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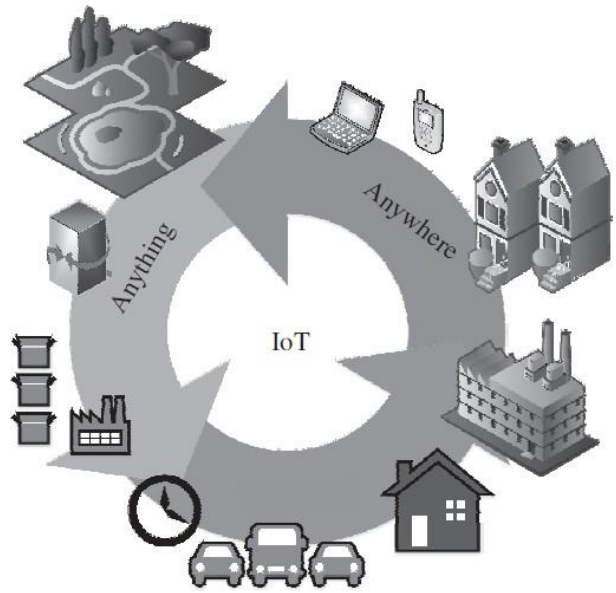
CMRIT — CMR Institute of Technology, Bengaluru

INTERNAL ASSESSMENT TEST – I

Sub:	INTERNET OF THINGS							Code:	BETCK105H
Date:	06/05/ 2025	Duration:	90 mins	Max Marks:	50	Sem:	II	Section	I-P

Answer any 5 full questions

		Marks	CO	RBT
1a	What is IoT? Explain the characteristics of IoT. The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.  IoT is an anytime, anywhere, and anything-network of Internet-connected physical devices or systems capable of sensing an environment and affecting the sensed environment intelligently. This is generally achieved using low-power and low-form-factor embedded processors on-board the "things" connected to the Internet. In other words, IoT may be considered to be made up of connecting devices, machines, and tools; these things are made up of sensors/actuators and processors, which connect to the Internet through wireless technologies.	03 [1+2]	CO1	L2
1b	Explain the factors affecting sensorial deviations. The sensorial deviations are considered as errors in sensors. ● The measurement range between a sensor's characterized minimum and maximum values is also referred to as the full scale range of that sensor. Under real conditions, the sensitivity of a sensor may differ from the value specified for that sensor leading to **sensitivity error.** This deviation is mostly attributed to sensor fabrication errors and its calibration. ● If the output of a sensor differs from the actual value to be measured by a constant, the sensor is said to have an **offset error or bias**. For example, while measuring an actual temperature of $0\,^\circ$C, a temperature sensor outputs $1.1\,^\circ$C every time. In this case, the sensor is said to have an offset error or bias of $1.1\,^\circ$C. ● If a sensor's output varies/deviates due to deviations in the sensor's previous input values, it is referred to as **hysteresis error**. ● The present output of the sensor depends on the past input values provided to the sensor.	07 Each factor 1 mark	CO1	L2

<table>
<tr><td></td><td>● Focusing on digital sensors, if the digital output of a sensor is an approximation of the measured property, it induces quantization error.
● This error can be defined as the difference between the actual analog signal and its closest digital approximation during the sampling stage of the analog to digital conversion.
● Dynamic errors caused due to mishandling of sampling frequencies can give rise to aliasing errors.Aliasing leads to different signals of varying frequencies to be represented as a single signal in case the sampling frequency is not correctly chosen, resulting in the input signal becoming a multiple of the sampling rate.</td><td></td><td></td><td></td></tr>
<tr><td>2a</td><td>Classify network types based on physical topology with examples.
1. Bus Topology
• Definition: All devices are connected to a single central cable called the bus or backbone.
• Example: Early Ethernet networks with coaxial cables.
• Advantages: Simple, low cost, requires less cable.
• Disadvantages: If the backbone fails, the entire network goes down; performance decreases as more devices are added.

2. Star Topology
• Definition: All devices are connected to a central hub or switch.
• Example: Most modern LANs using Ethernet.
• Advantages: Easy to add/remove devices; if one device fails, others remain unaffected.
• Disadvantages: If the central hub fails, the whole network fails.

3. Ring Topology
• Definition: Each device is connected to two other devices, forming a closed loop or ring.
• Example: Token Ring networks, some fiber networks.
• Advantages: Data flows in one direction, reducing collisions.
• Disadvantages: Failure of a single device or link can break the loop.

4. Mesh Topology
• Definition: Every device is connected to every other device directly.
• Example: Military networks, IoT sensor networks, some wireless networks.
• Advantages: Very reliable, high fault tolerance.
• Disadvantages: Expensive, complex to set up, lots of cabling.</td><td>05
Classifications=4 Example=1</td><td>CO1</td><td>L3</td></tr>
<tr><td>2b</td><td>Define sensor and explain characteristics of sensor.
A sensor is a device that detects or measures a physical quantity (such as temperature, pressure, light, motion, or humidity) and converts it into an electrical signal or readable output that can be processed, displayed, or transmitted.
• Accuracy: error between the result of a measurement and the true value being measured.
• Resolution: the smallest increment of measure that a device can make.
• Sensitivity: the ratio between the change in the output signal to a small change in input physical signal. Slope of the input-output fit line.
• Repeatability/Precision: the ability of the sensor to output the same value for the same input over a number of trials</td><td>05
[1+4]</td><td>CO1</td><td>L3</td></tr>
<tr><td>3</td><td>With a neat diagram, explain the, network communication between two hosts following the OSI model.
The ISO-OSI model is a conceptual framework that partitions any networked communication device into seven layers of abstraction, each performing distinct tasks based on the underlying technology and internal structure of the hosts. These seven layers, from bottom-up, are as follows:
1) Physical layer,
2) Data link layer,
3) Network layer,
4) Transport layer,
5) Session layer,</td><td>10
Fig=4
Explanation=6</td><td>CO1</td><td>L2</td></tr>
</table>

6) Presentation layer, and
7) Application layer

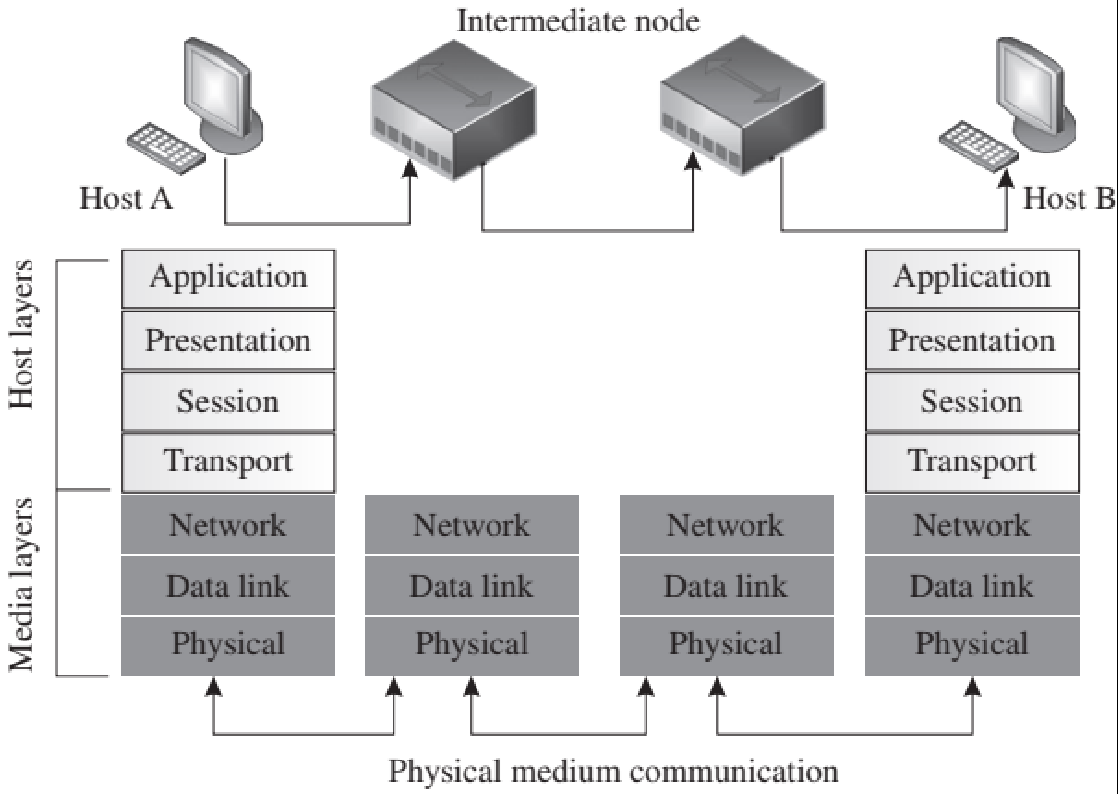


Fig 7: Networked communication between two hosts following the OSI model

(i) Physical Layer: This is a media layer and is also referred to as layer 1 of the OSI model. The physical layer is responsible for taking care of the electrical and mechanical operations of the host at the actual physical level. This layer is responsible for the topological layout of the network (star, mesh, bus, or ring), communication mode (simplex, duplex, full duplex), and bit rate control operations. The protocol data unit associated with this layer is referred to as a symbol.

(ii) Data Link Layer: This is a media layer and layer 2 of the OSI model. The data link layer is mainly concerned with the establishment and termination of the connection between two hosts, and the detection and correction of errors during communication between two or more connected hosts. IEEE 802 divides the OSI layer 2 further into two sub-layers, Medium access control (MAC) and logical link control (LLC). MAC is responsible for access control and permissions for connecting networked devices; whereas LLC is mainly tasked with error checking, flow control, and frame synchronization. The protocol data unit associated with this layer is referred to as a frame.

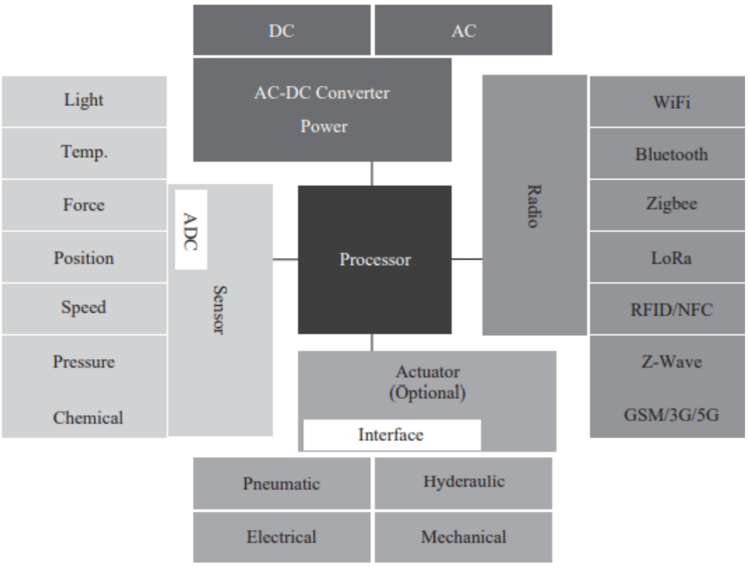
(iii) Network Layer: This layer is a media layer and layer 3 of the OSI model. It provides a means of routing data to various hosts connected to different networks through logical paths called virtual circuits. These logical paths may pass through other intermediate hosts (nodes) before reaching the actual destination host. The primary tasks of this layer include addressing, sequencing of packets, congestion control, error handling, and Internetworking. The protocol data unit associated with this layer is referred to as a packet.

(iv) Transport Layer: This is layer 4 of the OSI model and is a host layer. The transport layer is tasked with end-to-end error recovery and flow control to achieve a transparent transfer of data between hosts. This layer is responsible for keeping track of acknowledgments during variable-length data transfer between hosts. In case of loss of data, or when no acknowledgment is received, the transport layer ensures that the particular erroneous data segment is re-sent to the receiving host. The protocol data unit associated with this layer is referred to as a segment or datagram.

(v) Session Layer: This is the OSI model's layer 5 and is a host layer. It is responsible for establishing, controlling, and terminating of communication between networked hosts. The session layer sees full utilization during operations such as remote procedure calls and remote sessions. The protocol data unit associated with this layer is referred to as data.

<table>
<tr><td></td><td>(vi) Presentation Layer: This layer is a host layer and layer 6 of the OSI model. It is mainly responsible for data format conversions and encryption tasks such that the syntactic compatibility of the data is maintained across the network, for which it is also referred to as the syntax layer. The protocol data unit associated with this layer is referred to as data.
(vii) Application Layer: This is layer 6 of the OSI model and is a host layer. It is directly accessible by an end-user through software APIs (application program interfaces) and terminals. Applications such as file transfers, FTP (file transfer protocol), e-mails, and other such operations are initiated from this layer. The application layer deals with user authentication, identification of communication hosts, quality of service, and privacy. The protocol data unit associated with this layer is referred to as data.</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>

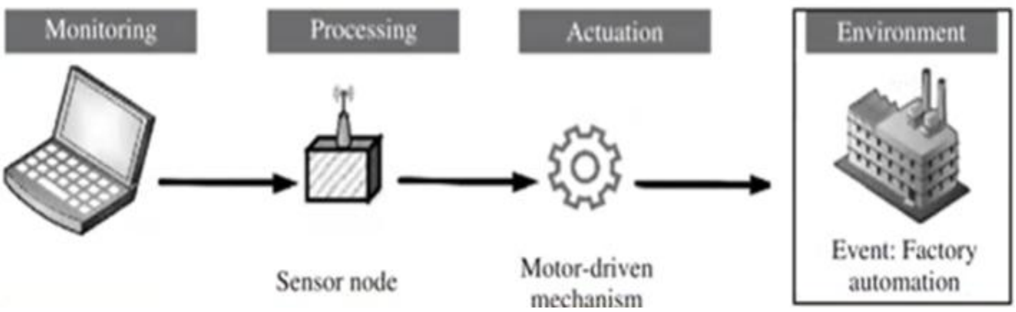
With a neat diagram, explain the functional blocks of a typical sensor node in IoT.



A) Sensor/Actuator block: serves as the data entry point in an IoT system.
B) Connectivity Block: sends the data collected by the sensor/actuator block to the remainder of the system.
C) Data Processing Block: examines and processes the obtained data.
D) Application Block: provides an interface for controlling and monitoring various terms.
Security Block: secures the IoT system using authentication and different functions

</td><td>10
Diagram=5
Explanation=5
[5+5]</td><td>CO2</td><td>L2</td></tr>
<tr><td>5</td><td>

What is an Actuator. With a neat diagram, explain working mechanism of actuator.
An actuator is a device that receives a control signal (usually electrical) and converts it into a physical action such as movement, force, displacement, or mechanical motion.



- An actuator can be considered as a machine or system’s component that can affect the movement or control the said mechanism or the system.
- Control systems affect changes to the environment or property they are controlling through actuators.
- The system activates the actuator through a control signal, which may be digital or analog.

</td><td>10
[2+8]</td><td>CO2</td><td>L3</td></tr>
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It elicits a response from the actuator, which is in the form of some form of mechanical motion.

- The control system of an actuator can be a mechanical or electronic system, a software-based system (e.g., an autonomous car control system), a human, or any other input. Figure 5 shows the outline of a simple actuation system.
- A remote user sends commands to a processor. The processor instructs a motor controlled robotic arm to perform the commanded tasks accordingly.
- The processor is primarily responsible for converting the human commands into sequential machine-language command sequences, which enables the robot to move. The robotic arm finally moves the designated boxes, which was its assigned task.

6a	Differentiate between IoT and M2M.	05	CO2	L3

Point	IoT (Internet of Things)	M2M (Machine-to-Machine)
Definition	A network of interconnected devices that collect, share, and analyze data over the Internet.	Direct communication between machines or devices without human intervention.
Scope	Broader, includes people, processes, cloud, analytics, and devices.	Narrower, focuses only on device-to-device communication.
Network type	Uses Internet, cloud services, and IP-based networks.	Often uses point-to-point communication over cellular, wired, or wireless networks.
Data handling	Includes data collection, cloud storage, big data analytics, AI.	Mainly real-time device communication with minimal data analysis.
Examples	Smart home, smart cities, industrial IoT, wearable devices.	ATM machines, fleet tracking, remote meter reading.

6b	Outline the difference between Transducer, Sensor and an Actuator	05	CO2	L2

Table 1: Basic outline of the differences between transducers, sensors, and actuators

Parameters	Transducers	Sensors	Actuators
Definition	Converts energy from one form to another.	Converts various forms of energy into electrical signals.	Converts electrical signals into various forms of energy, typically mechanical energy.
Domain	Can be used to represent a sensor as well as an actuator.	It is an input transducer.	It is an output transducer.
Function	Can work as a sensor or an actuator but not simultaneously.	Used for quantifying environmental stimuli into signals.	Used for converting signals into proportional mechanical or electrical outputs.
Examples	Any sensor or actuator	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	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).

7	Classify Sensor based upon (i) Power requirements (ii) Sensor output (iii) Power to be measured. **(i) Based on Power Requirements** 1. **Active Sensors** o Require external power supply to operate. o They generate output signal only when energized. o **Examples:** Thermocouples, photoconductive cells, strain gauges. 2. **Passive Sensors** o Do not require external power; they generate output signal by extracting energy from the measured quantity itself. o **Examples:** Piezoelectric sensors, thermocouples, photovoltaic cells. **(ii) Based on Sensor Output** 1. **Analog Sensors** o Provide continuous output signals (voltage, current, resistance) proportional to the measured quantity. o **Examples:** Thermistor (temperature), LVDT (displacement), RTD. 2. **Digital Sensors** o Provide discrete (on/off) or digital output, often in binary form. o **Examples:** Proximity switch, encoder, digital temperature sensor. **(iii) Based on Power to be Measured** 1. **Mechanical Sensors** o Measure mechanical quantities like displacement, force, pressure, speed. o **Examples:** Strain gauge, load cell, accelerometer. 2. **Thermal Sensors** o Measure heat or temperature. o **Examples:** Thermocouple, thermistor, RTD. 3. **Magnetic Sensors** o Measure magnetic fields, flux, or related quantities. o **Examples:** Hall effect sensor, magnetoresistive sensor. 4. **Optical Sensors** o Measure light intensity or properties of light. o **Examples:** Photodiode, phototransistor, LDR. 5. **Chemical Sensors** o Measure chemical properties or composition. o **Examples:** pH sensor, gas sensor, humidity sensor.	10 [3+3+4]	CO3	L2

CI **CCI** **HoD**