussed as follows:

- ◆ **Mobile Communication:** Mobile Communication refers to the infrastructure put in place to ensure that seamless and reliable communication goes on. These would include devices such as Protocols, Services, Bandwidth and Portals necessary to facilitate and support the stated services. The data format is also defined at this stage. The signals are carried over the air to intended devices that are capable of receiving and sending similar kind of signals. It will incorporate all aspects of wireless communication.
- ◆ **Mobile Hardware:** Mobile Hardware includes mobile devices or device components that receive or access the service of mobility. They would range from Portable laptops, Smart phones, Tablet PC's to Personal Digital Assistants. These devices will have receptors that are capable of sensing and receiving signals. These devices are configured to operate in full-duplex, whereby they are capable of sending and receiving signals at the same time.
- ◆ **Mobile Software:** Mobile Software is the actual program that runs on the mobile hardware. It deals with the characteristics and requirements of mobile applications. This is the engine of that mobile device. In other terms, it is the operating system of that appliance. It is the essential component that makes the mobile device operates.

Question 10

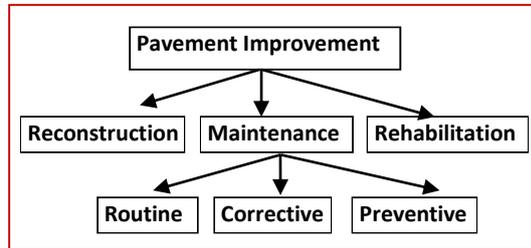
What is a Database Model? Discuss its various types.

Answer

A Database Model is a type of data model that determines the logical structure of a database and fundamentally determines in which manner data can be stored, organized and manipulated. Some prominent database models are as follows:

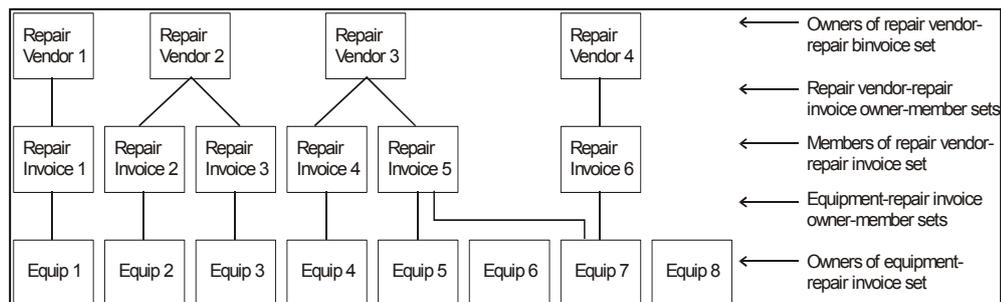
- A. Hierarchical Database Model:** In a hierarchical database model, records are logically organized into a hierarchy of relationships. A hierarchically structured database is arranged logically in an inverted tree pattern.

All records in hierarchy are called nodes. The top parent record in the hierarchy is called the **root record**. Records that “own” other records are called **parent records**. Each node is related to the others in a parent-child relationship. Each parent record may have one or more child records, but no child record may have more than one parent record.



Thus, the hierarchical data structure implements one-to-one and one-to-many relationships. (Refer the fig.)

- B. Network Database Model:** The network model is a variation on the hierarchical model such that it is built on the concept of multiple branches (lower-level structures) emanating from one or more nodes (higher-level structures) and that branch may be connected to multiple nodes. The network model is able to represent redundancy in data more efficiently than in the hierarchical model. The network model also permits a record to be a member of more than one set at one time that allows the network model to implement the many-to-one and the many-to-many relationship types.



- C. Relational Database Model:** A relational database allows the definition of data and their structures, storage and retrieval operations and integrity constraints that can be organized in a table structure. A table is a collection of records and each record in a table contains the same fields. Three key terms are used extensively in relational database models: **Relations, Attributes** and **Domains**. A relation is a table with columns and rows. The named columns of the relation are called **attributes**, and the domain is the set of values the attributes can take.

A relational database contains multiple tables, with at least similar value occurring in two different records (belonging to the same table or to different tables) that implies a relationship among those two records. Tables can also have a designated single attribute

or a set of attributes that can act as a "key" which can be used to uniquely identify each record in the table. A key that can be used to uniquely identify a row in a table is called a **Primary key**. Any column can be a key, or multiple columns can be grouped together into a **Compound key**.

- D. **Object Oriented Data Base Model (OODBMS):** It is based on the concept that the world can be modeled in terms of objects and their interactions. An Object-oriented database provides a mechanism to store complex data such as images, audio and video, etc. An OODBMS helps programmers make objects created in a programming language behave as a database object. Object-oriented programming is based on a series of working objects. Each object is an independently functioning application or program, assigned with a specific task or role to perform. An OODBMS is a relational database designed to manage these independent programs, using the data produced to quickly respond to requests for information by a larger application.

Question 11

What is an Operating System? Discuss various activities it performs.

Answer

An **Operating System (OS)** is a set of computer programs that manages computer hardware resources and acts as an interface with computer applications programs. The operating system is a vital component of the system software in a computer system. Application programs usually require an operating system to function that provides a convenient environment to users for executing their programs. Computer hardware with operating system can thus be viewed as an extended machine which is more powerful and easy to use. Some prominent Operating systems used nowadays are Windows 7, Windows 8, Linux, UNIX, etc.

A variety of activities are executed by Operating systems which include:

- ◆ **Performing hardware functions:** Application programs to perform tasks must obtain input from keyboards, retrieve data from disk & display output on monitors. Achieving all this is facilitated by operating system that acts as an intermediary between the application program and the hardware.
- ◆ **User Interfaces:** An important function of any operating system is to provide user interface. DOS has a **Command based User Interface (UI)** i.e. text commands were given to computer to execute any command, whereas Windows has **Graphic User Interface (GUI)** which uses icons & menus.
- ◆ **Hardware Independence:** Every computer could have different specifications and configurations of hardware. Operating system provides **Application Program Interfaces (API)** which can be used by application developers to create application software, thus obviating the need to understand the inner workings of OS and hardware. Thus, OS gives us hardware independence.
- ◆ **Memory Management:** Memory Management features of Operating System control how memory is accessed and maximizes available memory & storage. Operating systems also

provides Virtual Memory by carving an area of hard disk to supplement the functional memory capacity of RAM.

- ◆ **Task Management:** Task Management feature of Operating system helps in allocating resources to make optimum utilization of resources. This facilitates a user to work with more than one application at a time i.e. multitasking and allows more than one user to use the system i.e. timesharing.
- ◆ **Networking Capability:** Operating systems can provide systems with features & capabilities to help connect computer networks. Like Linux & Windows 8 give us an excellent capability to connect to internet.
- ◆ **Logical Access Security:** Operating systems provide logical security by establishing a procedure for identification & authentication using a User ID and Password. It can log the user access thereby providing security control.
- ◆ **File Management:** The Operating System keeps a track of where each file is stored and who can access it, based on which it provides the file retrieval.

Question 12

What is CPU? What are the three functional units of a Central Processing Unit (CPU)?

Answer

The Central Processing Unit (CPU or microprocessor) is the actual hardware that interprets and executes the program (software) instructions and coordinates how all the other hardware devices work together. The CPU is built on a small flake of silicon and can contain the equivalent of several million transistors. We can think of transistors as switches which could be “ON” or “OFF” i.e., taking a value of 1 or 0. The processor or CPU is like the brain of the computer. The main function of CPU is to execute programs stored in memory. It consists of three functional units:

- ◆ **Control Unit (CU):** CU controls the flow of data and instruction to and from memory, interprets the instruction and controls which tasks to execute and when.
- ◆ **Arithmetic and Logical Unit (ALU):** Performs arithmetic operations such as addition, subtraction, multiplication, and logical comparison of numbers: Equal to, Greater than, Less than, etc.
- ◆ **Registers:** These are high speed memory units within CPU for storing small amount of data (mostly 32 or 64 bits). Registers could be:
 - **Accumulators:** They can keep running totals of arithmetic values.
 - **Address Registers:** They can store memory addresses which tell the CPU as to where in the memory an instruction is located.
 - **Storage Registers:** They can temporarily store data that is being sent to or coming from the system memory.
 - **Miscellaneous:** These are used for several functions for general purpose.

Question 13

Discuss Information System Life Cycle.

Answer

Information System Life Cycle is commonly referred as **Software/System Development Life Cycle (SDLC)** which is a methodology used to describe the process of building information systems. SDLC framework provides a sequence of activities for system designers and developers to follow. It consists of a set of steps or phases in which each phase of the SDLC uses the results of the previous one. Various phases for developing an Information System are given as follows:

Phase 1: System Investigation: This phase examines that 'What is the problem and is it worth solving'? A feasibility study is done under the dimensions – Technical, Economical, Legal, Operational etc.

Phase 2: System Analysis: This phase examines that 'What must the Information System do to solve the problem'? System analyst would be gathering details about the current system and will involve interviewing staff; examining current business; sending out questionnaires and observation of current procedures.

The Systems Analyst will examine data and information flows in the enterprise using data flow diagrams; establish what the proposed system will do (not how it will do it); analyze costs and benefits; outline system implementation options. (For example: in-house or using consultants); consider possible hardware configurations; and make recommendations.

Phase 3: System Designing: This phase examines that 'How will the Information System do what it must do to obtain the solution to the problem'? This phase specifies the technical aspects of a proposed system in terms of Hardware platform; Software; Outputs; Inputs; User interface; Modular design; Test plan; Conversion plan and Documentation.

Phase 4: System Implementation: This phase examines that 'How will the solution be put into effect'? This phase involves coding and testing of the system; acquisition of hardware and software; and either installation of the new system or conversion of the old system to the new one.

Phase 5: System Maintenance and Review: This phase evaluates results of solution and modifies the system to meet the changing needs. Post implementation review would be done to address Programming amendments; Adjustment of clerical procedures; Modification of Reports, and Request for new programs.

Question 14

Differentiate between the following:

- (a) *Random Access Memory and Read Only Memory*
- (b) *Hierarchical Database Model and Network Database Model*
- (c) *Complex Instruction Set Computer (CISC) and Reduced Instruction Set Computer (RISC)*

Answer

- (a) The differences between Random Access Memory (RAM) and Read Only Memory (ROM) are given below:

Random Access Memory (RAM)	Read Only Memory (ROM)
RAM is a volatile memory and when the computer is turned off, RAM loses its data. When the computer is turned on again, operating system and other files are once again loaded into RAM usually from the hard disk.	Unlike RAM, ROM is non-volatile. The contents of ROM remain even after the computer is switched off.
This is Read Write memory wherein information can be read as well as modified.	Originally, the ROM used to be read-only; however, the new versions of ROM allow limited rewriting making it possible to upgrade firmware such as the BIOS by using installation software.

- (b) The differences between Hierarchical Database Model and Network Database Model are given below:

Hierarchical Database Model	Network Database Model
The hierarchical model permits a record to be a member of only one set at one time.	Unlike the hierarchical mode, the network model permits a record to be a member of more than one set at one time.
The hierarchical data structure implements one-to-one and one-to-many relationships.	The network model allows us to represent one-to-one, one-to-many and many-to-many relationships.
Each parent record may have one or more child records, but no child record may have more than one parent record.	Each parent record may have one or more child records, and even a child record may have more than one parent record.
The hierarchical model does not represent redundancy in data efficiently.	The network model can represent redundancy in data more efficiently than in the hierarchical model.
The hierarchical data structures require specific entrance points to find records in a hierarchy.	The network data structures can be entered and traversed more flexibly.

- (c) **Complex Instruction Set Computer (CISC):** If the Control Unit contains several micro-electronic circuitries to generate a set of control signals and each micro-circuitry is activated by a micro-code, this design approach is called CISC design. Examples of CISC processors are: Intel 386, 486, Pentium, Pentium Pro, Pentium II, Pentium III processors etc. CISC chips have a large, variable length and complex instructions and generally make

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use of complex addressing modes. Different machine programs can be executed on CISC machine. Since CISC processors possess so many processing features, the job of machine language programmers becomes easier. But at the same time, they are complex as well as expensive to produce. Now-a-days, most of the personal computers use CISC processors.

Reduced Instruction Set Computer (RISC): To execute each instruction, if there is separate electronic circuitry in the control unit, which produces all the necessary signals, this approach of the design of the control section of the processor is called RISC design. It is also called hard-wired approach. Examples of RISC processors: IBM RS6000, MC88100 processors etc. RISC processors use a small and limited number of instructions and mostly use hardwired control unit. These consume less power and are having high performance. RISC processors use simple addressing modes and RISC instruction is of uniform fixed length. Since RISC processors have a small instruction set, they place extra demand on programmers who must consider how to implement complex computations by combining simple instructions. However, RISC processors are faster, less complex and less expensive than CISC processors because of their simpler design.

Question 15

What is mobile computing? What are the three major concerns related to mobile computing?

Answer

Mobile Computing: Mobile Computing is the use of portable computing devices (such as laptop and handheld computers) in conjunction with mobile communication technologies to enable users to access the Internet and data on their home or work computers from anywhere in the world. Mobile computing is enabled by use of mobile devices (portable and hand held computing devices) such as PDA, laptops, mobile phones, MP3 players, digital cameras, tablet PC and Palmtops on a wireless network.

Major concerns relating to mobile computing are given as follows:

- Mobile computing has its fair share of security concerns as any other technology.
- Dangers of misrepresentation - Another problem plaguing mobile computing are credential verification.
- Power consumption - When a power outlet or portable generator is not available, mobile computers must rely entirely on battery power.
- Potential health hazards

Question 16

Name the various phases of System Development Life Cycle (SDLC) in the logically correct order.

Answer

The various phases of System Development Life Cycle (SDLC) are as follows:

- Phase 1: System Investigation
- Phase 2: System Analysis
- Phase 3: System Designing
- Phase 4: System Implementation
- Phase 5: System Maintenance and Review

Question 17

What is Server? Briefly explain any four types of servers based on the nature of service they provide.

Answer

Server: A server is a computer program running to serve the requests of other programs, the "clients". Servers are often dedicated, meaning that they perform no other tasks besides their server tasks. The clients either run on the same computer, or they connect through the network. Some of the different types of servers based on the nature of service they provide are as follows:

- **File server:** This is a computer and storage device dedicated to storing files. Any user on the network can store files on the server.
- **Print server:** This is a computer that manages one or more printers.
- **Network server:** This is a computer that manages network traffic.
- **Database server:** This is a computer system that processes database queries.
- **Application Server:** This is a program that handles all application operations between users and an enterprise's backend business applications or databases.
- **Web Server:** Web server has an IP address and possibly a domain name, and is the computer that delivers (serves up) web pages.
- **Mail Server:** Mail servers move and store mail over corporate networks.

Question 18

- Mention briefly the different types of application software.*
- What are the major advantages and disadvantages of DBMS?*

Answer

- (a) The different types of application software are as under:
- ◆ **Application Suite:** Has multiple applications bundled together. Related functions, features and user interfaces interact with each other. E.g. MS Office 2010 which has MS Word, MS Excel, MS Access, etc.
 - ◆ **Enterprise Software:** Addresses an enterprise's needs and data flow in a huge distributed environment. E.g. ERP Applications like SAP.
 - ◆ **Enterprise Infrastructure Software:** Provides capabilities required to support enterprise software systems. E.g. email servers, Security software.
 - ◆ **Information Worker Software:** Addresses individual needs required to manage and create information for individual projects within departments. E.g. Spreadsheets, CAAT (Computer Assisted Audit Tools) etc.
 - ◆ **Content Access Software:** Used to access contents and addresses a desire for published digital content and entertainment. E.g. Media Players, Adobe Digital etc.
 - ◆ **Educational Software:** Holds contents adopted for use by students. E.g. Examination Test CDs.
 - ◆ **Media Development Software:** Addresses individual needs to generate and print electronic media for others to consume. E.g. Desktop Publishing, Video Editing etc.
- (b) Major advantages of Database Management Systems (DBMS) are given as follows:
- ◆ **Permitting data sharing:** One of the principle advantages of a DBMS is that the same information can be made available to different users.
 - ◆ **Minimizing Data Redundancy:** In a DBMS duplication of information or redundancy is, if not eliminated, carefully controlled or reduced i.e. there is no need to repeat the same data repeatedly. Minimizing redundancy can therefore significantly reduce the cost of storing information on hard drives and other storage devices.
 - ◆ **Integrity can be maintained:** Data integrity is maintained by having accurate, consistent, and up-to-date data. Updates and changes to the data only must be made in one place in DBMS ensuring Integrity. The chances of making a mistake increase if the same data needs to be changed at several different places than making the change in one place.
 - ◆ **Program and file consistency:** Using a DBMS, file formats and programs are standardized. This makes the data files easier to maintain because the same rules and guidelines apply across all types of data. The level of consistency across files and programs also makes it easier to manage data when multiple programmers are involved.

- ◆ **User-friendly:** DBMS makes the data access and manipulation easier for the user. DBMS also reduce the reliance of users on computer experts to meet their data needs.
- ◆ **Improved security:** DBMSs allow multiple users to access the same data resources which could lead to risk to an enterprise if not controlled. Security constraints can be defined i.e. Rules can be built to give access to sensitive data. Some sources of information should be protected or secured and only viewed by select individuals. Using passwords, database management systems can be used to restrict data access to only those who should see it.
- ◆ **Achieving program/data independence:** In a DBMS data does not reside in applications but data bases program & data are independent of each other.
- ◆ **Faster application development:** In the case of deployment of DBMS, application development becomes fast. The data is already therein databases, application developer has to think of only the logic required to retrieve the data in the way a user needs.

Major disadvantages of DBMS are as under:

- ◆ **Cost:** Implementing a DBMS system can be expensive and time-consuming, especially in large enterprises. Training requirements alone can be quite costly.
- ◆ **Security:** Even with safeguards in place, it may be possible for some unauthorized users to access the database. If one gets access to database, then it could be an all or nothing proposition.

Question 19

Describe the following Recent technologies in the field of IT:

- (i) iPad
- (ii) Ultra Mobile PC (UMPC)
- (iii) I-pod

Answer

- (i) **iPad:** The iPad runs a version of iOS. iOS is designed for finger based use and has none of the tiny features which required a stylus on earlier tablets. Apple introduced responsive multi touch gestures, like moving two fingers apart to zoom in. iOS uses less power, and so gives better battery life than the Intel devices used by Windows tablets.
- (ii) **Ultra Mobile PC (UMPC):** An Ultra-Mobile PC is a small form factor version of a pen computer, a class of laptop whose specifications were launched by Microsoft and Intel in spring 2006. UMPCs are smaller than subnotebooks, have a TFT display measuring (diagonally) about 12.7 to 17.8 cm (5 to 7 inch screen), are operated like tablet PCs

using a touch screen or a stylus, and can also have a physical keyboard.

- (iii) ***iPod***: The iPod is a line of portable media players designed and marketed by Apple Inc. There are four current versions of the iPod: the ultra-compact iPod Shuffle, the compact iPod Nano, the touch screen iPod Touch, and the hard drive-based iPod Classic. Like other digital music players, iPods can serve as external data storage devices. Storage capacity varies by model, ranging from 2 GB for the iPod Shuffle to 160 GB for the iPod Classic.

Question 20

Write some Information Systems Control procedures covering the access safeguards over computer programs.

Answer

- (a) **Information Systems Control procedures covering the access safeguards over computer programs are as follows:**
- **Strategy and direction;**
 - **General Organization and Management;**
 - **Access to IT resources, including data and programs;**
 - **System development methodologies and change control;**
 - **Operation procedures;**
 - **System Programming and technical support functions;**
 - **Quality Assurance Procedures;**
 - **Physical Access Controls;**
 - **Business Continuity Planning(BCP) and Disaster Recovery Planning (DRP);**
 - **Network and Communication;**
 - **Database Administration; and**
 - **Protective and detective mechanisms against internal and external attacks.**

Exercise

1. *Discuss some of the benefits of using a Computer Network.*
2. *What are the Output devices? Discuss some of the examples of output devices.*
3. *What are the objectives of System Maintenance in SDLC?*
4. *Discuss some of the different parameters undertaken during Feasibility Study in SDLC.*
5. *Discuss some of the issues a computer network addresses to?*

6. *What are the major activities involved in the Conversion phase of System Implementation in SDLC?*
7. *Give some examples of business applications of Mobile computing?*
8. *Discuss different types of Application Software.*
9. *What are the advantages and disadvantages of the following:*
 - (a) *Application Software*
 - (b) *DBMS*