Scheme Of Evaluation
Internal Assessment Test II– March 2024

Sub:	INTERNET OF THINGS							Code:	22BETCK25
Date:	23/05/2024	Duration:	90 mins	Max Marks:	50	Sem:	II	Branch:	

Note: Answer 5 Questions

	Description	Marks Distribution		Max Marks
1	Outline the basic differences between transducers, sensors, and actuators		10	10
	• Sensors • Transducers • Actuators	4 3 3		
2	With a neat block diagram explain the functional blocks of a typical Sensor node in an IoT system		10	10
	• Block diagram • Expalnation	5 5		
3	Compare mechanical, soft, and shape memory polymer based actuators.		10	10
	• mechanical • Soft • Shape Memory	4 3 3		
4	Differentiate Structured and Unstructured data with examples.		10	10
	• Block diagram • Explanation	6 4		
5	Outline an IoT deployment (processing offloading) with the various layers of processing involving different application domains with a diagram.		10	10
	• Block diagram • Explanation	5 5		

6	With a neat diagram explain offsite processing topology.		10	10
	• Block diagram • Explanation	5 5		

<table>
<tr><th>Q.No.</th><th>Question</th><th>Marks</th></tr>
<tr><td>1</td><td>Outline the basic differences between transducers, sensors, and actuators</td><td>10</td></tr>
<tr><td>Sol</td><td>
<table>
<tr><th>Parameters</th><th>Transducers</th><th>Sensors</th><th>Actuators</th></tr>
<tr><td>Definition</td><td>Converts energy from One form to another.</td><td>Converts various forms of energy into electrical signals.</td><td>Converts electrical signals into various forms of energy, typically mechanical energy.</td></tr>
<tr><td>Domain</td><td>Can be used to represent a sensor as well as an actuator.</td><td>It is an input transducer.</td><td>It is an output transducer.</td></tr>
<tr><td>Function</td><td>Can work as a sensor or an actuator but not simultaneously.</td><td>Used for quantifying Environmental stimuli into signals.</td><td>Used for converting signals into proportional mechanical or electrical outputs.</td></tr>
<tr><td>Examples</td><td>Any sensor or actuator</td><td>Humidity sensors, Temperature sensors, Anemometers (measures flow velocity), Manometers (measures fluid pressure), Accelerometers (measures the acceleration of a body), Gas sensors (measures concentration of specific gas or gases), and others</td><td>Motors (convert electrical energy to rotary motion), Force heads (which impose a force), Pumps (which convert rotary motion of shafts into either a pressure or a fluid velocity).</td></tr>
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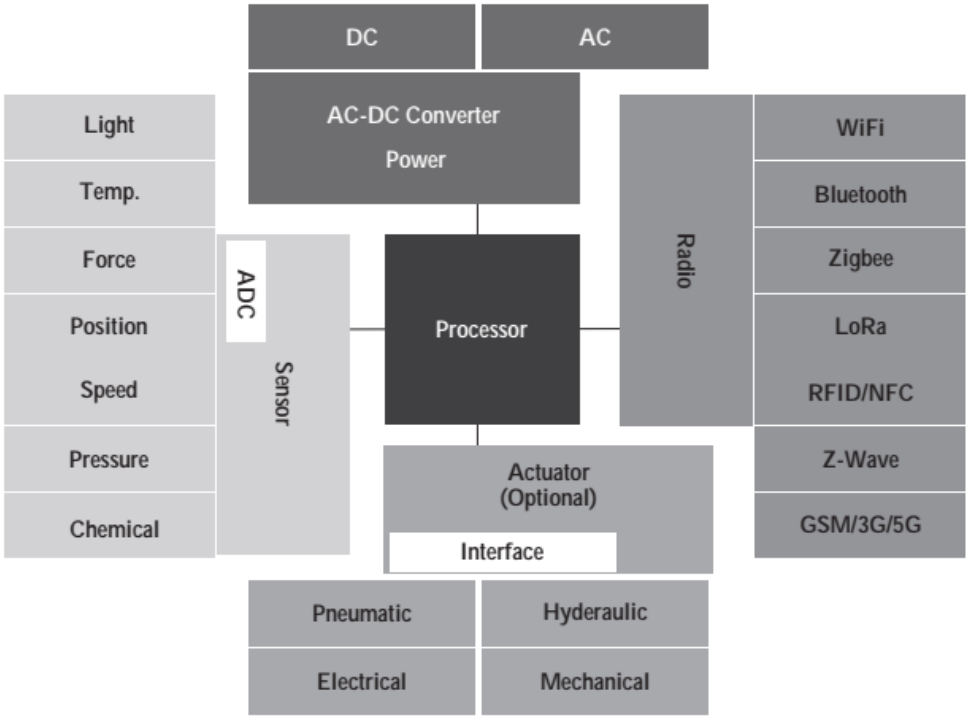
2	With a neat diagram explain the functional blocks of a typical sensor node in IoT.	10
Sol	 **Fig: The functional blocks of a typical sensor node in IoT** 1. A sensor node is made up of a combination of sensor/sensors, a processor unit, a radio unit, and a power unit. 2. The nodes are capable of sensing the environment they are set to measure and communicate the information to other sensor nodes or a remote server. Typically, a sensor node should have low-power requirements and be wireless. 3. This enables them to be deployed in a vast range of scenarios and environments without the constant need for changing their power sources or managing wires. 4. The wireless nature of sensor nodes would also allow them to be freely relocatable and deployed in large numbers without bothering about managing wires.	5 5
3	Compare mechanical, soft, and shape memory polymer based actuators.	10

Sol	**Mechanical actuators** 1. In mechanical actuation, the rotary motion of the actuator is converted into linear motion to execute some movement. 2. The use of gears, rails, pulleys, chains, and other devices are necessary for these actuators to operate. 3. These actuators can be easily used in conjunction with pneumatic, hydraulic, or electrical actuators. They can also work in a standalone mode. 4. The best example of a mechanical actuator is a rack and pinion mechanism. 5. The mechanical switches uses the mechanical motion of the switch to switch on or off an electrical circuit. **Soft actuators** 1. Soft actuators (e.g., polymer-based) consists of elastomeric polymers that are used as embedded fixtures in flexible materials such as cloth, paper, fiber, particles, and others. 2. The conversion of molecular level microscopic changes into tangible macroscopic deformations is the primary working principle of this class of actuators. 3. These actuators have a high stake in modern-day robotics. They are designed to handle fragile objects such as agricultural fruit harvesting, or performing precise operations like manipulating the internal organs during robot-assisted surgeries. **Shape memory polymers** 1. Shape memory polymers (SMP) are considered as smart materials that respond to some external stimulus by changing their shape, and then revert to their original shape once the affecting stimulus is removed. 2. Features such as high strain recovery, biocompatibility, low density, and biodegradability characterize these materials. 3. SMP-based actuators function similar to our muscles. 4. Modern-day SMPs have been designed to respond to a wide range of stimuli such as pH changes, heat differentials, light intensity, and frequency changes, magnetic changes, and others. 5. Photopolymer/light-activated polymers (LAP) are a particular type of SMP, which require light as a stimulus to operate. LAP-based actuators are characterized by their rapid response times. 6. Using only the variation of light frequency or its intensity, LAPs can be controlled remotely without any physical contact. 7. The development of LAPs whose shape can be changed by the application of a specific frequency of light have been reported. 8. The polymer retains its shape after removal of the activating light. In order to change the polymer back to its original shape, a light stimulus of a different frequency has to be applied to the polymer.	10
4	Differentiate Structured and Unstructured data with examples.	10
Sol (a)	Data Format 1. The massive volume of data generated by this huge number of users is further enhanced by the multiple devices utilized by most users. 2. This huge data volume is composed of a variety of data such as e-mails, text documents (Word docs, PDFs, and others), social media posts, videos, audio files, and images, as shown in Figure 1. These data can be broadly grouped into two types based on how they can be accessed and stored: 1) Structured data and 2) Unstructured data.	10

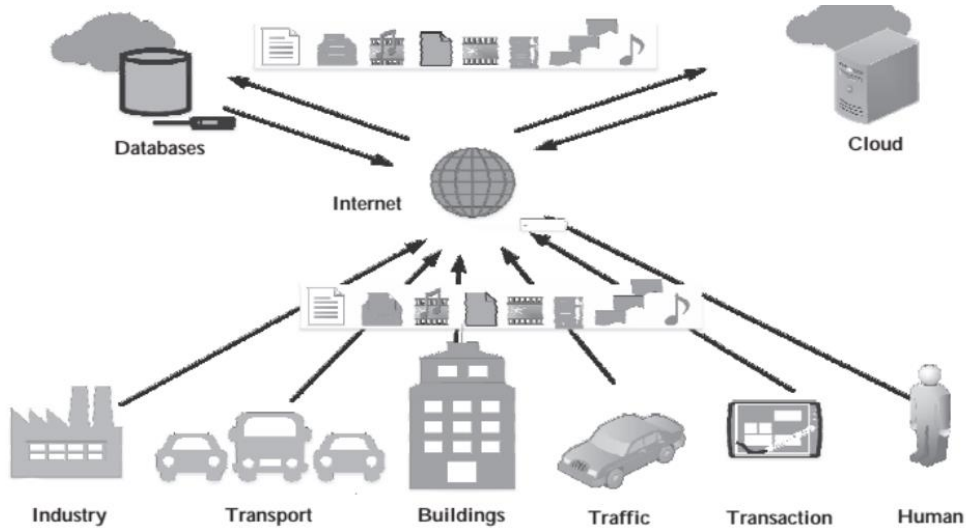
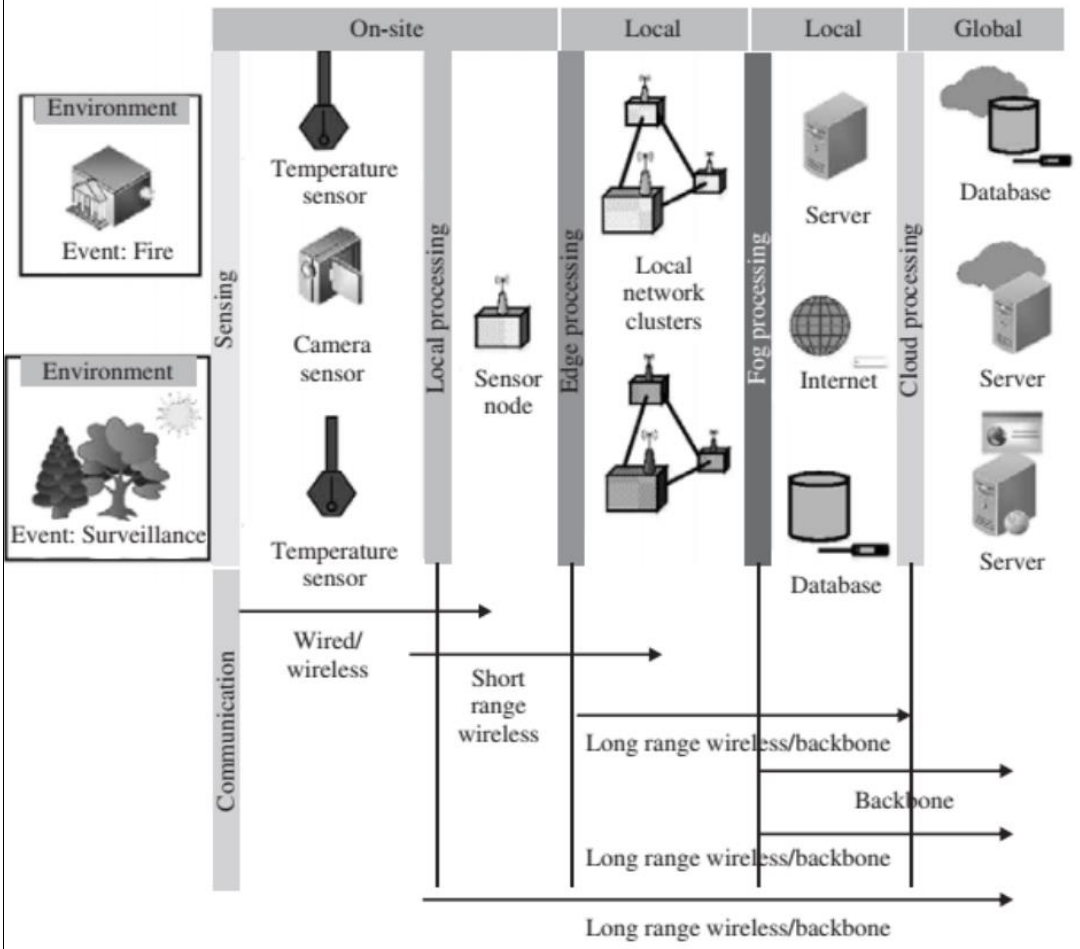


Figure 1: The various data generating and storage sources connected to the Internet and the plethora of data types contained within it

Structured data:
1. These are typically text data that have a pre-defined structure.
2. Structured data are associated with relational database management systems (RDBMS).
3. These are primarily created by using length-limited data fields such as phone numbers, social security numbers, and other such information.
4. Established languages such as Structured Query Language (SQL) are used for accessing these data in RDBMS.
5. Structured data holds a minor share of the total generated data over the Internet.
Unstructured data
1. These data types have no pre-defined structure and can vary according to applications and data-generating sources.
2. Some of the common examples of human-generated unstructured data include text, emails, videos, images, phone recordings, chats, and others.
3. Some common examples of machine-generated unstructured data include sensor data from traffic, buildings, industries, satellite imagery, surveillance videos, and others.
4. Querying languages such as NoSQL are generally used for this data type.

5	Outline an IoT deployment (processing offloading) with the various layers of processing involving different application domains with a diagram.	10

Sol


On-site
Local
Local
Global
Environment
Event: Fire
Environment
Event: Surveillance
Sensing
Temperature sensor
Camera sensor
Temperature sensor
Local processing
Sensor node
Edge processing
Local network clusters
Fog processing
Server
Internet
Database
Cloud processing
Database
Server
Server
Communication
Wired/ wireless
Short range wireless
Long range wireless/backbone
Backbone
Long range wireless/backbone
Long range wireless/backbone

	The processing offloading paradigm is important for the development of densely deployable, energy-conserving, miniaturized, and cheap IoT-based solutions for sensing tasks. Figure shows the typical outline of an IoT deployment with the various layers of processing that are encountered spanning vastly different application domains—from as near as sensing the environment to as far as cloud-based infrastructure. 1. Primary layer of sensing have multiple sensing types tasked with detecting an environment (fire, surveillance, and others). 2. For the majority of IoT applications, the bulk of the processing is carried out remotely in order to keep the on-site devices simple, small, and economical. 3. The edge layer makes use of devices within the local network to process data that which is similar to the collaborative processing topology. 4. Fog-based processing is still considered local because the fog nodes are typically localized within a geographic area and serve the IoT nodes within a much smaller coverage area as compared to the cloud. 5. The approach of forwarding data to a cloud or a remote server, requires the devices to be connected to the Internet through long-range wireless/wired networks, which eventually connect to a backbone network. 6. This approach is generally costly concerning network bandwidth, latency, as well as the complexity of the devices and the network infrastructure involved. Querying languages such as NoSQL are generally used for this data type.	

6 Sol	With a neat diagram explain offsite processing topology. Offload location The choice of offload location decides the applicability, cost, and sustainability of the IoT application and deployment. • Edge: Offloading processing to the edge implies that the data processing is facilitated to a location at or near the source of data generation itself. Offloading to the edge is done to achieve aggregation, manipulation, bandwidth reduction, and other data operations directly on an IoT device. • Fog: Fog computing is a decentralized computing infrastructure that is utilized to conserve network bandwidth, reduce latencies, restrict the amount of data unnecessarily flowing through the Internet, and enable rapid mobility support for IoT devices. The data, computing, storage and applications are shifted to a place between the data source and the cloud resulting in significantly reduced latencies and network bandwidth usage. • Remote Server: A simple remote server with good processing power may be used with IoT based applications to offload the processing from resource constrained IoT devices. Rapid scalability may be an issue with remote servers, and they may be costlier and hard to maintain in comparison to solutions such as the cloud. • Cloud: Cloud computing is a configurable computer system, which can get access to configurable resources, platforms, and high-level services through a shared pool hosted remotely and can be accessed globally. Cloud enables massive scalability of solutions as they can enable resource enhancement allocated to a user or solution in an on-demand manner, without the user having to go through the pains of acquiring and configuring new and costly hardware.	10