**Task 2 (Data Science)**

1. If you had to make this robot smart, how would you go about doing it? You may describe this in written along with any flow charts/block diagrams/rough sketches etc. For instance, consider this scenario:

* Say you have used various MEMS (Micro-Electro-Mechanical Systems) and other sensors which are gathering data in helping you making this robot semi-autonomous or fully autonomous and you have to prove to someone how the robot is smart, how would you go about explaining to them the various aspects and convince them of it being smart and autonomous?

Ans 1: To make the robot smart and autonomous, I would integrate various sensors and implement intelligent algorithms for perception, decision-making, and control. Here's a description of the approach and the components involved Sensor Integration, Perception and Environment Understanding, Decision-Making and Planning, Autonomous Control, User Interface and Communication. Also I connect some AR gear to the robot and have a vision of the insect and manover through the perception of the insect.

1. [This follows from point number 1] Depending on the nature of data that you are getting, is there scope for analyzing it using various data science techniques and processes and suggest any mechanical/electro-mechanical optimizations to maybe increase battery life, speed, ‘smartness’ etc.?

Ans 2: Yes ofcourse, there are numerous methodes to get RUL (remaining useful life) of various parts including batteries. Smartness is you can map the area it roams around and the use the data to find the shortest or the quickest path to desired place on the mapped area. If you see the insect robot it is omni-directional so we can make it smart by letting the algorithm decide the how it wants to move that is straight verticle, inclined or straight verticle path or even reorient and then move. Some other optimizations include Speed Optimization, Electro-Mechanical Optimizations.

1. Explore the use of MEMS sensors such as Inertial Measurement Units ( IMUs ), Pressure sensors, Accelerometers, Digital e-compass and other electro-mechanical sensors for functionalities such as motion detection, obstacle avoidance, or environmental monitoring, do you think it’s possible to achieve those with the mentioned set of sensors? If yes, then give a brief description of how it could be done...no need of a lot of details, just your preliminary thoughts on it. However, if any or none of those can be achieved, then provide reasoning and justifications and if applicable, suggest other or additional sensors that can give such capabilities.

Ans 3: Motion Detection: IMUs, accelerometers, and digital e-compass can be used together to detect and track the robot's motion in three-dimensional space. Obstacle Avoidance: Proximity sensors (such as ultrasonic or infrared sensors) can be incorporated to detect the presence of nearby obstacles. Environmental Monitoring: Pressure sensors can be utilized to measure atmospheric pressure, which can provide information about altitude or changes in environmental conditions. Similarly other sensors like temperature sensors or gas sensors can be integrated to monitor temperature variations and mimic the motion of inscet in real environment.

This all can be done with a lot of data and the observetion of real insects in various environments and boundary conditions.

**Bonus**

1. How would you use data science to guide you in selecting materials, composites, components etc. for making a more finalized version taking into account. aspects like power-to-weight ration, compatibility of various components, ease of integration and manufacturability?

Note: Focus on your creativity and skill in utilizing data science techniques for design optimization, material selection, and the integration of sensors to enhance the robot's performance. Feel free to explore innovative ideas and think critically about the data-driven aspects of the robot's design.

Ans 1: Data-science in mechanical design can be used in ways like generative design (reducing material consumption or weight without hampering its strength). In an alternate way we can use data-science to build a recommender system to get which materials to use for specific application based on previous decisions or projects and also get recommendation on which manufacturing process to use depending on the material. Income other application we can use the data to get estimation of projects total timeline and cost, but it all depends on the data availability and the quality of the data as well.