Q1. What is a BMS ? Types of BMS and differentiate the types of BMS.

⇒ A BMS (Battery Management System) which are mainly manages a battery pack or controling the battery and protecting the rechargeable battery from operating outside its safe operating Zone. by Monitoring its state, controling its environment, and also balancing the Lithium-ion cells inside the battery pack. And BMS is also known as the Brain of a battery pack.

The battery management system is critical to the battery's safe operation, overall performance, and longevity. Moreover, it protects whatever the lithium battery is installed in (boat, RV, etc.) and people who are using it. The primary function of the BMS is to protect the battery cells from damaged or over-discharged. Additionally, the BMS calculates the remaining charge, monitors the battery's health and safety by checking for loose connections and internal shorts. If it detects any unsafe conditions, the BMS shuts the battery down to protect the lithium-ion cells and the user.

The battery management system which monitors - individual cells in the battery pack. It then calculates how much current can safely go in (charge) and - come out (discharge) without damaging the battery.

The BMS also monitors the remaining charges in the battery. It continually tracks the amount of energy entering and exiting the battery pack and monitors cell voltages. BMS monitors the state of health (SOH) of the battery, collecting data, controls - environmental factors that affect battery.

Basically BMS is classified into two

1) Hardware BMS
2) software BMS / smart BMS.

- Hardware BMS

All BMS have atleast all the functions of hardware BMS. Mainly the functions are over voltage cut off, under voltage cut off, continuous current, over current detection, over temperature cut off.

The BMS will also control the recharging of the battery by redirecting the ~~recc~~ recovered energy or from regenerati. ve braking, back into battery pack.

Battery thermal management system can be either passive or active, and the cooling medium can either be air,

liquid or some form of phase changes.

- Software BMS / Smart BMS

It have all the features of hardware BMS. In addition to they can control data, it have monitor to store data, transmit data via CAN, Bluetooth. A smart BMS offers benefits such as online monitoring for battery status regarding voltage, current, impedence, internal temperature, etc.

A smart BMS can be called a BMS data centre due to all the historical data collection, storage, and analysis. At the same time, you can get real-time battery information via a certain system. Additionally, it is straight forward to setup and operate due to the friendly user interface design of the smart BMS.

- Types of Battery Management System

Battery management system range from simple to complex and can embrace a coride range of different technologies to achieve their prime directive to "take care of the battery". However these systems can be categorized based upon their topology which relates to how they are installed and operate upon the cells or module across the battery pack.

Q2. What are the technical parameters to keep in mind while procuring a BMS for assembling a battery pack.?

=> Mainly there are 6 technical parameters :

1) Battery cell monitor
2) cut off FET.
3) Monitoring temperature.
4) Cell voltage Balance
5) BMS algorithms.
6) Real time clock.

1) Battery cell Monitor

Battery cell monitor primarily monitor the voltages for battery system. It is a high speed system that offer a low overall cost for high voltage measurements.
The easiest way to determine the battery pack to charge is to monitor individual cell voltage with reference to the set voltage level, when the voltage of the first cell reaches the voltage limit the charging automatically drops. It indicates that the battery charging limit has been reached. If the battery pack has a lesser charge than the average cell then the least charged cell will reach the limit first, and the rest of the cells will be left partially charged.

2) cut off FET

FET driver is accountable for connection and isolation between load and charger of the battery pack. The behaviour

prediction is done through voltage, current measurements, in real time detection &. They can be connected to a battery pack low or high side, we use a low side FET drivers to reduce costs. Integrated solutions, since a charge pump is not needed. High voltage devices are not required in such cases. The ground connection of the battery pack floats using low side cut off FETs. This can affect the IC performance, making it more sensitive to insulated noise - measurement.

3) Monitoring temperature

With the increase in product requirement, the batteries have been on a constant surge in delivering currents at fixed voltages. The continuous operation process may cause a catastrophic event such as fire or explanation. We can identify wheather battery charging or discharging is desirable using temperature measurement Temperature sensors monitor the energy storage system or cell grouping for compact portable applications. The circuits, Temperature is monitored by the internal ADC voltage-powered thermistor. Employing the internal voltage references helps reduce the temp. in accuracies and improve overall measurement system.

4) Cell Voltage balance

It is crucial to determine the health of the battery pack. That it why cell voltage monitoring is done to ensure that the cells are in a proper running condition for attaining

a long battery life. The operating voltage ranges from - 2.5V to 4.2V in a Li-ion battery. The battery operations beyond the voltage range. This reduce the life of a cell which may even make if unfit for use. Connecting the battery pack in parallel increase the overall drive current, where as series connection adds the overall voltage.

5) BMS algorithms

To make quick and effective decision in real time based on the information received for this purpose, a microcontroller for battery management system is needed to collect, Organize and assess the information from the sensing circuity the memory, Space and micro controller for battery management system clock cycles. can be cleared using these Standa alone solutions.

6) Real time clock

. Allowing the user to know the battery pack's behaviour before any alarming event, the real time clock acts as a block box system for time-stamping and memory storage. The BMS electronics, is kept away from synchronizing with a third party battery pack through battery authentication. The peripheral power circuitry is used around the Components of battery management system through voltage regulator.

Q: What is the purpose of BMS with communication? What are the various protocols of communication used in a BMS.

→ • Communication is used for communication b/w devices. For example, a CAN 2.0 BMS sends communication from the battery to the vehicle control unit (VCU)

• It can continuously transmit data of the battery's thermal profile and monitor its temperature continuously.

• It uses the collected data points (temperature, voltage, current) to estimate the state of charge (SOC), state of health (SOH) etc... of the battery pack.

• The data can either be stored (on board), can be ~~safety operation region in terms~~ transmitted by CAN to the VCU or send to the cloud.

The main goal of BMS is to keep the battery within the safety operation region in terms of voltage, current & temperature during charge, discharge and in certain cases at open circuit when working with a BMS. Usually use a BMS IC depending on the BMS. IC being used to control BMS.

Communication protocols

UART :- Universal Asynchronous Receiver / Transmitter, is the most widely used communication protocol used in battery management system. UART is an form of serial communication which means bits are send at once which is what occurs

with parallel communications

CAN :- Controlled area Network, is most widely used network for communication in automobile industry. CAN communication are used frequently in automotives because it removes all signal noises. It also removes a host of wire harnesses from a system. Its one of the most robust and reliable communication protocol. The micro controller connects to the can chip. Which then connects to the outside devices. The CAN chip has TXD and RXD pins which allows to communicate with the micro controller.

SPI :- Serial peripheral Interphase, is a master-slave type - protocol that provides a simple and low cost interface blw a microcontroller and its peripherals. The SPI ~~com~~ protocol uses a dedicated clock signal that is created by the master device to synchronize the transmitter and receiver or master and slave. The micro controller can communicate along with the other peripheral devices that can communicate with the SPI communication. SPI communication uses 4 lines for each devices there is an input data line and output data line, a clock line and a - chip - select line to identify which slave device the matter - trying to communicate.

I2C :- Integrated circuit communication ~~is~~ is a protocol used for IC to IC communication. I2C is intended primarily for short distance communication between 2 ICs, on the same printed board. The I2C is a standard bidirectional interface that uses a controller known as the master to communicate with slave devices. The physical I2C interface consist of the serial clock and serial data lines. Both SDA & SCL line must be connected to Vcc through a pull or resister Being that SDA lines is bidirectional. It functions to transmit data or receive data.