

ID Number: _____

Name: _____

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI, PILANI CAMPUS

First Semester 2023-24, Comprehensive exam (Closed Book),

EEE F411: Internet of Things (Part A).

Duration (tentative, Part A): 2 hours

Date of exam: 13/12/2023

Max. Marks: 45

Instructions: Part A is built in. Kindly answer crisply and to the point

1		5		Recheck request
2		6		
3		7		
4		8		

Q1. For each of the questions choose most correct answer & fill in grid above. Overwritten answers won't be rechecked.

1. What type of programming model is typically followed in the WSN nodes [1M]

- a. multi-threading b. FIFO
- c. Event-driven d. LEACH e. Layered

2. Which of the following is not a WSN routing protocol [1M]

- a. Teen b. Apteen c. Pegasus
- d. Directed diffusion e. Aloha

3. What is the essential trade-off accounted while selecting the routing protocol in WSN [1M]

- a. Energy-lifetime b. Delay-coverage
- c. Energy-delay d. All of the above

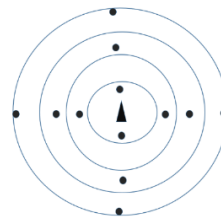
4. What kind of task scheduling is mostly preferred for WSN nodes [1M]

- a. LIFO b. FIFO c. Round-robin d. Gaussian

5. If the multi-layered transmission is not followed by a node, but it tries to send data to the BS directly, it will suffer in which aspect [1M]

- a. delay b. energy
- c. bandwidth d. all of the above

6. Assume that in the network shown below the transmission range of a node is 2m. How many layers are there in the network given that the base station is in the center of the network (shown by triangle) and each consecutive red concentric circle is 1m apart from each other (thus leading to the outermost circle being 4 m from the base station). [1M]



- a. one
- b. two
- c. three
- d. four

7. How many nodes are there in the layer closest to the Base station in the last question [1M]

- a. 2 b. 4 c. 6 d. 8

8. Which of them is not a time synchronization protocol [1M]

- a. TPSN b. FTSP c. RBS d. TOA

Q2. Fill in the blanks [1Mx15= 15M]

- a. What aspect should be given **greatest priority** while designing the protocols (mention only one) for a WSN network _____, for a VANET network _____
- b. What are the two most common kind of network architectures for routing of data in WSN networks _____
- c. Which routing strategy is best for VANETs and why? _____

d. In PEGASIS, how do the nodes in the network know who is leader and which direction to pass message

e. Highlight the importance of time synchronization for energy efficient radio scheduling.

f. What frequency is used for transmission by WSN motes and why?

g. i. Is MTP range based or range free protocol? Justify your answer. ii. What is the difference between relative and absolute localization?

i. _____

ii _____

h. What is the purpose of MAC protocol? What is the full form of MAC? What is fairness in the context of a MAC protocol?

i. What is data aliasing error during data acquisition? How can it be avoided.

j. A WSN network uses RSSI method for localization. It uses a beacon that transmits signal at 20 W. There is a node which is 5m away from the beacon which gets received power as 8 W. There is an another node which gets received power of 2 W. What is the distance of this node from the beacon? _____

k. Why does most of the traffic in WSN fall in converge-cast category. What is CCWS in VANET's? what is its function?

l. What are 2 "**most important**" differences in the way time synchronization is done in TPSN and FTSP.

Difference 1: _____

Difference 2: _____

m. How is the root node chosen in the FTSP protocol? Which specific inaccuracy of TPSN is overcome by FTSP.

n. Why can't two anchor nodes accurately localize an un-localized node. Why 3 are required?

o. What are the two chief defects with RF based TOA method for distance estimation of nodes.

Defect1: _____

Defect2: _____

Q3. Answer the following questions [2MX8= 16M]

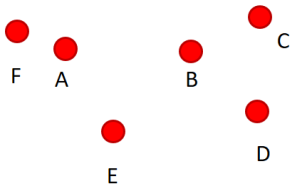
a. How is a network created in the PEGASIS protocol (for routing of the data)?

b. Mention the four kinds of delays which lead to error in a time synchronization protocol.

c. Which two out of the four delays mentioned in the last part are most un-deterministic? Justify your answer

d. If in a WSN network, in general every node is within the coverage of four anchor nodes. What is the easiest way, the localization of nodes be done. What would be the salient defect in such localization. How can that issue to solved.

e. What is the full form of CSMA/ CA protocol? A wants to send a message to B using the CSMA/ CA protocol. What ensures that C and D do not transmit during this period which may disturb this transmission



f. Explain how soldiers at border can use ad hoc networks. What makes its use even the more relevant in those scenarios (mention at least 2-3 major reasons).

g. If cellular infrastructure exists, why do we need VANETs (that require extensive deployment of RSUs)?

Reason 1: _____

Reason 2: _____

Reason 3: _____

h. What are proactive routing protocols. What are their specific advantages and disadvantages? In what scenarios would they be suitable and in which they will not be suitable

Q4. A node in WSN (which implements TPSN for time synchronization), during its level discovery stage receives level discovery packets from nodes at level 5, level 6, level 7 and level 8. Which level does this node belong to and why? [2M]

How does the node mentioned above achieve time synchronization? Using a figure show the packet exchanges it will do (and with which node) to achieve that. Clearly show the direction and order of packet flows for establishing synchronization, and corresponding derivation/ calculations that will be done to achieve time synchronization [4M]

Explanation:

Figure

Calculations:

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Duration: 1 hour

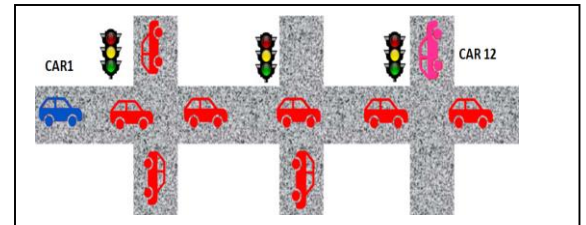
Date of exam: 13/12/2023

Max. Marks: 25

Instructions: Kindly answer to the point, and crisply. Answer all subparts of a question in same sequence and together.

Q1. Draw the physical layer details of VANETS (i.e. the different physical frequency channels and their use). [3M]

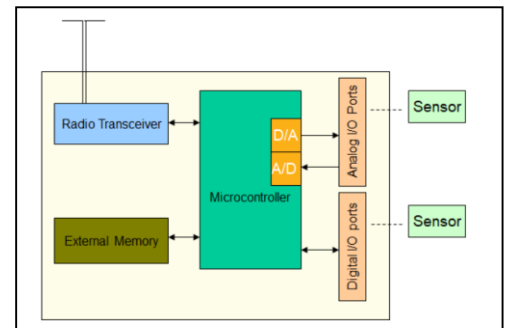
Q2. Car1 wants to send some information to Car12. Assuming that it uses **GYTAR** scheme, how is the best route and intermediate vehicular nodes decided. Please do give all relevant information. [3M]



Q3. Answer the following questions about the LEACH protocol [6M].

- What is done in LEACH protocol to avoid a particular node becoming cluster head very frequently. [1M]
- Assume that several nodes (of order of 1000's) are aerielly deployed in a forest for forest fire detection. The network plans to use LEACH protocol with only ~ 10% of the nodes becoming cluster head. What can be done while coding the nodes to ensure this (at least for the first round of network creation, i.e. selection of only 10% of the nodes as cluster head randomly). In other words, kindly write the few lines of code that can be written in the node's code to ensure this. [3M]
- How are clusters formed in LEACH and what MAC protocol is used during the cluster formation phase [2M].

Q4. You wish to design a WSN mote where you have an analog sensor which can measure the temperature in range -10°C to 50°C . The current generated as output by the sensor is 0 A when temperature is -10°C whereas it is 3 mA when the temperature is 50°C . You have a ADC with you which accepts input in range 0-12 V. What is the signal conditioning circuit you would use (between the sensor and the ADC) so as to make out the best use of the range of ADC for evaluation of the temperature? What is the smallest detectable temperature change (in $^{\circ}\text{C}$) given that you use an 8 bit ADC? [6M]



Q5. Answer the following questions [7M]

- Give 2 '*most important*' reasons why MQTT is a good IoT protocol for various real-time data transmission applications related to AI and robotics? [1M]
- How does the MQTT protocol manage scalability in large-scale IoT networks? [1M]
- How does the overhead associated with HTTPS and SSL/TLS impact the performance & efficiency of IoT devices? [1M]
- What are the pros and cons of using WebSockets in real-time, interactive web applications? [2M]
- How do the computational requirements of symmetric and asymmetric cryptography compare in the context of IoT devices? [2M]