VALLUVAR COLLEGE OF SCIENCE AND MANAGEMENT

DEPARTMENT OF COMPUTER SCIENCE

WIRELESS SENSOR NETWORKS

Unit 1 **Class:II-M.Sc.,(CS)**

Two marks:

1.Definition of wireless sensor networks?

Wireless sensor network refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location.

2. How does wireless sensor network work?

Sensor node is attached with sensors which sense and receives the required information. In addition to one or more sensors, each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device or antenna which is used to communicate with other neighbor nodes.

3. What are the components of wireless sensor networks?

Structure of a wireless sensor node. A sensor node is made up of four basic components such as

- sensing unit,
- processing unit,
- transceiver unit
- Power unit .

4. Wireless Sensor Network Applications?

Sensor nodes are used for constant sensing, event ID, event detection & local control of actuators.

The applications of wireless sensor network mainly include health, military, environmental, home, & other commercial areas.

5. Why we use wireless sensor networks

Wireless Sensor Networks and their Applications. In recent years an efficient design of a Wireless Sensor Network has become a leading area of research. A Sensor is a device that

responds and detects some type of input from both the physical or environmental conditions, such as pressure, heat, light, etc.

6. What are the types of wireless sensor networks?

Based on the parameters like computation rate, processing speed, storage, and communication range, sensor nodes are identified and selected for WSN formation [9]. Based on the node properties the sensor networks are classified into two types, homogenous sensor networks and heterogeneous sensor networks.

7. What are the challenges of wireless sensor networks?

Challenges in this type of WSN include deployment, localization, self- organization, navigation and control, coverage, energy, maintenance, and data process. environment, it is not uncommon for the sensor nodes to become faulty and unreliable .

8. What are the uses of sensor?

In the broadest definition, a sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics.

9. What are the characteristic requirements of wireless sensor network?

A wireless sensor network consists of many different components of which a sensor node is an important yet small part. The characteristics of a good wireless sensor network include power efficiency, scalability, responsiveness, reliability and mobility.

10. Sensing unit definition?

A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena.

11.What is event detection?

Wireless sensor networks are a spatially distributed network of autonomous sensors used for monitoring an environment. Energy cost is a major limitation for WSN requiring the need for energy efficient networks and processing.

12. **what is multihop communication?**

Multi-hop routing (or multihop routing) is a type of communication in radio networks in which network coverage area is larger than radio range of single nodes. Therefore, to reach some destination a node can use other nodes as relays. ... Wireless sensor networks.

13.What is data centric?

Data centric refers to an architecture where data is the primary and permanent asset, and applications come and go. In the data centric architecture, the data model precedes the implementation of any given application and will be around and valid long after it is gone.

14.What is sensor?

A sensor is a device that detects and responds to some type of input from the physical environment. ... An oxygen sensor in a car's emission control system detects the gasoline/oxygen ratio, usually through a chemical reaction that generates a voltage.

15.What is energy scavenging?

Energy harvesting (also known as power harvesting or energy scavenging or ambient power) is the process by which energy is derived from external sources (e.g., solar power, thermal energy, wind energy, salinity gradients, and kinetic energy, also known as ambient energy), captured, and stored for small,.

16.What is quality of service?

Quality of service is the description or measurement of the overall performance of a service, such as telephony or computer network or a cloud computing service, particularly the performance seen by the users of the network.

17. State deployment options.

The main function of WSN is to process extracted data and to transmit it to remote locations. A large number of sensor nodes are deployed in the monitoring area. Therefore, deploying the minimum number of nodes that maintain full coverage and connectivity is of immense importance for research.

18. What is processing unit?

A central processing unit, also called a central processor or main processor, is the electronic circuitry within a computer that executes instructions that make up a computer program. The CPU performs basic arithmetic, logic, controlling, and input/output operations specified by the instructions.

19. Types of WSNs.

- Terrestrial WSNs.
- Underground WSNs.
- Underwater WSNs.
- Multimedia WSNs.
- Mobile WSNs

20. What is active sensor?

An active sensor is a sensing device that requires an external source of power to operate; active sensors contrast with passive sensors, which simply detect and respond to some type of input from the physical environment.

Five Marks:

1.Explain the Various Challenges of WSN.

2.Discuss About Any four application in WSN.

3.Compare the MANET and WSN.

4.Discuss about the Components of WSN.

5.Discuss the Characteristic requirements of WSN.

6.Discuss about the enabling technologies to bulid up WSN.

7. Explain the innovative mechanism to relize the Characteristics requirement of WSN

8. Explain the Energy scavenging in WSN.

9. Describe the required Mechanisms.

10.Explain the Wireless Sensor Networks.

Ten Marks:

1.Overview of wireless sensor networks.

2.Discuss the potential applications of WSN

3.Explain about energy consumption of sensor nodes in detail

4. Describe about optimization goals of a WSN and figures of merit in detail.

Unit II

Two Marks:

1. What is sensor node?

A sensor node, also known as a mote, is a node in a sensor network that is capable of performing some processing, gathering sensory information and communicating with other connected nodes in the network. A mote is a node but a node is not always a mote.

2. What is controller and memory?

Controller: A controller to process all the relevant data ,capable of executing arbitrary code.
Memory:some memory to store programs and intermeadiate data ,usually,different types of memory are used for programs and data.

3. What is sensors a?

Sensor : In the broadest definition, a sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics.

4. What is Actuators?

Actuators allow a WSN node to influence its environment, providing a feedback channel through which its decisions can be enacted. Learn more in: Pervasive Wireless Sensor Networks. It is something, typically a mechanism, which converts energy to motion.

5. What is communication?

Wireless sensor networks (WSNs) are interconnected sensor nodes that communicate wirelessly to collect data about the surrounding environment. Nodes are generally low power and distributed in an ad hoc, decentralized fashion.

6. What is communication device?

A Wireless Sensor Network (WSN) is a distributed network and it comprises a large number of distributed, self-directed, tiny, low powered devices called sensor nodes alias motes [1]. ... Motes communicate with each other using transceivers.

7. What is transceiver?

The main component in any WSN network is WSN Transceiver. The Transceiver is the name given to the device which houses both RF transmitter and RF receiver.

8. What is energy consumption of sensor nodes ?

Wireless Sensor Networks (WSN) consist of low power devices that are distributed in geographically isolated areas. The energy consumption is an important concern for WSN. We propose an enhancement approach to reduce the energy consumption and extend the network lifetime.

9. What is radio transceiver?

The communication unit has both a transmitter and a receiver for establish- ing wireless communication between sensor nodes. The communication unit which combines both transmitting and receiving tasks are called transceiver.The Radio Fre- quency (RF) based wireless communication suits to most of WSN applications.

10. What is concurrent programming?

Wireless Sensor Network (WSN) systems are inherently concurrent. Support for concurrency is needed in all layers of the WSN software stack. At the application level, programs may define both node-level (e.g., collect data) and group level activities (e.g., aggregate data), each occurring concurrently.

11.What is dynamic energy?

A wireless sensor node is typically battery operated and energy constrained. ... In order to conserve energy and prolong the lifetime of WSN, we design and carry out a dynamic energy management strategy for sensors. The basic idea is to shut down all sensors' power when not needed and wake them up when necessary.

12.What is power management?

In WSN sensor nodes, have limited energy budget so this paper mainly focus on harvesting of energy and power saving. Power management schema use energy harvesting schemes on different nodes by sleep/awake method. Energy efficient algorithms increase efficiency of power and life time of battery.

13. What is sink?

The sink is the common destination of all data collected by nodes in the network in case of convergecast data profile. The sink can be a gateway between the WSN and other king of networks.

14. What is single hop?

When packet travels from source to destination using single networking device, it is known as single hop system. • When packet travels from source to destination using more than one networking devices, it is known as multi hop system.

15. What is multihop?

Multi-hop routing (or multihop routing) is a type of communication in radio networks in which network coverage area is larger than radio range of single nodes. Therefore, to reach some destination a node can use other nodes as relays.

16. What is multiple sink?

The wireless sensor network consists of small limited energy sensors which are connected to one or more sinks. Multiple sink WSN has an edge over the single sink WSN where very less energy is utilized in sending the data to the sink, as the number of hops is reduced.

17. Three types of mobility.

- Node mobility
- Sink mobility
- Event mobility

18. What is optimization?

The wireless sensor network consists of small limited energy sensors which are connected to one or more sinks. ... Multiple sink WSN has an edge over the single sink WSN where very less energy is utilized in sending the data to the sink, as the number of hops is reduced.

19. What is a figure of merit?

A figure of merit is a quantity used to characterize the performance of a device, system or method, relative to its alternatives.

20. What is energy efficiency?

Analysis of Energy Efficient Wireless Sensor Networks Routing Schemes. Abstract: Wireless Sensor Network (WSN) is one of the fastest growing technologies in wireless domain. ... So, efficient power saving schemes must be designed and developed to optimize energy consumption and thereby improve overall network lifetime.

21. What is scalability?

Scalability is that increase in the number of nodes after the WSN was established. Whether or not the WSN support the expansion is a very important factor in the design of the protocol. The routing protocols consider the sensor node characteristics in the design of the protocols.

22. what is robustness?

Abstract: Robustness in wireless sensor networks (WSNs) is a critical factor that largely depends on their network topology and on how devices can react to disruptions, including node and link failures.

23. What are design principles for WSNs?

Abstract Control applications over wireless sensor networks (WSNs) require timely, reliable and energy efficient communications. ... The approach suggests a joint optimization, or co-design, of the control specifications, networking layer, the medium access control layer, and physical layer.

24. What is self organization?

ABSTRACT. In an effort to better guide research into self-configuring wireless sensor networks, we discuss a technical definition of the term self-organization. We define a self-organizing system as one where a collection of units coordinate with each other to form a system that adapts to achieve a goal more efficiently.

25. what is Aggregation?

In WSNs, data aggregation is a process of collecting and combining the useful information in a particular region of interest. The effectiveness of the communication among nodes depends on the data aggregation technique being used.

26. What are gateway concepts?

A gateway is a network node used in telecommunications that connects two networks with different transmission protocols together. ... In most IP-based networks, the only traffic that does not go through at least one gateway is traffic flowing among nodes on the same local area network (LAN) segment.

27. What is tunneling?

Tunneling is a protocol that allows for the secure movement of data from one network to another. Tunneling involves allowing private network communications to be sent across a public network, such as the Internet, through a process called encapsulation.

Five marks:

1. Explain the sensor node hardware overview.

2.Discuss about the sensors and Actuators.

3.Define the types of sensors and examples..

4.Elaborate on the energy scavenging techniques for sensor nodes.

5.Dynamic energy and Power management.

6.TinyOS and nesCs.

7.Explain Transceivers Operational States.

8.Some Examples of Sensor Nodes.

9.Types of Mobility.

10.Discuss about the Energy efficiency.

Ten marks:

1.Discuss in detail the Transceiver characteristics and structure

2. Discuss about the energy consumption of the different components of a sensor node.
3. Discuss in detail the design principles for WSN
4.Explain about energy consumption of sensor nodes in detail

5. Describe about optimization goals of a WSN and figures of merit in detail.

Unit III

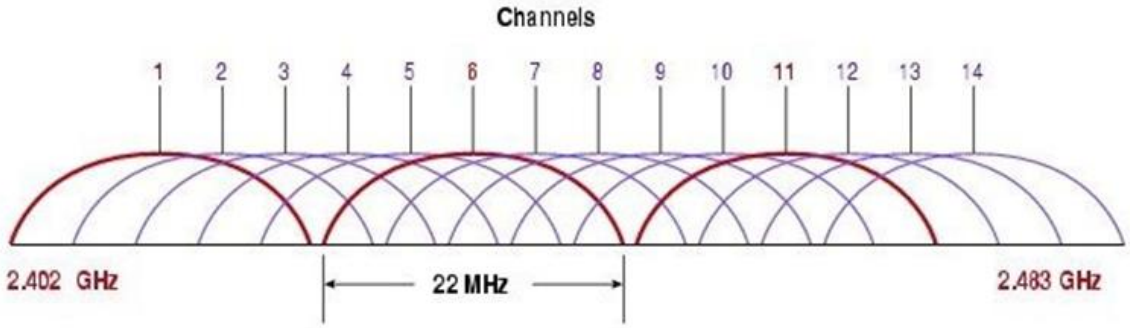
Two marks:

1.what is physical layer?

The physical (PHY) layer is responsible for the conversion of bit streams into signals that are best suited for communication across the wireless channel. ... The main types of technologies used for RF communication in WSNs can be classified into three as narrow-band, spread-spectrum, and ultra-wide-band (UWB) techniques.

2. What is wireless channel?

A WiFi channel is the medium through which our wireless networks can send and receive data. For routers made in the U.S., the 2.4 GHz band has 11 channels and the 5 GHz band has 45 channels.



3. What is wireless communication?

Wireless communication is the transfer of information or power between two or more points that are not connected by an electrical conductor. The most common wireless technologies use radio waves. The term wireless has been used twice in communications history, with slightly different meaning.

4. What is frequency allocation?

Frequency allocation is the allocation and regulation of the electromagnetic spectrum into radio frequency bands, which is normally done by governments in most countries.

5. What is dynamic modulation scaling?

Dynamic modulation scaling (DMS) is a technique useful for optimizing transmission energy with respect to number of packets that need to be transmitted at that particular time intervals. In general, DMS trades off transmission energy against transmission delays.

6. What is MAC protocol?

Medium Access Control (MAC) is an important technique that ensures the successful operation of WSN because it controls the radio's activity of sensor nodes, which consumes node's major energy. MAC protocols must be energy efficient in wireless sensor networks.

7. List the factors that are essential for PHY design in WSN.

The design complexity of a WSN depends on the specific application requirements such as

- The number of nodes,
- The power consumption,
- The life span of the sensors,
- The information to be sensed and its timing,
- The geography of where the sensors are placed,
- The environment,
- The context.

8. What is geographic addressing?

It is mainly proposed for wireless networks and based on the idea that the source sends a message to the geographic location of the destination instead of using the network address. In the area of packet radio networks, the idea of using position information for routing was first proposed in the 1980.

9. What are nested query?

A Subquery or Inner query or a Nested query is a query within another SQL query and embedded within the WHERE clause. A subquery can have only one column in the SELECT clause, unless multiple columns are in the main query for the subquery to compare its selected columns.

10.list out the key ingredients of ARQ protocols.

The basic elements of ARQ are:

- Error-detecting code with high error coverage.
- ACKs (positive acknowledgments)
- NAKs (negative acknowledgments)
- Timeout mechanism.

11.Define DVS

Building energy-efficient systems is one of the principal challenges in wireless sensor networks. Dynamic voltage scaling (DVS), a technique to reduce energy consumption by varying the CPU frequency on the fly, has been widely used in other settings to accomplish this goal.

12. Difference between contention based protocol and schedule based protocol.

Contention-based protocols provide a contention- based bandwidth allocation for sensor nodes and are widely discussed in urban applications.

Schedule-based, also known as contention-free, protocols require at least one central node time-synchronized or asynchronized networks.

13. State the fundamental tasks of address management in WSN`
Tasks of management that means function of management are planning,organising,staffing,controlling,directing,Reporting and budgeting.

14. Differentiate WSN routing with ad hoc routing.
Number of Nodes: WSN can handle more network nodes than Ad Hoc. Communication Traffic: WSN communication traffic flows on the direction of the computation center trough one or more sink nodes, while in ad Hoc network the communication can be established between any two or more nodes without any central control.
15. what is energy efficient routing?
Energy Efficient Flat Routing. Flat routing protocols are those protocols that keep the same criteria for all the nodes in a network, i.e., either source nodes or nodes forwarding the user data. The routing protocols in this category provide a route for each sensor node towards the sink.
16. what is geographic routing?
Geographic routing is a routing principle that relies on geographic position information. It is mainly proposed for wireless networks and based on the idea that the source sends a message to the geographic location of the destination instead of using the network address.

17. Define Assignment of MAC address.

A media access control address (MAC address) is a unique identifier assigned to a network interface controller (NIC) for use as a network address in communications within a network segment. ... The address typically includes a manufacturer's organizationally unique identifier (OUI)

18. What is gateway?

A gateway is a network node used in telecommunications that connects two networks with different transmission protocols together. In most IP-based networks, the only traffic that does not go through at least one gateway is traffic flowing among nodes on the same local area network (LAN) segment.

19. What is a Routing protocol?
Routing Protocols in WSN in a Proactive, Proactive, Reactive and Hybrid Protocol the nodes switch on their sensors and transmitters, sense the environment and transmit the data to a BS through the predefined route. The Low Energy Adaptive Clustering hierarchy protocol (LEACH) utilizes this type of protocol.
20. What are wakeup radio concepts?
Wake-up radio is promising approaches to mitigate the problem of idle listening, which incurs additional power consumption for the Internet of Things (IoT) wireless transmission.
Five marks:

1.Discuss about Modulation and Demodulation in Physical Layers

2. Explain the Channel models.

3.Write about the Structure of OS and Protocol stack in WSN

4. Explain the concepts of Mediation Device protocol.

5.Elaborate on the requirements of MAC protocols for WSN.

6.Discuss about the PHMAS protocol in detail.

7.Explain the important classes of MAC protocols.

8.Explain the conceptof TRAMA protocol

9.Discuss about the content –based addressing in detail.

10.Explain geographical forwarding .

Ten Marks:

1.Describe in detail about SMACS.
2.Explain data centric routing protocols.
3.Discuss the basics of Position Based Routing Protocol for WSN.

Unit IV

Two marks:

1. what is localization?

Localization is extensively used in Wireless Sensor Networks (WSNs) to identify the current location of the sensor nodes. A WSN consist of thousands of nodes that make the installation of GPS on each sensor node expensive and moreover GPS will not provide exact localization results in an indoor environment.

2. Advantage of localization?

*Low cost,
* High accuracy,
*low power consumption of nodes
*complete coverage are the benefits of this approach
* Long term in localization is the disadvantage of this method.

3. What is topology?

The characteristic of this is to divide WSN into network based on Topologies i.e. Bus, Tree, Star, Ring, Mesh, Circular, Grid. ... Sensor networks spatially distributed autonomous sensors to monitor physical and environmental conditions at different locations, such as temperature, pressure, motion sound, vibration etc.

4. Discuss the parameters defined by the homogeneous topology control for WSN.

Topology construction and maintenance However, the administrator has control over some parameters of the network: transmission power of the nodes, state of the nodes (active or sleeping), and role of the nodes. etc. By modifying these parameters, the topology of the network can change.

5. What is clustering?

Clustering is one of the important methods for extend the network lifetime in wireless sensor networks (WSNs). It involves grouping of sensor nodes into clusters and electing cluster heads (CHs) for all the clusters.

6. List various services offered by localization.

Currently, WSN (Wireless Sensor Network) is the most standard services employed in commercial and industrial applications, because of its technical development in a processor, communication, and low-power usage of embedded computing devices.

7. Why is topology control necessary for WSN?

The main component of WSN is battery-powered sensor nodes having low-cost and power. ... Therefore it is important to form, the efficient topology which ensures neighbors at a minimum distance, reduces message being lost between sensors, reduces the interference, thus reducing the waiting time for sensors to transmit data.

8. What are advantages of clustering?

Various advantages of cluster-based WSN are

- energy efficiency,
- better network communication,
- efficient topology management,
- minimized delay,
- Consequently,

Clustering has become a key research area in WSN.

9. What is positioning?

WSN node positioning refers to when the position of the unknown target node is calculated based on the communication between the anchor nodes whose position information is known in the network by specific techniques, algorithms, and schemes.

10. What is time synchronization?

Time synchronization is helpful in saving energy in WSN because it provides the possibility to set nodes into the sleeping mode. In wireless sensor networks all of above applications need that all sensor nodes have a common time reference.

11. What are task driven in sensor nodes?

In WSN, the main task of a sensor node is to sense data and sends it to the base station in multi hop environment for which routing path is essential. For computing the routing path from the source node to the base station there is huge numbers of proposed routing protocols exist .

12. What is information based tasking?

Information-based sensor tasking wireless body area networks in U-Health systems. Conference Wireless sensor networks (WSNs) usually operate in wide.

13. What is sensor tasking?

In WSN, the main task of a sensor node is to sense data and sends it to the base station in multi hop environment for which routing path is essential. ... A second class of routing protocols imposes a structure on the network to achieve energy efficiency, stability, and scalability.

14what is sensor control?

WSNs are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity.

15. What is synchronization?

Time Synchronization in wireless networks is extremely important for basic communication, but it also provides the ability to detect movement, location, and proximity. The synchronization problem consists of four parts: send time, access time, propagation time, and receive time.

16. What is synchronization communication?

Synchronization is the coordination of events to operate a system in unison. The conductor of an orchestra keeps the orchestra synchronized or in time. Systems that operate with all parts in synchrony are said to be synchronous or in sync—and those that are not are asynchronous.

17. What is network localization?

In these schemes network nodes measure the distances to their neighbors and then try to determine their locations. The process of computing the locations of the nodes is called network localization.

Five Marks:

1.Discuss about details any two localization and positioning algorithms.

2.Explain the two time synchronization in WSN.

3.what are task driven in sensor nodes and explain.

4. What is the information based tasking and explain utility measures.

Ten marks:

1. Discuss on Angle of Arrival (AOA) and Time Difference of Arrival (TDOA) based tracking mechanisms .
2. Explain the concept of localization and positioning in detail.
3. Explain any two time synchronization algorithms of WSN

Unit V

Two marks:

1. What is sensor node hardware?

A basic sensor node platform consists of a CPU, a radio and a power supply. For the last 10 years a number of research institutions and companies have been designing and producing nodes with these three components as a minimum.

2. What is TinyOS?

TinyOS is an embedded, component-based operating system and platform for low-power wireless devices, such as those used in wireless sensor networks (WSNs), smartdust, ubiquitous computing, personal area networks, building automation, and smart meters.

3. Where is it used TinyOS?

TinyOS is an embedded, component-based operating system and platform for low-power wireless devices, such as those used in wireless sensor networks (WSNs), smartdust, ubiquitous computing, personal area networks, building automation, and smart meters. ... TinyOS has been used in space,

4. Classify the sensor node hardware.

As wireless sensor nodes are typically very small electronic devices, they can only be equipped with a limited power source of less than 0.5-2 ampere-hour and 1.2-3.7 volts. Sensors are classified into three categories: passive, omnidirectional sensors; passive, narrow-beam sensors; and active sensors.

5. Define Berkley notes.

Berkeley also argues against abstractionism in Alciphron and A Defense of Free-thinking in Mathematics (Berkeley 1948-1957, 3: 292-293, 331-335, 4: 134-5). ... Such an argument could only play a supporting role in the attack on materialism.

6. What do you mean by node level simulation?

In order for designers to focus on the application-level code, a node model typically provides or simulates a communication protocol stack, sensor behaviors (e.g., sensing noise), and operating system services. If the nodes are mobile, then the positions and motion properties of the nodes need to be modeled.

7. What is a challenge for sensor network platform?

Multi-media sensor nodes are typically deployed in a pre- planned manner into the environment to guarantee coverage. Challenges in such WSN include high bandwidth demand, high energy consumption, quality of service (QoS) provisioning, data processing and compressing techniques, and cross-layer design.

8. What are the different platforms available for sensor networks?

Examples from this category are Tmote from Moteiv, Mica2, MicaZ (Mica family), and Imote2 from Crossbow. These platforms integrate micro electromechanical systems (MEMS) sensors, microcontroller, and wireless transceiver technologies on one chip, an application-specific integrated circuit (ASIC).

9.what is node level software platform?

A node-level platform can be a node-centric operating system, which provides hardware and networking abstractions of a sensor node to programmers, or it can be a language platform, which provides a library of components to programmers.

10. What is a node level simulator?

In node-level simulators, a component can be a sensor node, and the events can be communication packets; or a component can be software module within and the events can be message passings among these nodes.

11. What is centric programming?

Example-centric programming is an approach to software development that helps the user to create software by locating and modifying small examples into a larger whole.

12. List the major concern sensor node hardware

Wireless Issues and challenges related to Wireless Sensor Networks. Terrestrial WSN in terms of equipment, deployment, and maintenance. The major issues that affect the design and performance of a wireless sensor network are as follows

13. What is THNYGALS?

TinyGALS is a structured globally asynchronous and locally asynchronous programming model for event driven embedded systems. Software components are composed locally and through synchronous method calls to form modules, and asynchronous message passing is used between modules to separate the flow control.

Five Marks:

1. Explain clearly about Berkeley Motes.

2. Explain about PIECES.

3. Explain about TINYGALS

4. Explain the challenges for sensor network platforms.

5. Explain in detail the programming challenges.

6. Explain the state centric programming.

Ten marks:

1.Write detailed notes on any one node-level software platforms.

2. Explain clearly about Berkely Motes. Mention the advantages and disadvantages of it.

3. What are the different types of platforms available for sensor networks and explain any one in details