**Electronic Systems for Cancer Diagnosis**

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**Lecture – 47**
**Lab: Introduction to Clean Room and Cleanroom Equipments**
**Gowning Procedure in Clean Room**

Hello everyone. Welcome to the course on Electronic Systems for Cancer Diagnosis. I am Alekhya, TA for the course. Today, I am standing here in the clean room facility of biomedical and electronic engineering systems laboratory DESE, IISc Bangalore.

So, this is a class 10000 clean room. What is a class 10000 clean room? Oh yes, when you are walking in a fabrication you know facility like this. So, there are different standards ISO standards. So, there is class 100 and there is class 100, there is class 10000. So, class 10000 talks means that the number of it is classified based on the number of particles and the size of the particle in the given in the cubic feet area.

So, today let us see how even before we start off with the fabrication process, let us see how do you do follow a gowning procedure while you work in an environment like this. Initially let us see I put on a gown and then, I pick up a hairnet. So, make sure you cover your entire hair like you see I have pretty long hair, but then I tied it up. So, when you work in a fabrication facility like this, it is clearly a known know to have you know; to have makeup or you have long earrings or accessories; kindly avoid all of them while you work.

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Once I am done with the hairnet, I pick up a face mask. So, you see there is a small metal strip that would actually help you to fixing them right on your nose; make sure you cover your entire nose and your mouth. The two folds towards wearing these face masks right; one like I said you want to keep the particulate matter in the environment as low as possible. So, we are the major carriers of particulate matter. So, when we sneeze, cough, there is lot of you know bacteria why which would actually contaminate the area where you work and the other part is when you are working with you know (Refer Time: 03:17) lithography you do not want to inhale the harmful gases.

So, always ensure you wear your face mask right. And then, you pick up the right size gloves. The choice of gloves while you work is also important. So, the gloves what I am using now is a Nitrile glove. So, when I am just working you know just on a microscope or when I am handling devices, I can use these gloves, but when you are working with concentrated acids, when you are working with HF or you know highly concentrated chemicals, then it becomes very important to wear you know gloves which are chemical resistant. So, it is either the Teflon or the Mapa gloves which are mandatory when you are working with harmful chemicals.

So yes now, that I have worn my gloves; so, there is a sequence which I followed. The importance behind following a sequence is so say when you wear your gloves first and then, wear a mask what happens is your gloves actually gets contaminated with all the

sweat, the salts or you know the skin flakes which would actually settle on your gloves and then, when you are handling your devices with the same you know the contaminated gloves, it could hamper the working of your device.

So, ensure you follow the procedure in a right manner. It is mandatory to rapidly you know to follow these instructions when you are working in an environment like this. Now, let us see how Rathan who is also a TA for the course would want to work on one of the systems here. Let us see how he would follow the procedure, come into the clean room and demonstrate to you guys, how actually the procedure needs to be followed.

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As you can see there is an air curtain which is mounted on top of the entrance door. The main purpose of using the air curtain is it trashes air onto the person or any other equipment which would actually get inside the cleanroom. So, the purpose of it is to reduce the influx of air on the person would actually reduce the amount of particulate matter which would enter inside the cleanroom.

Now, we have Rathan would pick up the lab coat and once he wears like you can see there is a sensor just beneath, as soon as the door opens the sensor would activate the air curtain. The rate at which the air flows is approximately 10 meters per second in order to ensure that the; in order to ensure minimal amount of air influx happens from the outside to the cleanroom environment and there is also a sanitizer which is just beside the door.

In case you feel your hands are not clean before you work, kindly ensure you make use of the sanitizing and have your hands clean.

It becomes very important while you work to ensure you have clean and dry clothes; make sure you do not wear clothes which have fur or you know sweater like cardigan which would actually have stuff which would come out and cause contamination in the air. Once you wearing your lab coat, you would pick up the right size hairnet. Make sure your hair is completely covered and once the hairnet has been put on; use the facemask, like you can see he is insure that the facemask the strip is on top. So, that it sits properly on his nose and then, pick up the right gloves.

It becomes very important to follow these instructions even before you enter your workstation, it causes I mean if in case you donot follow these instructions in the right procedure. It could cause a lot on your time, it could even impact on the functioning of your device and if you also feel that you are wearing additional you know things on your hands say watch or you have keys or you are carrying a mobile phone, also ensure you keep them aside in a tray or you have a specified locker, please put them because once your hands gets dirty or when you are dealing with chemicals and there are chances that you might touch back your phone with the same contaminated hand which is actually a not good practice and which could impact on your health.

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Once the gowning procedure is done we also ensure there is a eye gear which is there at one end of the cleanroom. So, there are two types of yeah, there are two types of eye gear protective gears. So, the one which is in Rathan's hand is actually used when you are working on lithography. So, within there really harmful gases you donot want them to impact on your eyes; your eyesight could be affected or damaged. So, always ensure you wear them like you could see, he is worn it on top of his glasses. He is got you know the sight; always wear it on top of them. So, that it does not hamper your vision while you are in your workstation.

Yes, if you could please show us the other glasses which could actually be worn when you are working with microscopy or you know when you are working with high intensity light, the light could actually cause some disturbance to you while you are working; so, just make sure you wear these glasses, while you work.

Yes, now you can see the complete gowning procedure with the hairnet, the safety glasses, the facemask, lab coat the, you know hand gloves and the shoe cover. Rigorous enforcement of following the gowning procedure in a cleanroom environment is vital for an effective research. Let us follow a safe and clean process while in order to promote healthy research. So, now, that we have demonstrated the gowning procedure what ensures you know the amount of pressure, what keeps the particulate count to a minimal and how does it make a class 10000 clean room.

So, yes; now that we have seen the complete gowning procedures, there are two falls to us following the gowning procedure; one it acts as a personal protective equipment. So, that you safeguard yourself while you work in your workstation and the other you do not contaminate the environment where you work.

Now, let us see what are the other utilities which would actually enable having a proper temperature, humidity, pressure in an environment like this. The air filtration systems are of three types; one is the EPA, second the HEPA, third is the ULPA. So, what is EPA? EPA stands for Efficient Particulate Air filter. The HEPA stands for High Efficiency Particulate Air filter and the ULPA is the Ultra Low Penetration Air filter. Among these, we have HEPA filters which are used in our lab.

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So, in our lab we have HEPA filters is one two; two in the biology section that is three and here this is the fourth HEPA filter and then, there is an air pressure module which is on the other side of the cleanroom. So, why do we have this air pressure module? The as you can see the pressure that is there inside the cleanroom is a positive pressure that is the air is actually suck pumped up and the pressure inside the environment in the cleanroom area is slightly higher than the environment that the pressure that is there outside the lab.

Then, why do we have an increase; you know an increase in pressure when you are working in a lab facility? One, when you have a higher pressure inside the lab the influx of air from outside to inside the lab would reduce. Hence, the load on the HVAC system would reduce. In order to ensure that the amount of clean filtered air does not you know flow out you know. So, we have these facilities like the air curtain and the high pressure module which actually enforces you know the filtered air to be recirculated within the lab environment.

The HEPA filters forms the heart of the air filtration system inside the cleanroom. These filters have a lifetime like any other air filtration system, these filters they are used; these are used in research laboratories, they are used in defense purpose, they are used in military, they are also used in you know pharmaceutical industries.

The one what we what we have here has a positive pressure module and why is it important, to make sure you know they are they work efficiently or you always monitor the pressure of these systems to ensure their performance is great. By default, where these filters have efficiency up to 99 percent when we say efficiency, they can detect filter air particles at sub micron levels.

So, now that they; now that we have seen that these filters are effectively used in an environment to maintain the positive pressure, condition the air at certain temperature and also reduce the particulate matter to certain levels. Now we see that they have a lifetime or you know a life cycle through which they perform efficiently. So, how do we monitor them on a regular basis? We keep a check on the pressure drop. So, once as a once as a significant pressure drop inside and when you measure the pressure drop inside the lab environment and outside that actually tells you the performance of these filters.

And then, how do you actually increase their life cycle; how do you enhance I mean give a better performance and how do you reduce the load on the HVAC system is that you reduce by following a gowning procedure, the step one you would already reduce the particulate matter which would enter the cleanroom and the second cases it also depends on the volume of air that is actually taken in for filtration. The amount of volume the frequency of you know the frequency of inflow and outflow of air would impact on its performance and second thing is the volume of recirculated air, it recirculates the air the filtered air.

So, the load on the system would reduce when the air is conditioned because it is not the complete air which is already being filtered. So, 50 percent of the air is always being recirculated. So, once we ensure the air the particulate matter in your cleanroom is maintained to certain levels, the load on these systems would definitely you know they we would ensure that they work better and we would help you know in increasing the lifecycle and the performance.

I am sure, now that I have demonstrated what actually forms the cleanroom what is the kind of environment in a cleanroom, I am sure you are all inquisitive to learn more about fabrication; what goes into the devices; how are they fabricated; how are they integrated with electronic systems and how do you test the biological samples and how do you store the biological samples.

Let us learn more about these devices, how to fabricate them, how can they be incubated, how the cells biological cells which have been extracted, have been incubated or they refrigerated and how do you use microscope, the different microscopes for different purpose, let us see all that in our next module.

Thank you.