

ONLINE INTERACTIVE SESSION WITH PROFESSOR DR. K. RAMACHANDRA

On 15th October, 2020, the regular batch of class XI students at Mushtifund Aryaan Higher Secondary School had the wonderful opportunity of interacting with Professor Dr. Ramachandra.

Dr. Ramachandra has been an outstanding scientist and Former Director of the prestigious Gas Turbine Research Establishment, which was exclusively formed for the Kaveri Engine development project by DRDO. He has been a former CEO of National Program on MICAV-NDRF Consortium. He also served as a President of Bird Strike Research Group of India. He has also been former coordinator of the Propulsion Panel of Aeronautical Research & Development Board. He has been the former Hon. President of the Engineering Design and Analysis Forum(EDAF). He has been a member of the Academic Senate of Visvesvaraya Technological University, Belgaum. He was also former chairman and is a Present member of Board of Studies in Aeronautical Engineering at Visvesvaraya Technological University, Belgaum. He has been a member of several governing committees. He is a member of the advisory council at RV College Bangalore of which the famous cricketer, Anil Kumble was an alumnus. Dr. Ramachandra has a Bachelor's degree in Mechanical Engineering and Master's Degree in Machine Design. He has a Ph.D. in Mechanical Engineering. He also has an MBA in Financial Management. He has eight years of teaching experience and 35 long years of quality research and development experience. He has affiliation with several professional institutions. He has co-authored a text book on Experimental Stress Analysis and also has close to 100 national and international publications. He has also guided 15 Ph.D. students and 50 M. Tech students. He has also received two national and one international award.

Dr. Ramachandra put together a presentation for us which centered around a very interesting topic - Current Paradigm Shift: R&D Goals in Engineering and Technology. Dr. Ramachandra highlighted a few pointers related to the current situation with regards to Covid 19 and the likely scenario to emerge post Covid. He said that students should look at multidisciplinary options and not stick to specialized subjects. He encouraged us students to train our minds to think out of the box and provide end-to-end solutions and look at futuristic requirements. He spoke about healthcare, agriculture, aeronautics and automobiles. He stressed on the big role pharmaceutical companies are playing in the present context of Covid and also the insurance companies. Speaking about healthcare of the modern day, he touched upon the usage of drones to collect blood samples, urine samples, etc. from remote areas of Simla which would otherwise be inaccessible due to snowfall, and how the test results are conveyed via telephone. He said the focus now is on the healthcare system and how technology is being used to expand the reach of healthcare. He gave the example of the use of a foam-based aircraft to deliver blood plasma, etc to hospitals in an African country. This aircraft was launched using a catapult. He also

mentioned about the use of non-invasive medical devices and how students can explore possibilities of coming up with new devices to help diagnose and monitor diseases such as malaria, tuberculosis, etc.

He suggested the use of drones in road accident cases, especially when the accident takes place in a remote location where medical services may not be easily reachable. The drones can come in, take pictures and videos of the survivors so that a fair picture is conveyed to the medical team and then the team can come in prepared for the kind of medical attention to be provided to the survivors. This technology can also be used for organ transport, to ensure that the organ reaches the recipient well within the stipulated time. He touched upon the topic of modern organ transportation containers which can keep the organ in usable condition for more time than the traditional containers that have been used until now. Perfusion containers may be the solution for this. These are at present large in size and the need is to try and miniaturize these to make them flight worthy.

He then spoke about Bio-printing which is additive manufacturing much like 3-D printing but unlike 3-D printing which uses materials like plastics, metals, etc., bio-printing involves printing



with cells and biomaterials and creating organ-like structures that let living cells multiply. He enlightened us with his views on how this technology can be advanced further to make human organs or living tissues. Using this, living organs can be printed. This field has huge potential and can help the field of medicine make great advances in the coming future.

Next he spoke about agricultural technologies and the role of drones in this. Use of LIDAR (Light Detection and Ranging), which is a camera system can be made for spraying crops with pesticides, picking up soil samples for testing, and to tackle the threat of locusts. Crop damage can also be assessed with the help of this. As far as fishing is concerned, drones can be used to check the fish density in a certain location and this information can be used to efficiently perform fishing activity. All this helps in carrying out what is called precision agriculture.

He stressed on the need to improve the indigenous manufacturing capabilities of the various kinds of drones and all the gadgets that they have to carry so as to perform all the functions mentioned above in the fields of healthcare, agriculture, fishing, etc.

While drones have all the useful applications, they can also be misused by rogue elements to inflict damage in various ways. Defense installations can be compromised and/or attacked. To prevent this misuse of drones, anti-drone technologies have to be developed as well. Rogue drones have to be identified and then neutralized.

Drones can help to monitor the quality of water in aqua ponds, so that loss of fish or prawns in these aqua ponds can be prevented. He spoke about how the quality of water is not only checked

but if found to be not good for the health of the fish, then aeration of the water can be done by introducing compressed air from the atmosphere into the water, thus rejuvenating the water and keeping the fish in good health. Similarly, boats can also be used for coastal safety monitoring related to the nuclear radiation levels of sea water because of the waste generated and released by nuclear power plants.



Artificial intelligence based drones can be used for large greenhouses to monitor the health of the plants and take remedial measures if anything is found wanting while monitoring. He spoke about the need to develop small de-weeding boats for de-weeding of ponds.

He then switched to the topic of coupled aerodynamics and hydrodynamics wherein he spoke about seaplanes, which can be either a float-plane or a flying boat. These are amphibians and they can take off from land and land in water and vice-versa. India has about 30 major ports and about 185 minor ports, and we do not have enough seaplanes whereas countries like Greece, Maldives have enough seaplanes. So, there is a huge need that has to be fulfilled. The other aspect of this activity is their usage in emergencies. Seaplanes can be effectively used in urban and forest fire fighting. In case of fires in densely populated cities, there can be a large delay in the fire brigade reaching the site of the fire owing to the traffic in crowded metropolitan cities like Bangalore or Mumbai. A seaplane however will not face these issues and it also has the capacity to suck in around 10 to 12 tons of water from the sea and go and dump this on the fire and extinguish it efficiently and in the process limit damage to lives and property.

Next, he spoke about amphibian hovercraft. In our country, coracles are used, which are very unsafe given their structural design and the physical conditions prevalent in the water bodies that they have to overcome. Hovercrafts can be used very safely in such cases for rescue operations in flood situations, the only drawback being that they are very slow. Varieties of mini underwater vehicles are being developed, to study and monitor marine life. It is very interesting to study the movement of fish in water and how the number of fins they have help in this movement. These features need to be included in the mini underwater vehicles. Intelligent vehicles which have smart materials in them can behave like amphibians. These vehicles can be used in checking the conditions of marine structures, example, oilrigs.

Wind energy is a very important part of modern day energy requirements. He gave his insight on how he thought that vertical axis wind turbines have a lot of potential. This remains largely unexploited in India, unlike countries like USA, China, Canada and such others. Hybrid systems can be incorporated in these where wind energy and solar energy can be combined in such a way that solar energy is used during the daytime and wind energy comes into the picture at nighttime.



Next, he spoke about fuel-cell technologies. Fuel cells are being used in fuel cell gliders and boomerangs. Today, fuel cells are also needed to power on-road vehicles. Charging the cells of vehicles again and again is not desirable and feasible. So, fuel cells, which are energy efficient, need to be developed. Virtual passenger dummies are nowadays used to do car testing where simulation of

the impact on human body in car crashes is done. These dummies are very much like the human body in terms of the internal blood vessels and other organs and in this way it can also allow exploration of possibilities of using these dummies in healthcare as well.

Dr. Ramachandra said that having gas-turbine based automobile range extenders included in the automobiles can help in improving the mobility of the automobiles. Anti-viral filters of aircrafts can be miniaturized and included in the automobile design. Aircraft accidents happen because of huge flocks of birds coming close to the aircraft and getting sucked in or hitting the aircraft. Developing bird-shaped drones to scare away birds from the vicinity of airports and aircrafts would be a very good idea. Bird-hazing devices need to be used for these purposes as well. There is scope for lot of work in these areas and students can take up such projects. Helicopter propeller configuration is a wonderful technology. Dr. Ramachandra felt that all IITs should have propeller design as part of the curriculum. He spoke about a special welding technology called linear friction welding to weld blades on a disc which is part of aircrafts. Magnetic bearings work on magnetic levitation philosophy. High speed trains work on this principle.

Dr. Ramachandra also spoke about 2-D/3-D thrust vectoring nozzles used at the end of the aircraft. How submarines can detect underwater ice and how submarines communicate with satellites while being a few kilometers under water.

He also wanted students to think about the possibility of providing the equivalent of a reverse gear to the aircrafts so that the aircrafts can be self-dependent and not require external support from tractors to pull back and get on the runway for take-off. Students build satellites in their institutes, but these need to be made useful for some practical applications rather than just remaining of academic interest.

To summarize, Dr. Ramachandra highlighted how students must relate whatever they learn in theory to practical applications in their day-to-day lives. He again stressed on the need for students to become multidisciplinary or interdisciplinary and how they must think out of the box and provide end-to-end solutions. With this, he concluded the enlightening presentation and then we began with the question-answer session.

VPD Sir opened the interaction session with a question about the Kaveri engine team. He asked why it could not be used in spite of the amount of work done on the LCA. Dr. Ramachandra

responded saying that typically, an engine development program abroad takes 5-10 years and this 5-10 year development program is linked with huge infrastructure available in electronics and control systems. In their case, they developed everything ab initio and they did not have the requisite infrastructure and therefore it took a lot of time. The program was to put together an engine and do the aircraft integration and flight trials. They came up to ground testing. They had a target of thrust which was the most important thing and they were falling short of the thrust by about 10%. They had a cushion and therefore there was a possibility that having tested in various conditions, they could have achieved the desired results, but lack of infrastructure and a changing goalpost was what led to them not achieving the desired result. Next, VPD Sir asked about what is the propeller efficiency and Dr. Ramachandra said it was around 80%.

VPD Sir then asked Dr. Ramachandra about his experience of working with Dr. Kalam and how he felt about it. Dr. Ramachandra responded to this saying that, Dr. Kalam would have a lot of time to solve any problem. He believed in starting a meeting with a purpose and not ending it until the purpose was achieved.

A student then asked if there were any engines being currently developed to power the advanced medium combat aircrafts like Tejas, Mach 2, or the unmanned combat aircrafts. Dr. Ramachandra answered this question saying, today, there are at least six or seven engine development agencies even in the private sector and that in fact, India has great indigenous capacity and capability to design, develop and manufacture a combat aircraft engine which can naturally be accelerated by technology transfer and close collaboration with trusted international partners.

After a few more questions from the students the session then ended with a brief summary of the lecture and a beautiful vote of thanks addressed by one of our students.

We were indeed lucky to have Professor Dr. Ramachandra amongst us. It isn't every day that we get to meet society's exceptions. We really have our Institute Director and guru Vyankatesh Prabhudessai Sir to thank, for providing us with such a wonderful opportunity. Dr. Ramachandra's approach to current existing and developing technology and its futuristic applications had us all intrigued. We are now motivated by his encouraging words and he inspires us to do more.

Written by,

Suhani A. Prabhu Chodnekar