Welcome you to the next session lecture 9 of embedded software testing, in the previous session we had learned the V-model life cycle that,
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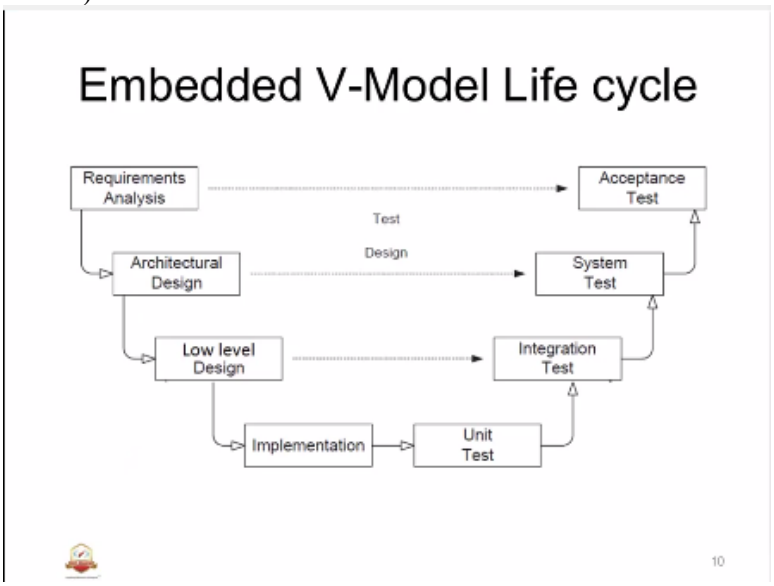

Embedded software three to then V model typical elements requirements implementations and for this is we have testing standard of the right hand side, so we will develop the tests as per the concern line, so the requirement high level test or architecture test we have for design. We have a test under low level units we will right integrations test for the sources code, we have the unit testing and we also learned that for any embedded software development and testing, so we have proto typing and formal life cycle proto typing, what we do is we will define our own prototype impressions.
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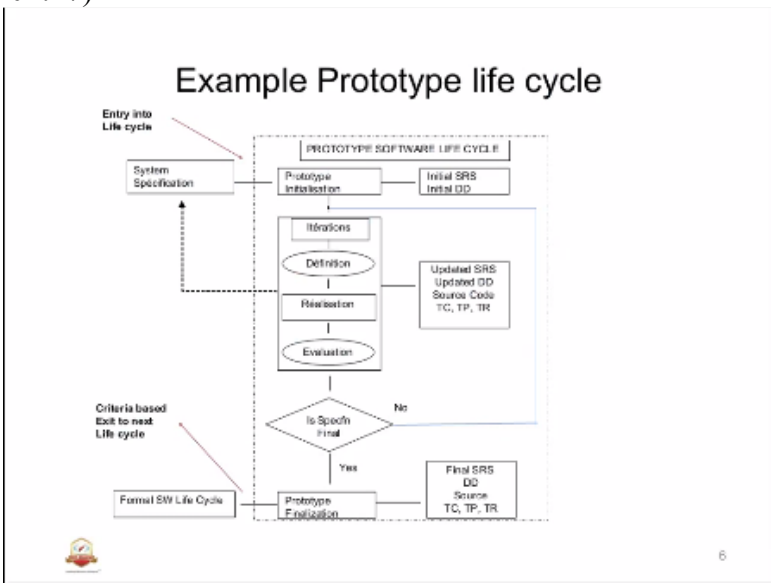

Where we will define realize and evaluate the various items of the embedded software life cycle and that will be till it life. So the end of this proto type we have a finalized SRS inter document sources test cases test, procedures and set of test result and also we learned that,

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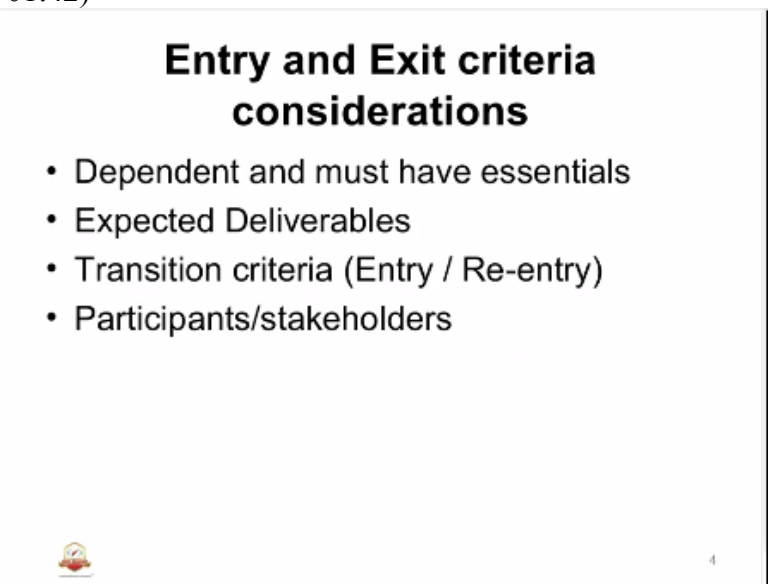

For each term of the life cycle there are has to be an entry legislating, we know that the conditions must be segregate, based on the target it can move to the next stage.
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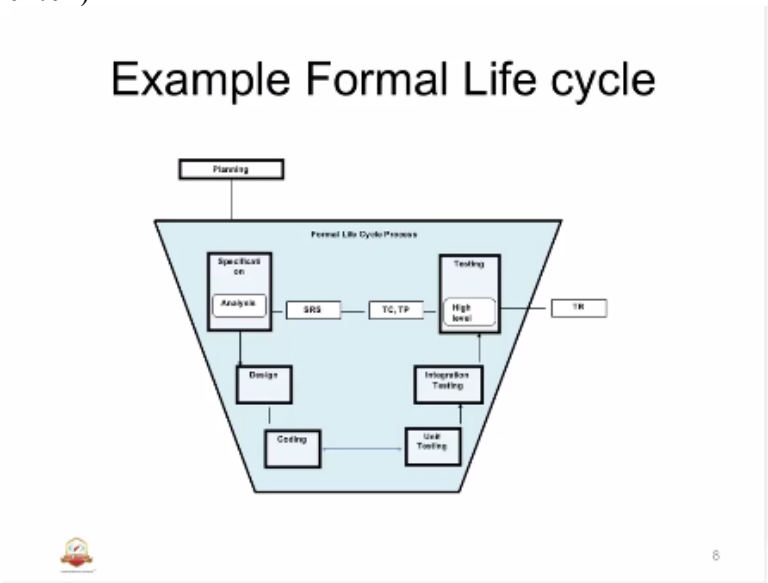

Formal life cycle as we study where we pick up a sample out specification design coding, on for that with that testing integrations testing and unit testing, so this looks like a V shape, that is why it is called a V life cycle there are different modules that are allowed that are used such as water fall in general in embedded system, we follow the V model.
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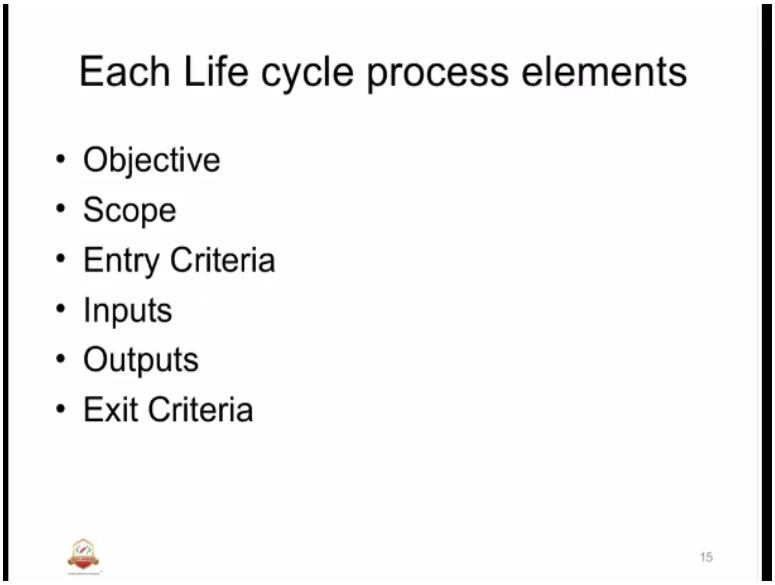

So that is what we learned in the session 8 and in this session, we will focus on some of the process that are followed for each of this stage, so each stage will have the process that process elements are objectives, scope, entry criteria, inputs, outputs and exit criteria, what are those objectives what are those scope, how do we give a entry what is the top code exit etc.

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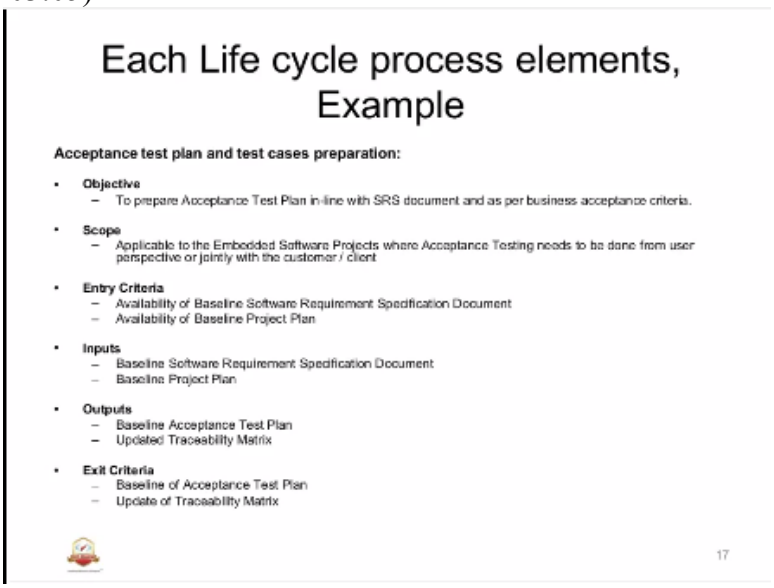

So taking examples of testing this plan and test cases, we identify or define use many events for objective, we say that prepare acceptances test plan in the SRS and as per the business acceptances criteria scope is applicable for embedded software project, you can design name the project name where acceptances done from the user prospective scope, is only for the customer or the along with the client something like that, we will have it on scope entry criteria tells that we need a based line.

Software requirement perpetuations with the help of which we will satisfy the objective and availability of the plan, I mean the plan is have already tool environment and his schedule for the point, so that will be an entry or the inter criteria that is identified and once, we have the entry

criteria there are various input that are used base line software requirements specifications base line project plan.
That we see the input and what is the outcome of the accept test plan is that base line test plan and preparations and once it is complete, we agree with that criteria next that is about a example of a to one acceptances plan test and preparations, we will go in detail with the definition of each of this in the next slides okay.
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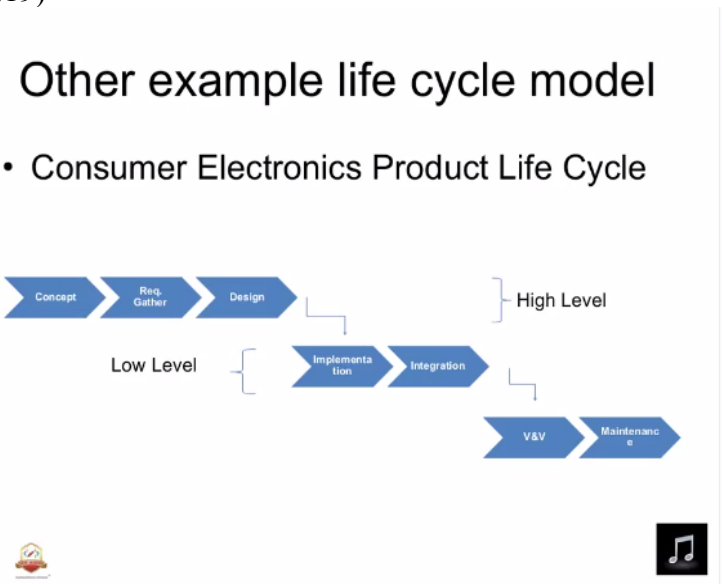

For example a DVD player Worcester play stations etc., so there what they do is they define three levels high level, low level and next the output level or the concept level are existing so in high level what they do is they will fix the concept and they will gather the requirement they will do the design with this they will handle the things and the next level life cycle we will have implementations and integrations.
This two combine once this done they will directly go with the re entry that is validations and verifications, they will take the all the inputs right from the high level to the low level and they do the re entry and once re V&V is complete the products is fixed for working and it can be deployed once it is there they will go for other thing the interesting thing is that a consumer electronic product has to entry to it and there is a supporting mechanism, that is a required for the organizations for the customer, or the clients so they will had maintains as one of the product as towards the end, so this an example of consumer electronics products life cycle.
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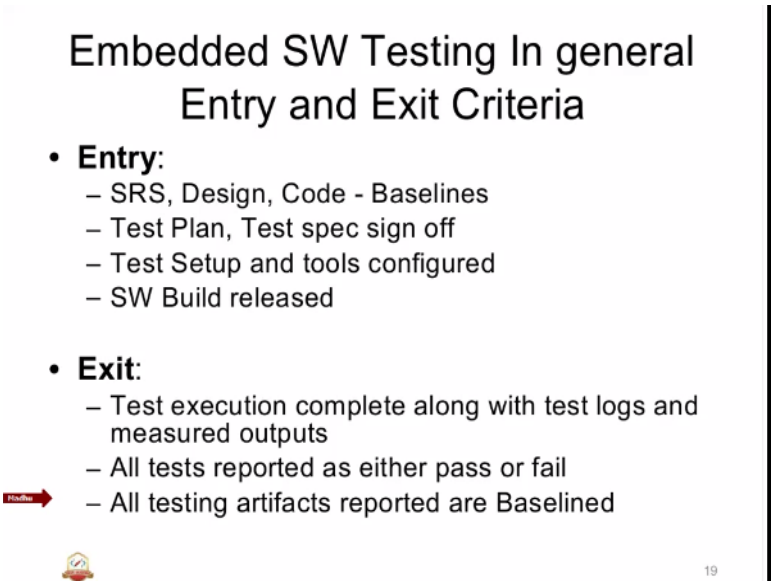

In general for embedded software testing entry and exist criteria how they are used in general I am talking about if you want to do a software testing defined for the embedded system the entry should have SRS design code minimum it is based on the base line the entry should have the test line test spec sign off that means in order we cannot go without the test plan w need to have the test plan test specifications identity the producers and should be signed off that means they should be approved by the test team.

As well as the qualifying authority or the cure team along with that as per the test plan the test set up and tool should be configure, that means they should be available for the usage and that will be consist use across the testing life cycles, till the testing is complete and in order to do the testing, we need to have the software build on the software build we will apply the testing mechanism, with the help of the tester.

So these are the entry criteria for doing the embedded software testing as an out of this life cycle, what is the exit criteria, what is the exit test executions completion, along with the test logs and measured outputs, so we will say testing life cycle is complete, when we have the exit of this executions completed with the test logs, or the reports generated and any measurement, that we have done as an output of this testing activity.

All tests should be reported the pass or fail that means each test is need to have the reporting those test have passed, or those test have failed and what are the artifacts we reported should be based on? base line means, we will stop it stage where we say that it complete with the identifications base line number, it will take up what is base line and all that when we go through the configures management session of configurations, so in general the entry and exit are very important.

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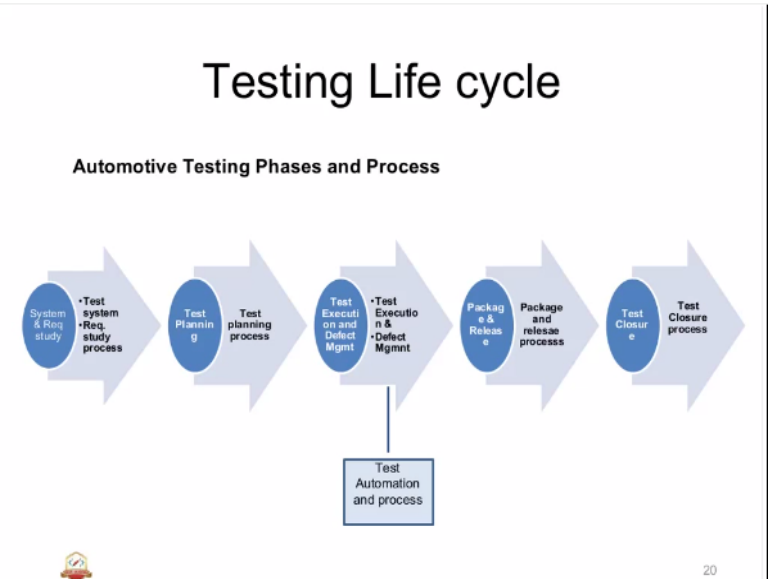

So we will taken an example one testing life cycles, so touch be on what are the equipments that automotive testing phases and process take it to complete the testing life cycle, go through automotive testing phases and process, what are those see basically automotive testing phases categorized to five phases, you can see it systematic requirement studies, test planning, test executions on and defect management, package & release and test closure.

As I said in earlier session, or in the previous session that software development life cycle, has development as well as testing so this in particular talking about only the testing, that is testing life cycle, so do not get confused with the development life cycle testing life cycle, this all part of the integral process of the embedded software system, so that has the development cycle here I am looking into the testing life cycle only okay.

So automotive testing phases and process, so w have five phases system requirement that study testing planning, test execution and test management, package & release, test closure, this typical automotive testing for example, take a engine control in it or elements system, or any breaking control system, or any version system etc., as part of the automotives specially cars okay so each one will attach bases.

So what do to we do in the system and the requirement study and what do w do in test planning, what we do in test executions and test management and what do we do in the package & release, & each one have his own process systems and requirement, study as you see within the arrow there is process define for test execution and defect management, there also can have a automations.

As I told earlier you have multiple scripts running one shot you can automotive as a batch and that is nothing but test automations & that also has the process, which we can apply for the test execution as part of the test executions & the defect management process, only this test executions is completed, we are going have the release mechanism of this process we do a package of the product, so that also the part of the test equipments how we are going to do it finally we handle the test closure process, how are we going to close the testing life cycle, so each one will take up.

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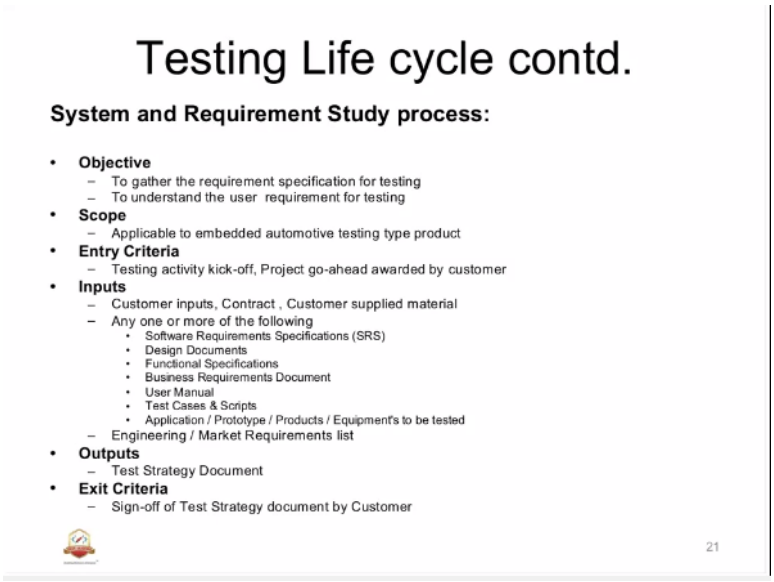

The first is being system & requirement study process, as I said earlier we need to have the objective scope entry between entry and exit, we will identify inputs & outputs, okay for system and requirement study process, what are those objective to gather the requirements, specifications for testing to understand the user requirement first again straight forward, similar one so we will gather the requirements of the system under the test.

We will understand or analyzer requirement, so this is very important so we need to have the system knowledge of the embedded system, which is under test then we will define a scope so what are the scope of the testing, so we say applicable to embedded automotive testing pipe product, that is whatever we do this objectives this is applicable, only for the particular testing of the particular product & we have the entry criteria.

As a next elements in the process testing activity took of project hold by the customer that is means, we will enter into this phases of system & requirement, study once customer say yes go ahead with this, or if it is by internal project, or re product approving authority, or go ahead authority, who will say you can start so testing activity is a test, where the entry is done once we have the entry.

We are going to have all the inputs, or the inputs that are identified, what are those input it could be a customer inputs that is customer inputs specifications, it could be a contract even be the customer it will identify all the inter material & customer supplied materials, as I said as part of the contract and any of the below or all of the below whatever it is it will be a software requirements specifications,

It will be design document here design document is something which is been an outcome of development phases functional specifications. What are the functionality is that this product is going to have & any business requirements documents, from the customer prospective & any user manual that customer wants or customer as given or the development and test cases and the scripts, here is not at the testing life cycle test cases that is sample test cases,

From similar product earlier or customer as anything to valid this product those things are part of this & applications proto type product life cycle equipments, to be tested. That means the actual product are the actual en target system or the actual applications these is to be tested this is very

important input for us to study another thing is engineering, or market requirements list that means what are the engineering requirement?
It is not just enough to have a SRS for the tester or for the developer he need to have a element as a understanding of the product under development or the test he need to have marketing material that means the requirement. So what is that when the customers have it what this product is deployed into the costumer or the end users all this will be consider, in terms of the inputs development or identifications of the inputs.
The next one is that outputs, output of this activity is test strategy, that means how I am going to test it, how means it is not a piratical steps, or it is not the real steps of what value that I am going to use it off overall, I know that what system is I have understood how this system is going to be help what are the functionality it has what are the customer expected customer expectations has in terms of the product that is going to be deployed in the market.
For the tester or for the developer he needs to have an enduring element as an understanding of the product under development of tests, he needs to have marketing item material that means the requirements, so what you that when customer is gone to have it? Once this product is deployed in to the customer and resource, all this will be considered in terms of the inputs development or identification of the inputs.
The next one is outputs. Output of this activity is test strategy that means how am I going to test it? how means it will not hat practical steps or it is not that the real steps of what values I am going to use that all overall I know that what system is I have understood how the system is going to behave? What is the functionality it has? What customer expectation has? In terms of the product that is only employed in the market.
Concerning all that how I am going to test it as a defect change product, that strategy we will produce as an output of this activity that means it could have multiple methods or outputs in or different set of requirements ort re products all this will be laid out as a document which is nothing but test strategy document, so that is the outcome of this system and requirement process, we can also list out an example,
Suppose some unlock set of requirements or functionalities how I am going to test it? What is that strategy that I will adapt for testing those features? So that all will be part of this document so that is nothing but test strategy document. And this test strategy has to be signed off by the customer if it is customer or some authority is going to approve it. For him the test team or has the thing the study process has to submit the strategy,
And he will assume and approve it, so that is why I continue so once again we have objective of this system and requirement process will gather the requirement we will understand what is system is? And the scope is to test it for the testing type of the product into criteria we will have kick off and go ahead from the approving authority of the customer the inputs that are required for this study this all quest of records, re material, SRS and documents.
For the development team or the developed product functional specification business requirements, user manual test cases, steps and example aspects you have done for doing an initiative testing replicas to the entire developer end that also can be input. And from the engineering prospective the inputs that are required that also will be an input and then we have the outputs as a test strategy document.

And exit and sign off from the internal customer or the real customer. So that is about system requirement study process, it is nothing but the first face of the testing life cycle it is something like a study process. The next one once we study and understand the system and identify different things what is you are going to require for conducting a testing? We are going to plan it,
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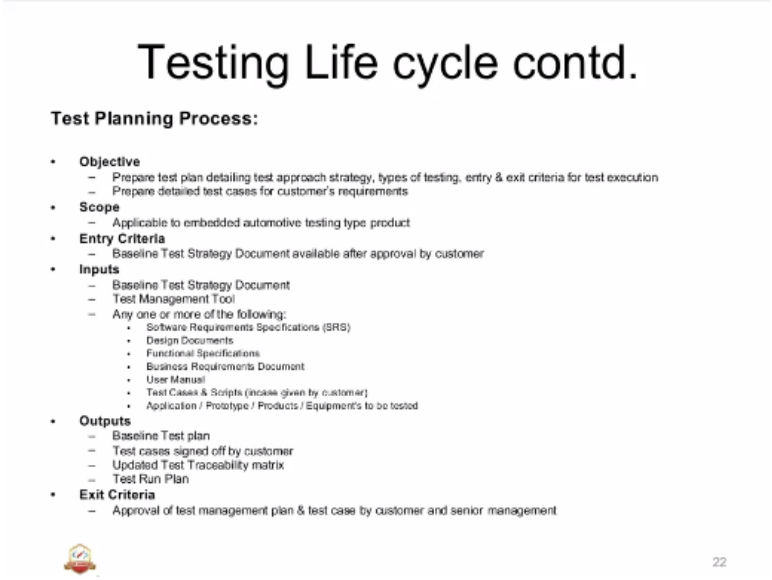

How I am going to do it and how means what sort of a planning I need to have in order to do the testing? So the planning also I can have the objectives, code entries, code output exit. The object reveals here prepared test plan detailing, test approach, strategy, types of testing and entry and exit criteria for test execution. Prepare detail test cases for customer requirements that means test cases identified for the customers inputs.

In the part of the planning identify samples with details how it is looks like what is it going to have? All this will be part of the planning process then we will define scope again it is for the embedded automotive testing type how we are going to enter in to this test planning process is base line test strategy document available or approved by the customer so you remember test strategy output of the previous face,

Where we have done this study and understanding of this system that will begin here and that is an input as well. Test management tool anything that will go on to manage with a help of a tool that also can be input and these are the multiple inputs that is SRS design for specification basis requirements user manual test cases and scripts on many customer and application features prototypes, equipments that are to be tested from the customer prospective.

These are all will go into the planning process because I need the plan what I am going to deploy? How I am going to execute? All this will be made out as a plan and the output of this activity will have waste lined test plan and the test case is signed off by customer that means I am going to develop few samples with some details and that should be agreed by the customer or the internal management.

We will also develop traceability that traceability will map into the test strategy with the requirements and ho I am going to run? Such as that I have laid out test on plan which is called as run plan that will identify the pre conditions execution performance and that outputs that is

expected, I guess this sample test plan we went through on this session may be I will open up again sometime later in this session or if time permits or the next session.
So exit criteria are approval of test management plan and test cases the customer and stake holders within the session. So this is about the test planning. So we have gone through two phases of the testing life cycle and this system and requirements of the other test planning. The next one is the most important thing the important one that is test execution and defect management.
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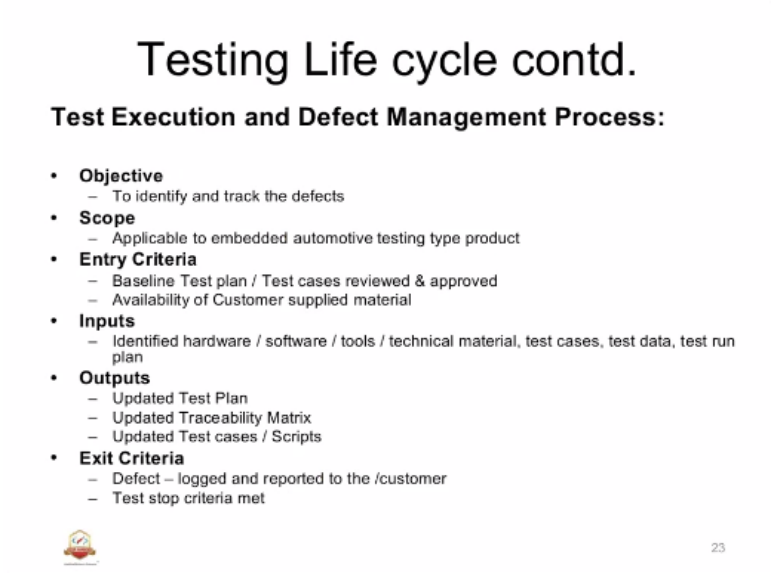

So this has the test execution and defect management process has objective to identify at track and tracking defects that means here basically we are going to execute as a result of execute definitely there will be some issues or defects how those defects are going to mitigated or those defects are going to be fixed? And how they are going to be tracked? How it is the part of the software queue? And the scope is again for testing automotive test product.
Here entry criteria is base line defects plan the previous cycle, usually it will be a previous cycle exit transport will be the entry criteria here test cases when you have output base line test plan and availability of customers supply criteria because I need to execute on the N target definitely I need to have it as a the target based testing system so definitely we are going to have the required material test of the plan.
The inputs that are required are identified earlier software pools, technical material, test cases, test data, test some plan so all this will be required because with the help of this only I am going to execute. The outputs of this activity is updated test plan, updated testability matrix as a result traceability matrix is a very important aspect of the testing life cycle because I need to trace each of the requirements how I have tested? How I have covered?
In terms of what sort of testing? All this will be part of the traceability matrix and also we come up with the test cases aspects as an outcome of this activity of test execution and defects management. Exit criteria we have all the defects logged and supported to the customer could be an internal developing team also or internal management we will route all this defects to fix by the development team or if it is an issue,

The requirements are reviewed from the customer then customer needs to fix it we have to lock to him, there are situations where some of the tests will result in modifying the requirements or some of the results failed will result in modifying the product to an extent such that it can be testable and deployable and all the testing which cannot continue like I have here I will take an example I have suppose some 100 requirements to be tested.

In that I need to take care about 60% that means 60 requirements have and all I found out that 50% of this requirement have resulted in bucks that is, eta by 50% is too high say 20, 20% of tested requirements have bucks meaning that there are 12 requirements have been failed, so two requirements have failed that means it is a sampling which the distinct has to consider or based on the sampling that defining the test plan.

So we will take a call attention or we will take a call either to stop a test or to start a test or continue the test. So this is very important aspects of testing that is called tollgate, tollgate is nothing but a s ample criteria wherein a digit code is taken to continue that activity or the product is enough to take up the next level that is what the tollgate is so based on the plan this will be taken that is for tollgate is taken care.

So that is what the exit criteria to stop certain criteria whether it is correct or not or to continue, so that is what is about test execution and defect management process so this is the third phase what we have seen and valued that test automation could also be there where we do the execution with the help of batch execution script tuning and all that, so automation will definitely help in, test automation will help in speeding the process of execution.

It also helps in manual intervention and any defects that are due to manual also can be avoided that means more you automate the chance of injecting human errors are less. That is the use of automation so for the automation you can define an automation process where we can have a small entry to output exit criteria putted separately and not told here may be we can take it up in exercise where we go to the practical sessions.

So that is about the third life cycle which is nothing but test execution and defect management. Test automation and process also can be defined as part of this activity, so it is very important activity of all the testing life cycle. Next is the package once we have that test execution defects we are good to go for package and test process, so what are the things that it has?

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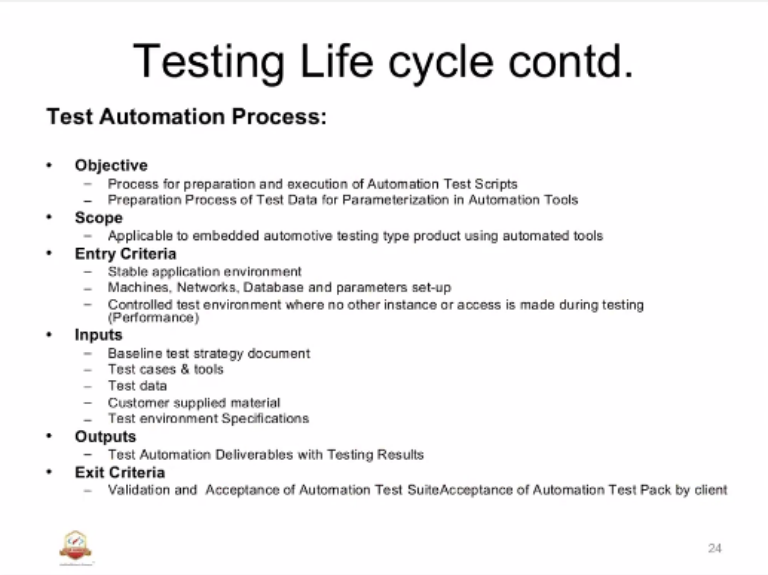

So objectives process for preparation and execution of automation prospects preparation process of test data for parameterization in automation tools, I am sorry this is not about the package and release we have already listed out the automation process as a defected here all this can be applied in this slide, here what we do is exhibition of automation will define automation process the objective is the preparation and execution of test prospects.

And parameterization automation tools that means what are the parameters that will be used those parameters are usually a test data inputs and test data outputs all this will be fed into the automation tools, automation tools can be done with the help of python or rain of data and patch execution all this will have a test data, test data needs to be parameters for this process scripts, inputs execution.

Of course there is various automation tools with the help of NS lab view test and it is together they use it easily of national interprets. That is about the test automation and tools that we have used it these are same and these stable application that means automation allows we are ready to do the automation we should not crumble in between that means it cannot fail so it is difficult to find out once we are good to run.

All the tests then we are going to have a batch execution for that we need to have a stable environment that means the testing environment , that means whatever we are going to execute should be stable enough to take care of all this automation. Of course the machines, networks, database and parameters all should be set up for taking care of the test automation that controlled test environment where no other instance or access is made during the test.

That means the performance is no compromise of the tests, test environment completely controlled with the help of automation and there is no intervention between when there is function is on. Whatever inputs based line test strategy again test strategy can identify what is sort of automation plant test data that will be used for automation execution and those things will be defined in the test strategy documents, so that is one of the input that should be based lined.

And test cases and tools, test data, customer supplied material test environment, test specification is not just enough o have test environments in place is very important to have test environment defined with the speck and it is called work instruction that means sort of a how to use the test

environments because the testing team has to be independent and you know it is very, very having in a college of the system,
Should be tested with the help of this defined test specification or instruction, the output of the test automation process is test automation deliverables with testing results that means as an output of the testing with the help of automation w will have the results that is an outcome of this process. The exit criteria are validation acceptance of automation test suite acceptance of automation test pack by client that means the output of the automation should be accepted by the relevant stake holders.
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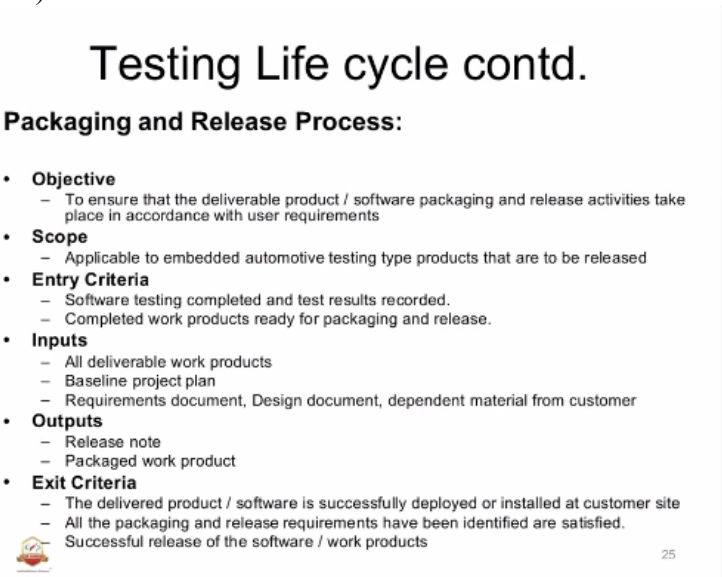

Now come to packaging and release once we have done with the testing what are the process that we follow for packing and release of the embedded test product? Here objective is to ensure that the deliverable product or software packaging and release activities take place in according to the user requirement that means we cannot product saying that tested undertake it we should have well defined process well defined packing mechanism,
Packaging does not mean that is packaging with any biding or folders are like that, It also important document where we are going to deliver the tested the product, that is very important because, there should be acceptable user and we should be able to pick as see in the cycle, it is not having any knowledge of the interrupt are not the packaging developed or release product, we should be able to pick the process,
For the well different instructions as per the processor that, is the objective of this process. Scoping again the testing product of the embedded system, the entry criteria is software tested operate and test results are recorded. At test results all the test result should ideally be past, basically individual expects. Test 2 results are addressed here, mostly it is past for the failed once, there should be enough test specifications telling that.
Such instruction features are not tested or I will say it is not tested, it is justified saying that, some features are not tested in the well defined manner or it could be tested but there is enough hint is saying that, which is not occurs or saying that, certain things are tested to be send to

mechanic. Basically, that can be consider past on the information should be there for the other items where it is tested directly or any alternate mechanism of testing.
So that is the entry criteria for packaging the product. computing the product ready for packing inputs, the inputs for doing packaging and it is needs, all desirables should be a level, should be based and, as per the project plan should be test drive that means, project plan will be used it, how it is indirectly in terms of packaging and releasing. Requirement documents and design documents define in between the process.
Whatever they are used for testing the product? Have to be categorized to, and that should be available what the input is? Are given for the living it that is same thing should be available for the living product. Outputs, where we note with the, mentioning all the release items, what are the items that are release? So, what is the configuration question for that? Any visual information, any manual it is going to point to, or any work instructions all should be used.
All this any trouble should be, information all this will be part of this reliving note, reliving note will not have the creator for all this but, it will have a point term. It will have information about all this things, and the package one product see are all in the output that, means the output is clean the manual as per what is being told in the earlier process of the planning process that means, such for them should have such past result or failed result.
And here where the build is there all this will be part of the product structure that should be part of the output. And how we exit is, the derived product that, means it should be successfully developed and install it customers said. Usually, it is not enough to say or telling her to the customer or individual it should be satisfactorily for trick was said and it should be available for the customer and that is what is called as applied successfully at the deliverable end.
All this packaging and release requirements are identify or satisfy successful release of software for products, all the items required as for requirements should be available at customers said, satisfactorily and should be running all the time that is what we learned of the packaging of the process so, that is about the four pieces.
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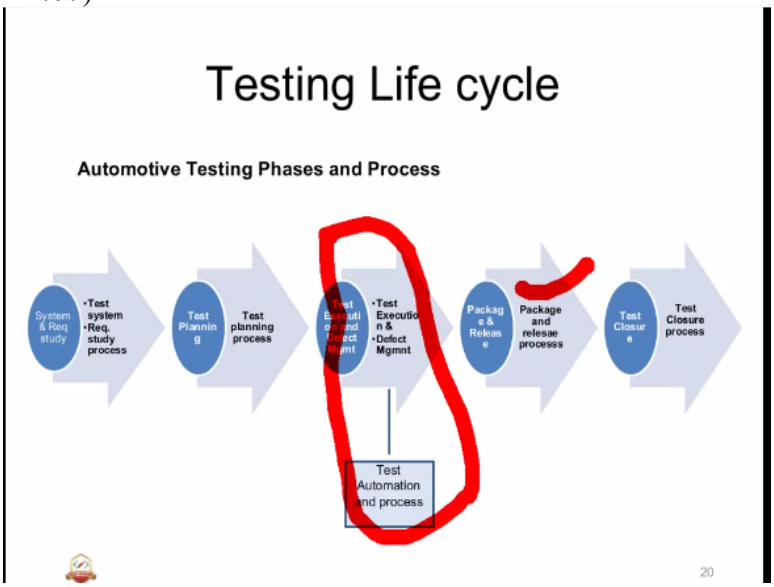

Literally testing process because, we have called up the test strategy process, so you have done with this process of the packaging and release. Next one is the last process in the testing life cycle, is nothing but test closure so,

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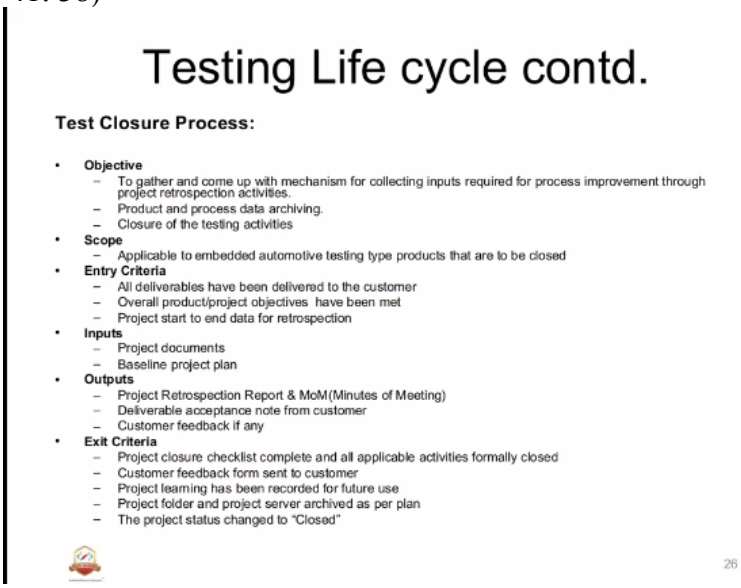

What it as test closure process? It is the objective of gather come up with the mechanism for collecting inputs process improvement through project retrospection activities what it means? Here what we do is? We have relative product, we have tested the product and applicable product, available at customer, it is not just enough to see that, we have done. It is very important to come up with what we have done so far?

The entire life cycle of development it could be a testing or it could be a sub processor or automation or any future use work tricks all this have to be recorded for the three product aspect because, we are going to lead with the embedded system for the critical life cycle or it could be different based systems are all this called retrospection and another one it is very important base practices these aspects will recorded it, will have it, that is an objective of it, is called closure activities

As part of it was record the, we record all the aspects what we have done in the processor? And how you can improve on the business that we have learnt? While implementing the testing and we are going to archives the product we have delivered because, it could be required any time to visit or deliver or whatever it is? We need to have as per the plan

Closure of the testing activities, we are going to test up with all this testing aspects scope is applicable again, product maintain in to test and we have a all criteria all derivable have been delivered to the customer respectively, overall product objectives having at including the special customer inputs. Once start to end it the retrospection we should respect it, what we have done. So, the retrospection has been meeting the company.

It will be held depending on the stakeholders any customer involve, any feedback all this will be consider for doing the beginning to end. Will respect to what and all happen, as the part of retrospection we do lessons learnt best practices and off course improvement what we are going

to improve for the simple project or products in terms of how it can be better utilized, so that, it is going to be minimized or it could be cycle reduction or it could be a cost, whatever it is?
So this very important that, all this will be consider for the test process inputs are doing all this we need project products which we have done. And we are able to base line, project plan in the base line, because we have defined the project plan so showing that, how am going to close it the project. Output of the test activities, project retrospection report, we are typing for it, and there is minutes of meeting us all know that.
We have to record what the units are? That is done in the meeting that minutes will identify that discussion summary any assumes required anything want to high light all this will be part of this outputs and off course as part of the outputs of this closure we will definitely have a feedback of the actions from the user of the customer as we said the customer feedback is important because, that is going to feed in to next level.
In terms of improvement or applying the various other aspects in the system of output or it could be an application also what will be out and best, so that we can use it, those parts are very important and very good also and last one is exit? How you're going to exit? Project closure checklist, in a checklist there should be completed which will be maintained in the server by comes under simple and all applicable activities should be closed.
There should be not any open terms, so the product is closed and either we would have deliver customer feedback which is not we may stricked is part of the closure so, that will happen when sometime, when project in to be closed for internal perspective where we have a use the test and project deliver to customer, need to be evaluate the product partially saying that, it is difficult will agree with a deliverable.
But he would not come back with complete feedback so in that, case what we will do is? we will dissolve the T, keeping one or two stakeholders it will get a update customer and a part of contact so that, is why told here, customer feedback, project learning recorded, project folder and project server or objective the project status changed to be closed means the data base or whatever it is will be indentified project as started the progress open that, means a project is open but not doing any progress and project is stall or alt it, at closed these are some of the project status called.
So it should be closed definitely that, the one look for project has to be closed in order to close this process, so that is about the test closure process of the embedded testing, so this will complete the automotive testing processes as an example there are 5 faces there are different fasces involved for different domains here I have told about automotive this is a different process that is involved as I said.
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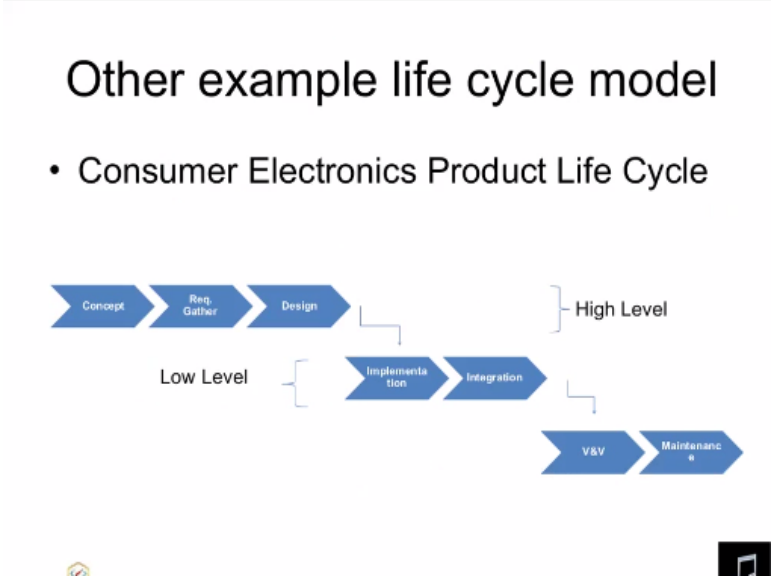

Consider I have example to this and example of automotive testing faces and process, similarly we can apply based on the lead for other term as like space or telecom etc so one example we have gone through consider the electronics product life cycle. So we will look into some of the embedded system terms and words.

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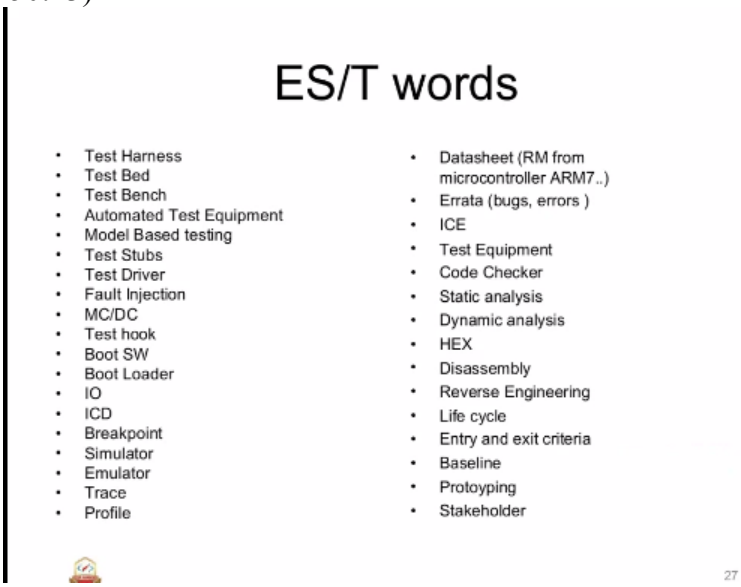

So this will be growing each session so I will keep adding so that you are aware of this because this has to be there any time for an embedded system tester, test harness, test bed, test bench, automated test equipment, model based testing, and test stubs, test drivers, fault injection, is about embedded system terms and testing words this is will keep on growing as we go through different sessions because these words have to be there in testers mind.

Because this is also be in common works getting used always by the tester or the embedded system developer so we needs to have an idea about this words all the time matter what area or what the main result for test harness, test bed, test bench, model based testing, test stubs, test

driver, fault injection, MCDC, test hook, boot software, boot loader, input, output, ICD, break points, simulator, emulator, trace, profile,
Data sheet for RM 7, micro controller it is a reference manual so called as, errata, and all these issues any errors for the particular micro controller, in circuit emulator, test equipment. Code checker, static analysis, dynamic analysis, HEX, disassembly, reverse engineering, life cycle, entry and exit criteria, baseline, prototyping, stake holder some of these we studied today. May be some more words I will add it in next session. So that you can understand or study those words in detail, so I have a question for this session, what are they? I mean,
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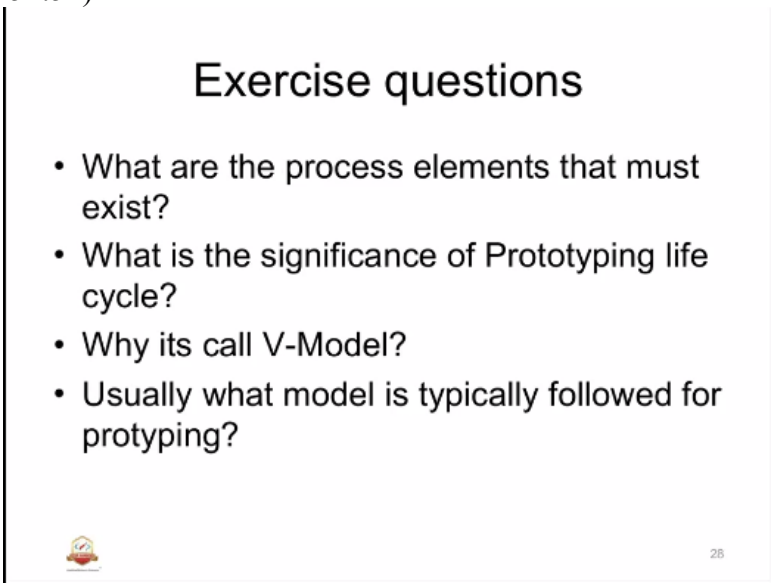

This session includes for the previous session also I think for the previous session these questions are applied the current session I will add it in the next session, we have studied about life cycle in detail about V model and all that so this questions are about that what are the process elements that must exist? The next question is what is the significance of prototyping life cycle? So why do we need a prototyping life cycle? And V model why it is called as V model? Usually what model is typically followed for prototyping? So what model we use for doing the prototyping of the embedded system development of testing? That is all about today's session, so we will see in the next session.